Galactic Observer

John J. McCarthy Observatory

Volume 7, No. 3 March 2014

Speed Demon

In space there are no traffic cops. In this image taken by the Spitzer space telescope, a runaway star, HD 2905, 4,000 light years away in the constellation Cassiopeia, is barreling across our galaxy at 2.5 million miles per hour relative to its neighbors (1,100 km per second). This massive insult is causing the diffuse particles of interstellar dust and gas in its way to glow red – a phenomen called bow shock.

Credit: NASA/JPL-Caltech

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

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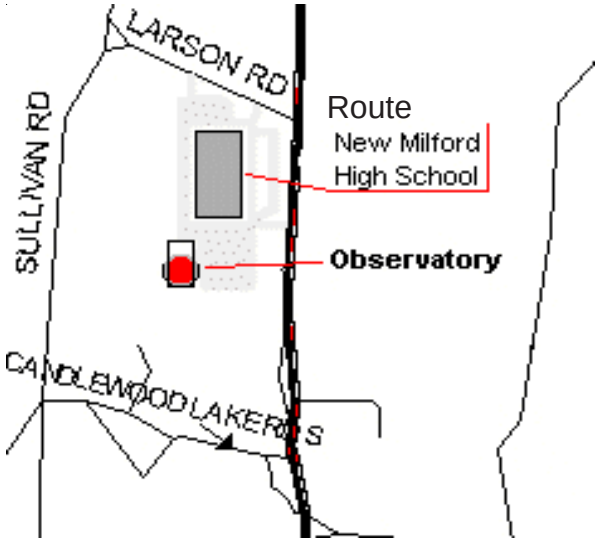

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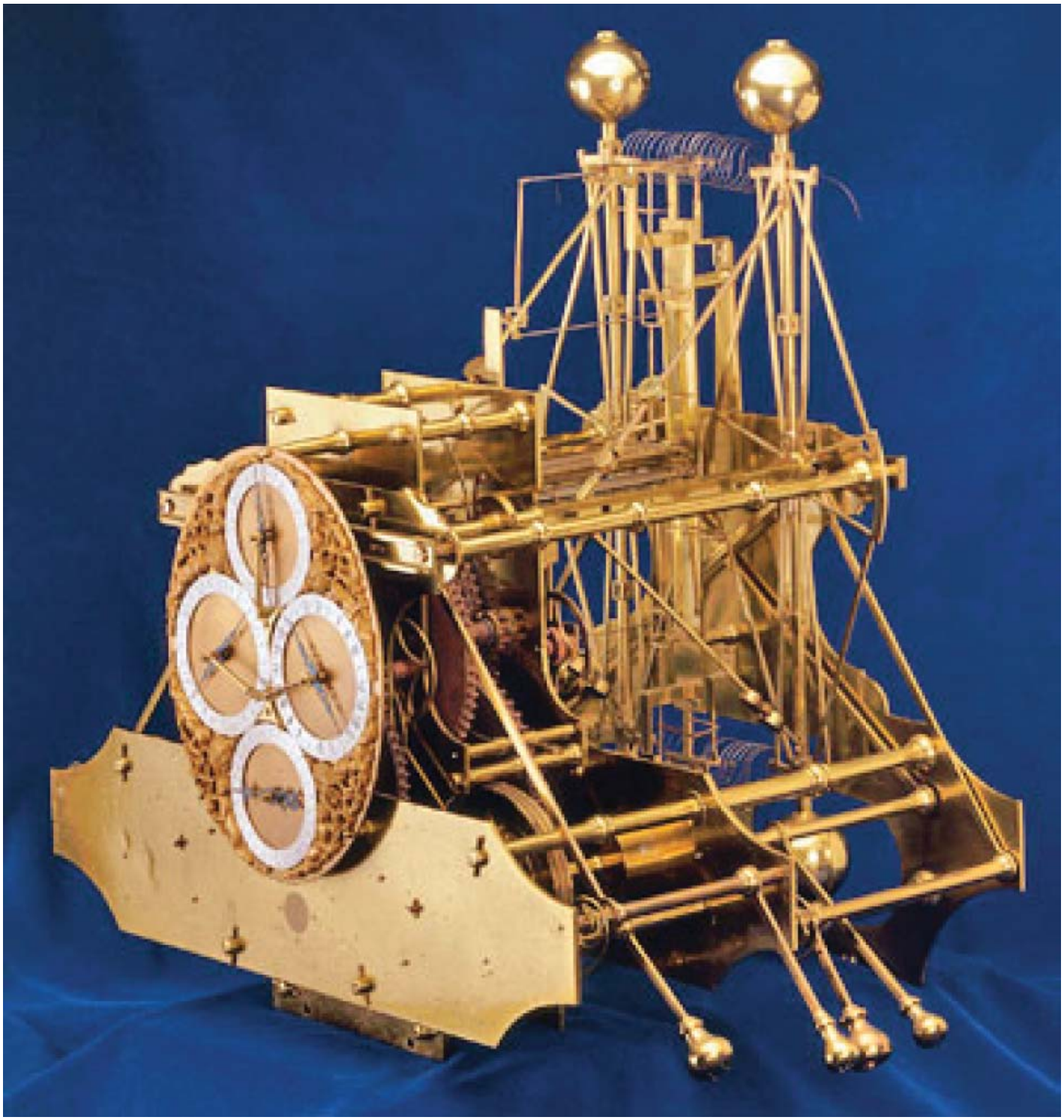
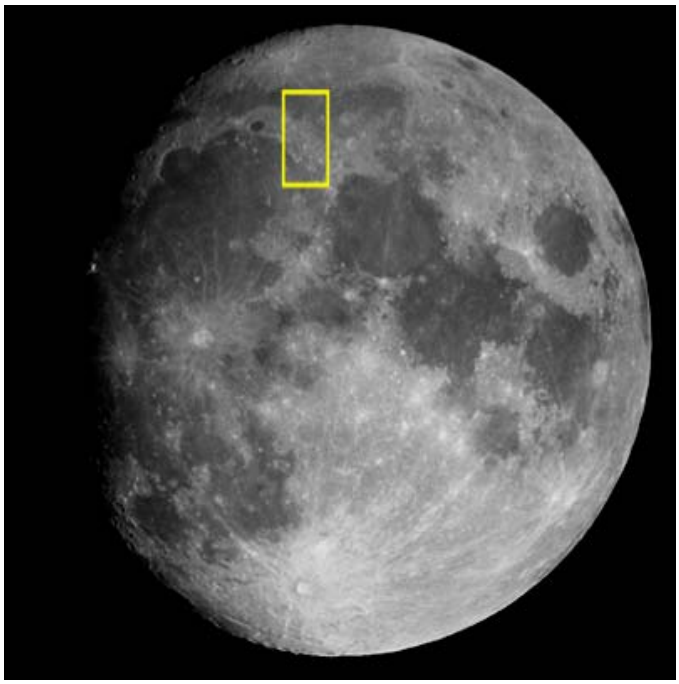


John Harrison's first "sea clock" (H1) is currently on display at the Royal Observatory in Greenwich. It was constructed between 1730 and 1735 as a means of finding longitude at sea.

Photo Credit: National Maritime Museum

"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



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

column may provide some thoughts to ponder when planning your visit (if only in your imagination).

The view this month is dominated by Mare Nectaris (the Sea of Nectar) and two large craters along its shore that suffered dramatically different fates. Only the rim of the 62 mile (100 km) diameter complex crater Theophilus is sunlit in the image on the following page. Fourteen thousand feet below the rim and hidden in darkness, is a smooth, flat floor and a massive, central peak complex. Impact melt pooled north of the crater wall provides visual evidence of the power of an ancient impact that could liquefy solid rock.

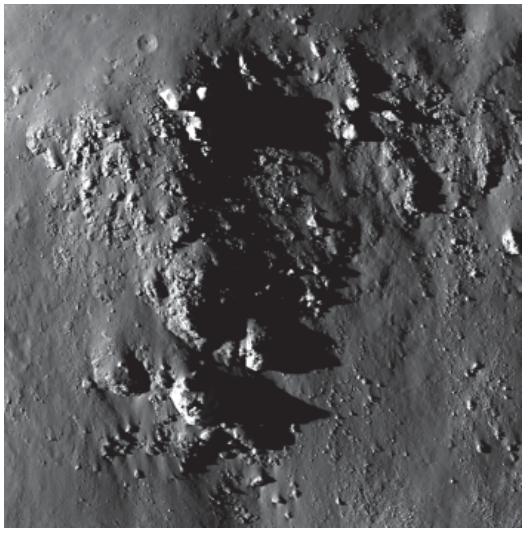
Basaltic fragments from Mare Nectaris may have been transported more than 200 miles (350 km) by the impact, based upon the samples collected by both the Apollo 11 and 16 astronauts.

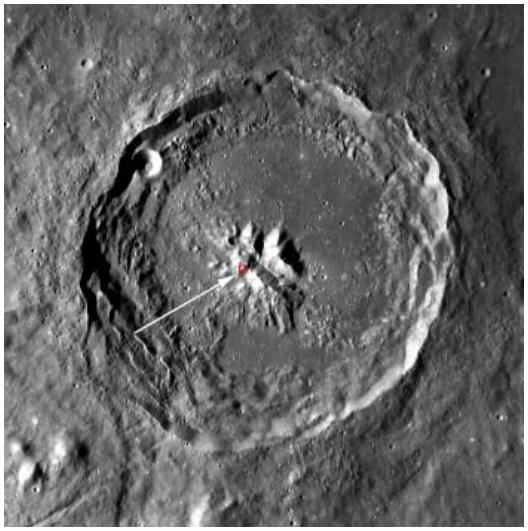
While almost identical in size to Theophilus, the fractured-floor crater Fracastorius is a shell of its former self. Located at the southern end of Mare Nectaris, the crater has been flooded by mare lavas through breaches in its northern wall. Any remnants of its terraced walls and central peaks are buried deep beneath the lava. A low lying lava dome with a summit pit is visible just to the north of the crater wall.

Southeast of Theophilus, and north of Beaumont, is a small crater with a dark halo. The dark material was originally thought to be deposits of pyroclastics around a volcanic vent. However, further studies suggest that the material around this particular crater (Beaumont-L) is the darker mare basalt excavated by the impact that created the crater. The basalt had been covered by lighter ejecta from the impacts that had created the larger craters, like Theophilus and Fracastorius.

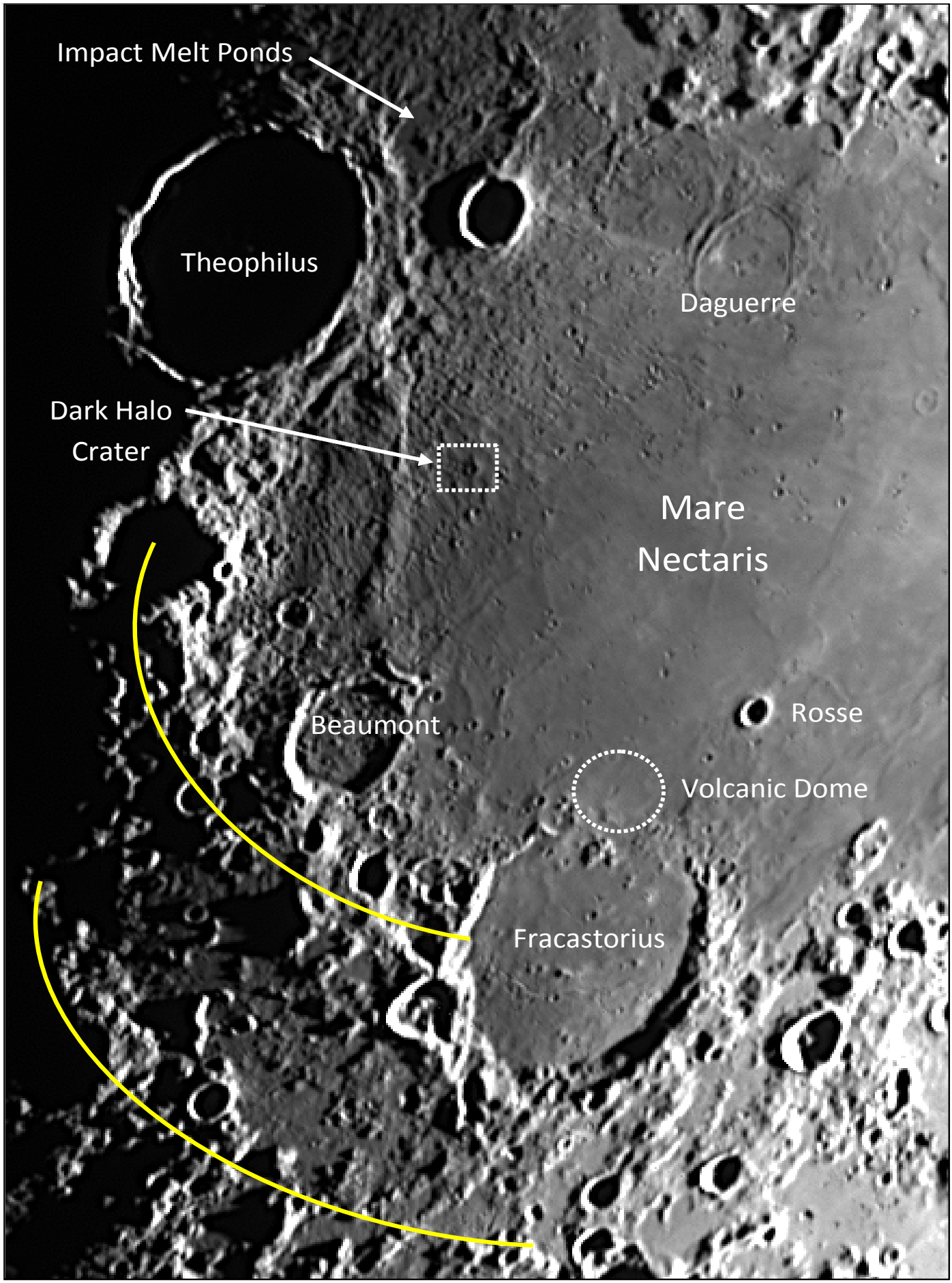
Mare Nectaris occupies one of the oldest impact basins on the nearside of the Moon and is believed to have formed 3.92 billion years ago. Three impact rings (portions designated by yellow arcs) have been identified with the basin: the Inner Ring (250 miles (400 km) in diameter) contains the mare lavas, the next larger but less distinct Catharina Ring at 375 miles (600 km) in diameter and outer Altai Ring (not shown) at 525 miles (840 km) in diameter.

A view of the central peak of Theophilus crater, formed by ejecta forced up by an impact event about 1.1 billion years ago. Credit: NASA/GSFC/ Arizona State University





Theophilus crater with the central peaks marked in red. These peaks consist of crustal rock, forced up from deep below the surface during the impact event Credit: NASA/ GSFC/Arizona State University


Impact Melt Ponds
Theophilus
Daguerre
Dark Halo
Crater
Mare
Nectaris
Beaumont
Rosse
Volcanic Dome
Fracastorius

Supernova in M82

Twelve million years ago in a galaxy far, far away, a small white dwarf star underwent a cataclysmic detonation. The light from this event started its journey through space before humans walked upright upon the dry land and raised their eyes to the star filled sky. On January 21st, students at the University of London Observatory selected the galaxy (M82) as an observing target during a demonstration of CCD camera technology by astronomer Steve Fossey. The first images acquired that night showed a new, bright star superimposed on the galaxy.

The supernova had gone undetected for almost a week and has been since classified as a Type 1a supernova. The detonation of a white dwarf is thought to be caused by the runaway fusion of carbon and oxygen within the core of the star. The chain reaction is triggered by mass drawn from a nearby companion star, until a critical mass is reached. Debris from the explosion is moving away from the core at velocities up to 12,500 miles per second (20,000 km/s).

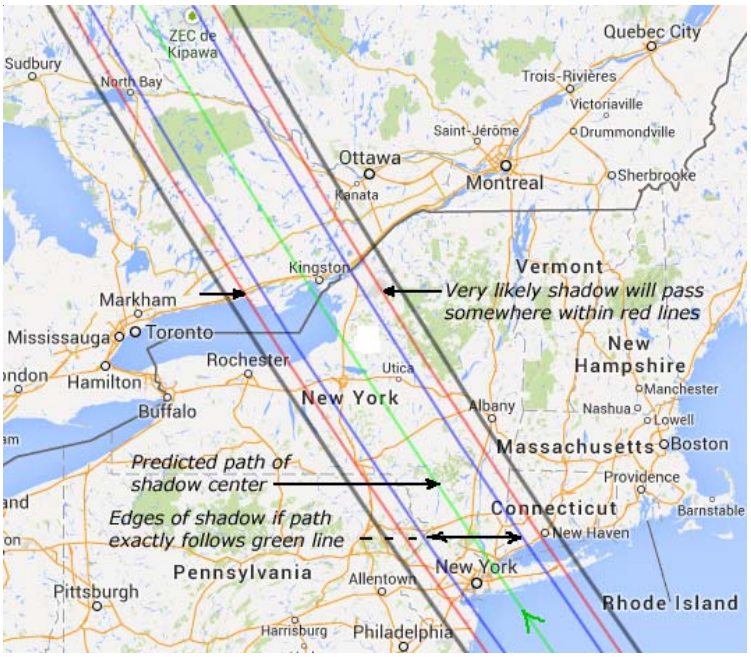
Marc Polansky imaged the galaxy and its supernova (marked by yellow bars) on the night of January 24th from the McCarthy Observatory. The composite image below was created by combining a total of 10 minutes of exposure time through various colored filters.

Type 1a supernovas are of particular interest to astronomers. Since the detonation is the result of a critical mass, which is a constant, the luminosity from the explosion is nearly the same from star to star. This allows astronomers to use this type of supernova as a "standard candle" from which to measure vast distances (by comparing the luminosity of the supernova in a distant galaxy to what if would have been if it had occurred nearby. The study of Type 1a supernovas has also contributed to our understanding of the expansion of the universe.

Marc Polansky imaged the galaxy and its supernova (marked by yellow bars) on the night of January 24th from the McCarthy Observatory. The composite image (above) was created by combining a total of 10 minutes of exposure time through various colored filters.

Occultation of Regulus by an Asteroid

Observers in central New York State and western Connecticut may witness (if the weather cooperates) a rare event when an asteroid passes in front of the bright star Regulus, causing the star to disappear for up to 14 seconds.

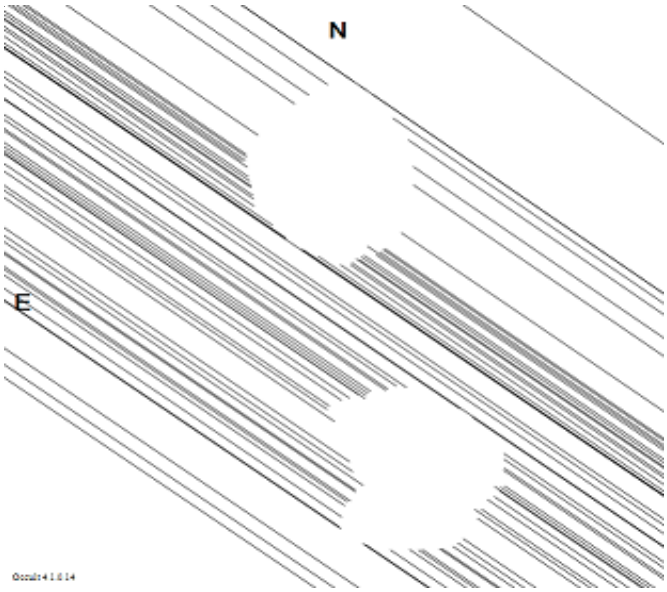


The event will occur on March 20th shortly after 2 am EDT (if you are within the path of the occulation (bounded by the blue lines).

Regulus is about 4 million times further away than the 45-mile-wide asteroid (163) Erigone so the event is only visible along a narrow band extending from Long Island up through Ontario, Canada. The map (above) is provided by the International Occultation Timing Association (IOTA). IOTA is asking observers to submit their observations (even if the you didn't see Regulus disappear). You can find more on the event and how you can participate at IOTA's site: ***http://occultations.org/regulus2014/***.

Accurate timings of the star's disappearance and reappearance by observers along the path can help build a better understanding of the occulating asteriod. For example, observations from an occulation of asteriod (90) Antiope on July 19, 2011 revealed that the asteriod was actually a binary body (as seen in the IOTA image below).

Regulus is the brightest star in the constellation Leo. On the morning of March 20th, the star will be located in the west southwestern sky, about 40° above the horizon. A waning gibbous moon will be in the southeast but shouldn't be bright enough to interfere with observations.



Cold Case Solved?

Senior Lieutenant Yuri Alekseyevich Gagarin was a Soviet pilot and cosmonaut when he made history on April 12, 1961, becoming the first human to orbit the Earth. The Vostok spacecraft in which he rode completed a single orbit in 108 minutes, traveling at an altitude of 188 miles (302 km) at a speed of 18,000 miles an hour. (Photo Credits: RIA Novosti)

Upon returning to Earth, Gagarin received a hero's welcome, traveling the world as an ambassador of good will. Six years later and longing to return to space, he began training on the Soyuz spacecraft. He was the backup pilot for the Soyuz 1 flight on April 23, 1967, when his fellow cosmonaut Vladimir Komarov was killed upon reentry after the capsule's parachute failed to fully deploy.

Gagarin died the following March (1968) during a routine training flight. The circumstances surrounding the crash of his MiG-15 fighter spawned rumors and conspiracy theories of sabotage, murder and political foul play. Government reports attributed the accident to more mundane causes such as pilot error, weather, or a bird strike.

After all these years, a recently declassified report may shed some light on what really happened on the rainy day in March. Gagarin's MiG wasn't the only aircraft flying that day. A much larger aircraft, a Su-

15, was also conducting a test flight in the area. Although scheduled to be to flying well above Gagarin's plane, witnesses report seeing the Su-15 emerging from the low clouds on afterburner at a much lower altitude, closer to one Gagarin would have been flying. Computer simulations have shown that a close encounter with the larger Su-15 could have flipped the smaller MiG and sent it spiraling into the ground.

The close encounter with a second plane agrees with the recollections of cosmonaut Alexei Leonov who was on the ground that fateful day waiting for a parachute training flight. Leonov recalls hearing two loud noises seconds apart, the first attributed to a sonic boom and the second, the crash. The timing suggests that the planes could have passed within 30 feet of each other, an encounter that the MiG would not survive.

First to Walk in Space

On March 18, 1965, cosmonaut Alexei Leonov became the first to perform a spacewalk, spending 12 minutes and nine seconds outside his spacecraft, Voskhod 2. As it turned out, leaving the spacecraft was a much less demanding task than returning.

Sergei Korolev, considered the founder of the Soviet space program, had the Voskhod spacecraft modified to carry an inflatable airlock. This allowed Leonov to exit the spacecraft without depressurizing the entire capsule. The walk, initially televised live, went well until Leonov tried to reenter the airlock. During the walk, the spacesuit had become a rigid balloon in the vacuum of space making it difficult to even move his gloves.

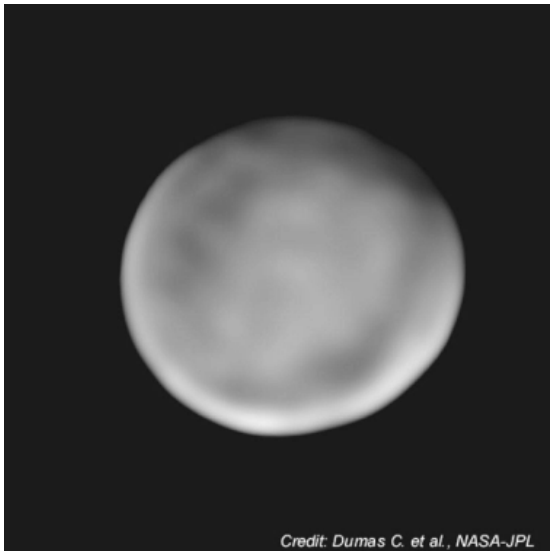
Alexei Leonov during spacewalk
Photo Credit: RIA Novosti

The bloated spacesuit prevented Leonov from entering the airlock. Unbeknownst to mission controllers, Leonov began to vent oxygen from his suit to space to reduce the pressure % fast enough so that he would be able to reenter the spacecraft before his oxygen supply ran out, but not too fast that he would pass out from oxygen deprivation. With the lower pressure, Leonov was finally able to squeeze back into the airlock, allowing his pilot, Pavel Belyayev, to close and re-pressurize the airlock. Television coverage had been cut short at the first indication of a problem with the return, and there was no public acknowledgement of the ordeal, or how close Leonov was to becoming the first space fatality.

Had NASA known about Leonov's struggles, they may have been better prepared when Ed White encountered a similar situation during his Gemini 4 spacewalk in June of 1965. White's struggle to squeeze back into the Gemini capsule and close the hatch was too much for the suit's cooling system, causing his visor to fog up and his vision to become impaired from sweat dripping into his eyes.

Water Detected on Ceres

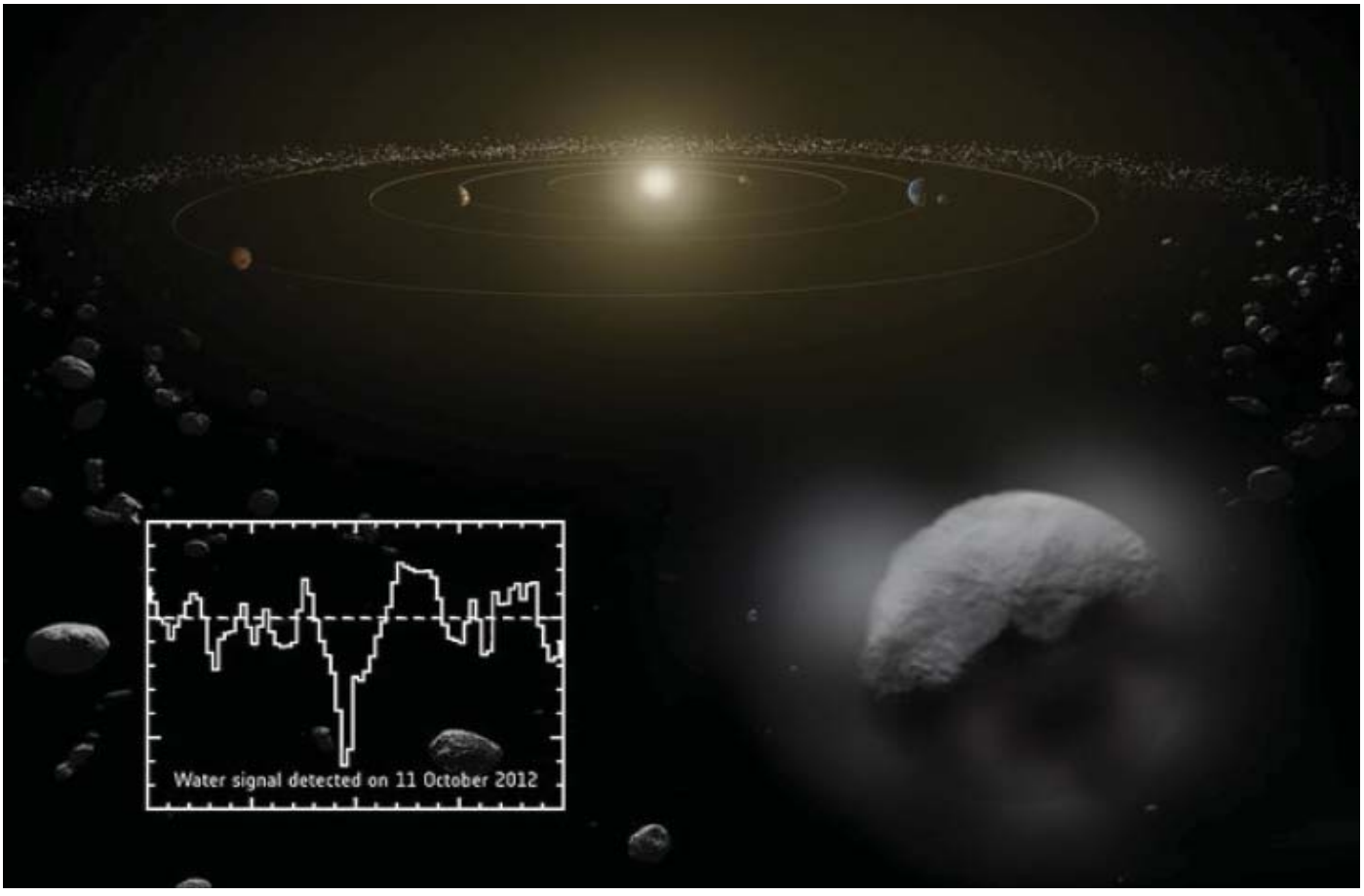
The dwarf planet Ceres is the largest object in the asteroid belt, containing almost one-third of the total mass of the belt. The planetoid is thought to have a rocky core and a thick mantle of water ice. When the Dawn spacecraft finally reaches Ceres next spring (2015), it will find a much more dynamic planetoid than scientists anticipated when the spacecraft was launched in 2007.



The European Space Agency recently announced that its Herschel Space Observatory detected water vapor around the 590 mile (950 km) diameter planetoid during the telescope's operational phase. The telescope was designed to observe in the far infrared and sub-millimeter portion of the electromagnetic spectrum. By observing Ceres throughout its nine hour rotation, the source of the water vapor was pinpointed to two dark areas that the Hubble telescope had previously mapped.

The dark areas are thought to be small reservoirs of water ice that sublimate as Ceres moves closer to the Sun in its orbit (similar to a comet) – or they could be geysers or icy volcanoes that are triggered by the warmer temperatures. A temperature-driven process is consistent with Herschel's observations; water vapor was not detected on one of its five observation campaigns between 2011 and 2013, when the planetoid was furthest from the Sun.

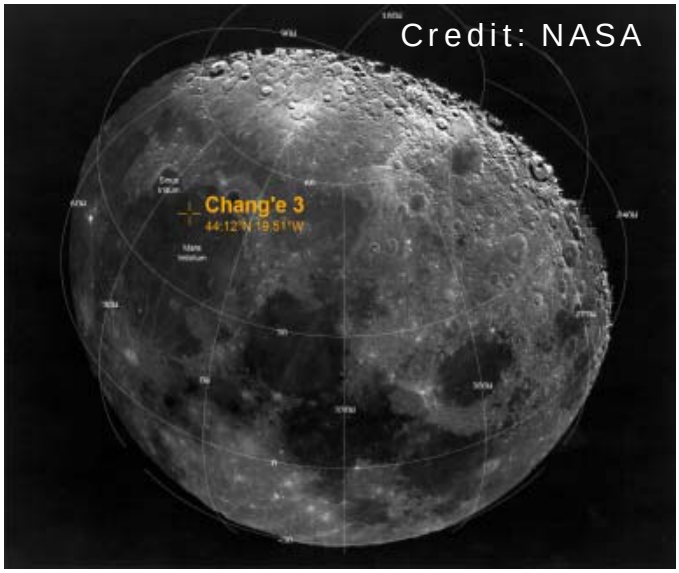
Herschel's observations mark the first time that water vapor has been detected around an object in the main asteroid belt. It will be Dawn's mission to fill in the details and add to our knowledge of these primal bodies.



Artist's Impression of Ceres Credit: ESA/ATG medialab/Küppers et al.

"The reports of my death have been greatly exaggerated"

In late January, the Sun set on Mare Imbrium and the Chang'e 3 landing site. In preparation for the two week long lunar night, the rover "Yutu" (Jade Rabbit) was commanded to stow its equipment and reconfigure its solar panels. This involved folding one of the solar panels over the equipment deck, providing insulation from the nighttime temperatures that can reach several hundred degrees below zero.

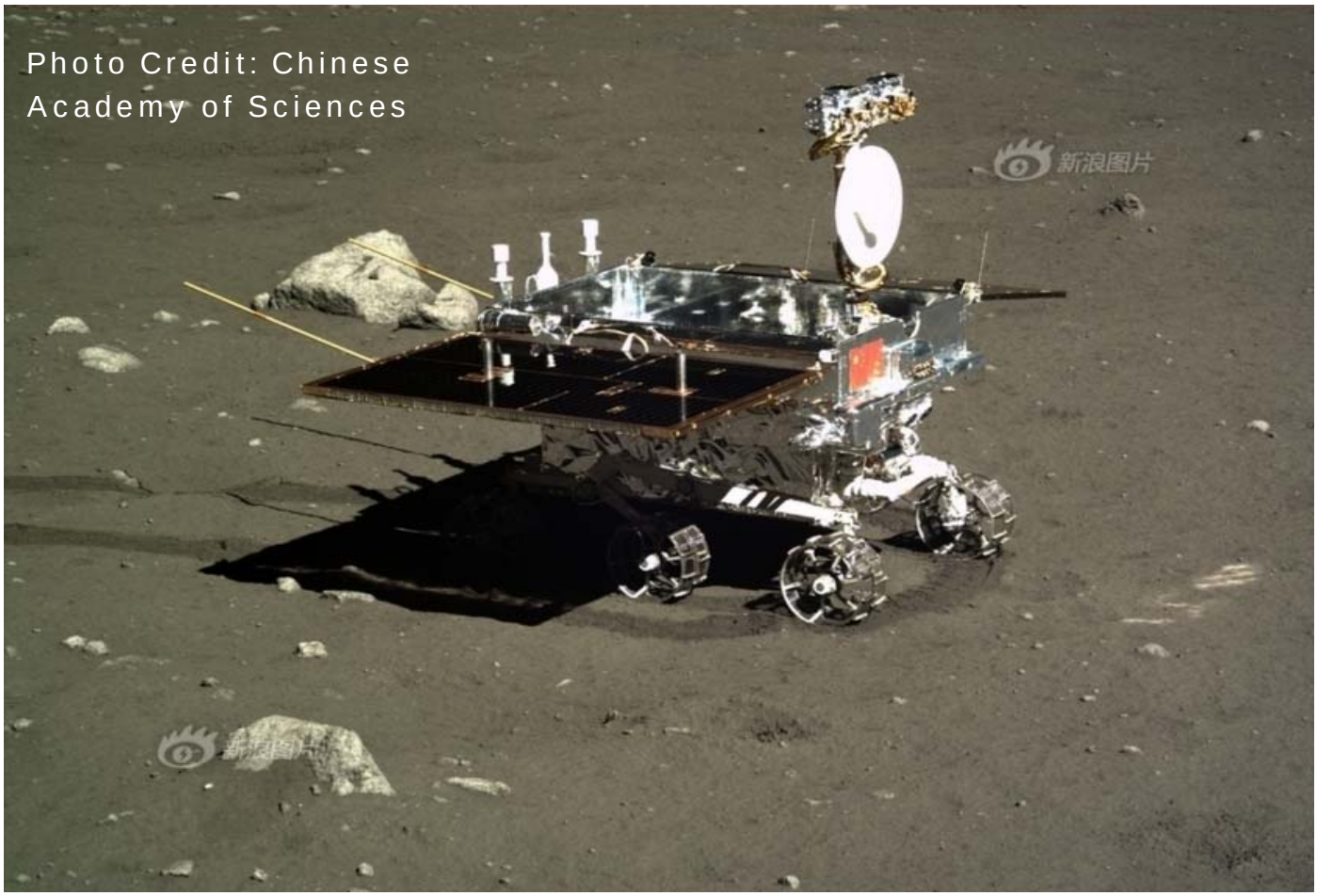


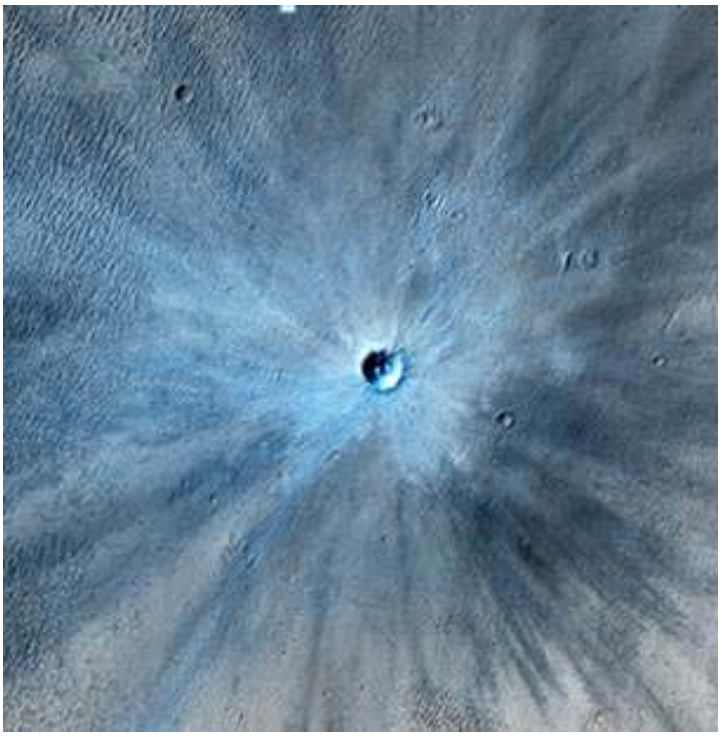
Chang'e Landing site in Sinus Iridum.

While this was the second time that Yutu had prepared for hibernation, there were indications that, this time, a critical sequence may not have completed. If not in the proper configuration, the radioisotope heater would have been unable to maintain a survival temperature for the rover's equipment. Speculation focused on a potential mechanical failure, due to the extreme temperatures and the intrusive, highly abrasive lunar dust.

It would be two weeks before the Sun would return and the rover's handlers could confirm the rover's status. Initially, Yutu failed to respond when the Sun's rays once again illuminated the landing site, prompting reports that the rover had frozen to death. However, three day later, a downlink signal was detected.

While the Chinese have acknowledged that the little rover is operable, they have not revealed the severity of the problems or whether they can be resolved before night falls once again.





A Bad Day on Mars

Collisions played a major role in the formation of the solar system and, possibly, the transfer of the building blocks of life throughout the universe. In recent years, fresh impacts have been observed in the cloud tops of Jupiter, on the lava plains of the Moon, and on Earth (last year in Russia). Mars is the latest victim in the cosmic shooting gallery.

The Mars Reconnaissance Orbiter (MRO) has been in orbit around the red planet for the past eight years, mapping the planet, as well as, changes on the planet's surface over time. Sometime between July 2010 and May 2012, based upon a comparison of historical images, an impact excavated a crater 100 feet (30 meters) across. Debris from the impact was tossed up to 9.3 miles (15 km), creating a starburst pattern that radiates from the crater. The impact site was recently reimaged (on November 19, 2013) by MRO's HiRISE camera (photo left).

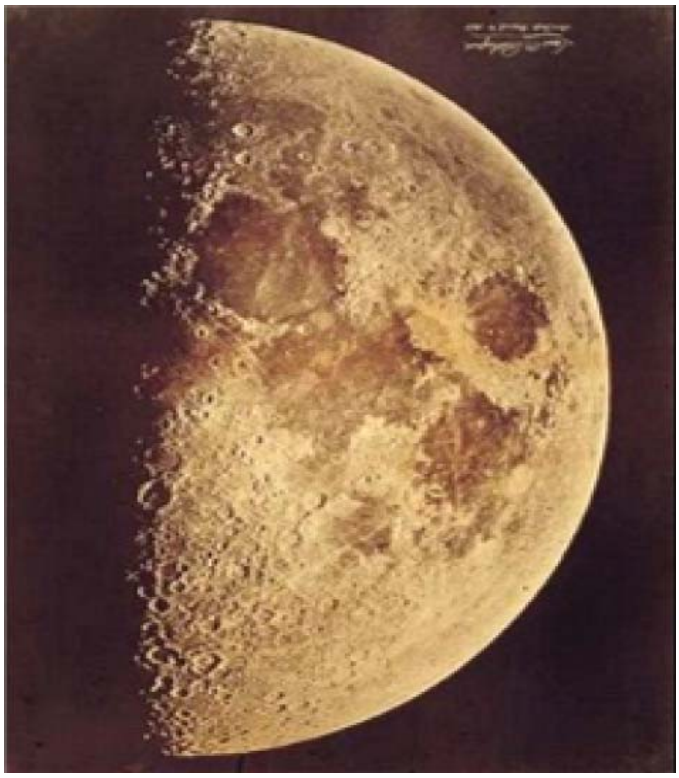
The blue color in the enhanced image of the crater (below) is due to the lack of reddish dust removed by the impact.

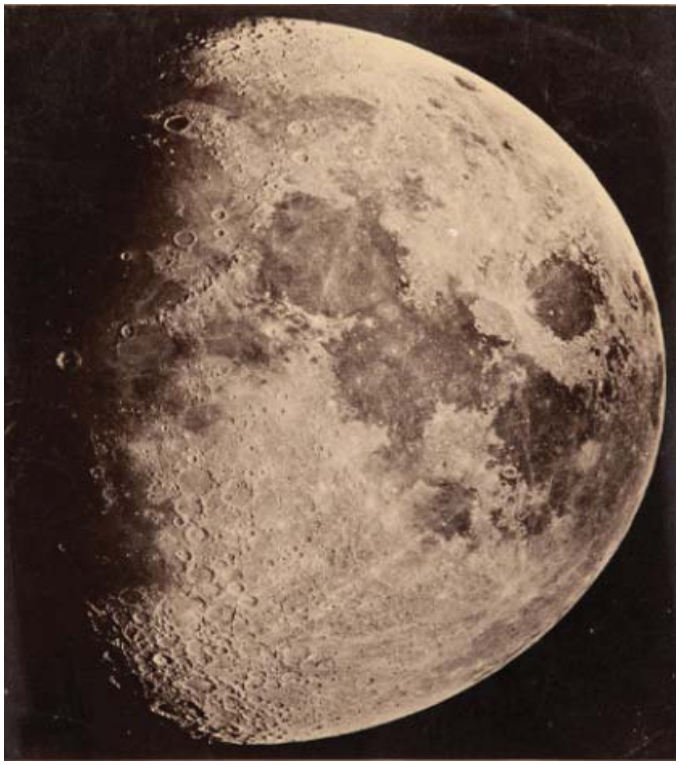
Astrophotography

Photography was born in the early 1800s with the development of light sensitive emulsions that could capture and retain an image. Early attempts at photography involved toxic chemicals (e.g., mercury fumes), hour long exposures, and subjects that didn't move or that could maintain a static pose. As the technology advanced and exposure rates became manageable, photographers became more creative and photography found more applications. One of those applications was astrophotography, or the imaging of celestial objects. A common target was the bright Moon, with its short exposure times.

A pioneer in the field of astrophotography was Lewis Rutherfurd. Trained as a lawyer, he was also an amateur scientist. In 1849, Rutherfurd decided to dedicate his studies to astronomical photography and spectroscopy. In doing so, he had an observatory built at his home at 11th Street and 2nd Avenue in New York City, complete with an 11¼ inch refractor telescope constructed by Henry Fitz and modified under Rutherfurd's guidance for photography. He began his work in astrophotography in 1858, capturing a negative of the full moon later that summer.

His images of the Moon, with graduated exposures to compensate for the uneven brightness, were unrivaled in detail for over a century. His image (below left) of the first quarter Moon was taken on





March 4th, 1865. The waxing gibbous (below right) was taken two days later on the 6th.

In 1868, Rutherfurd acquired a 13 inch refractor with a correcting lens specifically designed for photography. With it, in 1897, he acquired a series of unparalleled photos of the Sun that displayed exquisite details of sun spots, faculae and the photosphere. Before he died in 1892, Rutherfurd donated his negatives of sun, moon and stars to Columbia College.

Twist of Fate

On March 3, 1969, a Saturn V rocket carried the crew of Apollo 9 into Earth orbit for the first manned flight test of the lunar module. The ten day mission was the most complex mission that had been conducted with two manned spacecraft, including the evaluation and testing of the first spacecraft designed to operate solely outside the Earth's atmosphere, a spacewalk, rendezvous and docking exercises, and the test firing of the lunar module's descent engine. The successes of Apollo 9 paved the way for the lunar landing missions that followed.

A year earlier, the crew of Apollo 9 (astronauts James McDivitt, David Scott and Russell Schweickart) had been assigned to Apollo 8, with the same mission objectives. However, by mid-year 1968, it was clear that the lunar lander, due to numerous manufacturing and technical concerns, would not be ready for a year-end flight. With a growing concern that the Soviets were ready to begin flying their new Soyuz spacecraft again (after a fatal accident on its first flight), NASA decided to send Apollo 8 on a flight around the Moon without the lunar lander. McDivitt considered the mission no more than a publicity stunt and turned it down, opting to switch with the Apollo 9 crew in anticipation that the lunar lander would then be available for that flight. McDivitt's decision would ultimately determine who would be the first to walk on the Moon, as the backup crew for Apollo 8 would become the prime crew for Apollo 11. With the crew switch, Pete Conrad went from the commander of Apollo 11 to the commander of Apollo 12 and from the first to the third person to walk on the Moon.

Apollo 11 crew: Armstrong, Collins, Aldrin

Comet History

Eighteen years ago, we were treated to the first of what would be two spectacular comets as Comet Hyakutake made its close approach to Earth in March of 1996. The comet was visible high overhead and throughout most of the night. Its tail could be traced halfway across a darkened sky.

The picture on the right was taken on March 27, 1996, at 2:30 a.m. as the coma of the comet passed Polaris, the North Star. The comet was truly a ghostly apparition. Its eerie iridescence was reminiscent of the glow-in-the-dark stars that you stick to a child's bedroom ceiling. The night was so quiet, you wondered if the comet's appearance was somehow responsible. Who knew that Hyakutake was a portent of another bright comet (Hale-Bopp) that would appear the following year?

March History

On March 16, 1926, in Auburn, Massachusetts, Robert Goddard launched the first liquid fueled rocket on a flight that lasted only 2½ seconds. A graduate of Worcester Polytechnic Institute, despite discharging a powder rocket from the basement of the physics building, the significance of Goddard's feat is compared by space flight historians to the first aircraft flight at Kitty Hawk.

Among his achievements, Goddard was first to prove that rockets would work in a vacuum and to mathematically explore the practicality of using rocket propulsion to reach high altitudes and even the Moon (1912). While he was eventually banished from the fields of Auburn by the fire marshal, the site is commemorated by markers on what is now the Pakachoag Golf Course.

The next time you are driving on the Massachusetts Turnpike towards Boston and points north, look to your left as you pass Exit 10. Just beyond the large shopping mall is where history was made.

Credit: NASA photo showing Dr. Goddard with his a liquid oxygen-gasoline rocket "Nell" in its launching frame

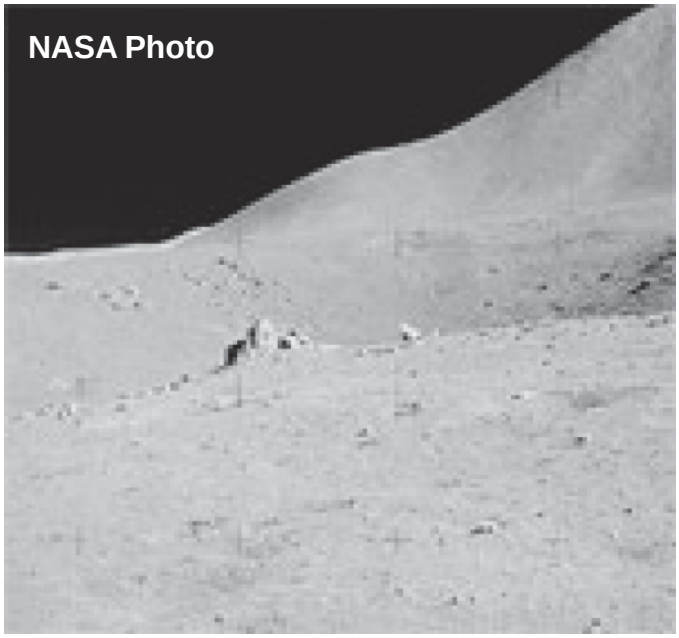
The Power of Reading

The National Education Association's *Read Across America* national reading celebration takes place each year on or around March 2nd, the birthday of Dr. Seuss. Theodor Seuss Geisel, the creator of such characters as The Cat in the Hat, understood the power of the imagination to entertain, inspire and educate.

Many of NASA's engineers and the Apollo astronauts grew up reading science fiction stories of space exploration and alien worlds. In many instances, the stories led them to pursue educations in science, technology, engineering and math.

The Apollo 15 astronauts went so far as to name several craters and other features around their landing site after references in various science fiction classics including *Dune* (Frank Herbert), *Dandelion* (Ray Bradbury), *Earthlight* (Arthur Clarke), *St. George* (Jules Verne), *Durins Bridge* (Tolkien) and *Rhysling* after a Robert Heinlein character in *The Green Hills of Earth*. Joe Allen, Mission Scientist and EVA CapCom on Apollo 15, quoted Heinlein's fictional

blind poet Rhysling as David Scott and Jim Irwin wrapped up their final lunar excursion and prepared the lunar module Falcon for their return to orbit. In the transcripts, Allen tells the astronauts that "we're ready for you to come *back again to the homes of men on the cool green hills of Earth*."



Crater Dune at the Apollo 15 landing site:

Prior to the launch of STS-125 in May 2009, I had theNASA Photo opportunity to interview one of several astronauts made available to the press. I requested time with Dr. Janice Voss because we had something in common: we both grew up reading science fiction.

Dr. Voss worked for Orbital Sciences Corporation before being selected as an astronaut in 1990. She was a veteran of five shuttle missions, logging over 49 days in space and traveling 18.8 million miles in 779 Earth orbits. One of her more memorable moments as an astronaut was on STS-63, in February 1995, when the shuttle docked with the Russian space station, Mir. She also served as the Science Director from 2004 to 2007 at the NASA Ames Research Center for the Kepler (planet finding) space telescope.

Dr. Voss became hooked on science fiction in sixth grade when she read Madeleine L'Engle's *A Wrinkle in Time*. It was after reading that story that she decided she wanted to become an astronaut. It was also the start of a life-long interest in reading and, in particular, science fiction which filled her book shelves at home.

William Borucki, a principal investigator for the Kepler mission, recalls that "Whenever anyone mentioned a science fiction story, Janice would pull out a

Dr. Janice Voss (1956 - 2012)

small notebook that she carried to see if she had already read the story. If she hadn't read the story, it would quickly be added to her list to read."

Janice Voss passed away on Feb. 6, 2012 at the age of 55 after losing a battle with cancer.

More March History

Caroline Herschel was born in Hanover, Germany on March 16, 1750, the fifth of six children. Her four brothers were brought up to be musicians like their father, a talented musician and bandmaster. Caroline's mother saw no need for a girl to be educated and preferred that Caroline become a house servant to the rest of the family. Unfortunately, Caroline contracted typhus at age 10. It permanently stunted her growth (she was just over four feet tall as an adult), further convincing her mother that she wouldn't amount to much.

Caroline's brother William escaped to England during the French occupation of Hanover in 1757. Her father Isaac, who had left to fight the French, returned home in poor health. Caroline lived at home as a servant until his death in 1767. Against her mother's will, she then left Hanover to join her brother William in England.

William Herschel was an accomplished musician although he gained considerable fame with his hobby as an astronomer and telescope maker. His reputation as a craftsman allowed him to quit his job as a musician and concentrate on astronomy. Caroline became her brother's apprentice, helping him design and build larger and more powerful telescopes. She also assisted her brother in recording his observations, sitting in a window and writing by candlelight while her brother called out what he saw through the telescope's eyepiece.

Astronomy became a full-time occupation when William discovered the planet Uranus in 1781 and received an annual endowment from King George III. When her brother was away, Caroline would use her own telescope to sweep the sky looking for comets. On August 1, 1786, Caroline discovered her first comet, the first comet to be discovered by a woman. Between 1786 and 1797 she would discover eight comets, as well as a number of deep sky objects.

With the marriage of William to Mary Pitt in 1788 and the birth of their son John in 1792, Caroline became involved in the education of her nephew. Under his father's and aunt's tutelage, John would become the first astronomer to thoroughly survey the southern hemisphere. Following William's death in 1822, Caroline continued to assist John in his astronomical work.

Caroline catalogued every discovery she and William made. Two of her catalogues are still in use today. She lived to be 98 and was recognized by the King of England, the Royal Astronomical Society, the King of Prussia and the King of Denmark for her life-long scientific achievements. After her death, Caroline Herschel was honored by the astronomical community by the naming of a lunar crater after her (C. Herschel) and an asteroid (281) Lucretia (her middle name).

Winter Favorite

A favorite observing target in the winter sky is NGC 891, an edge-on spiral galaxy discovered by Caroline Herschel in August 1783. Located at a distance of 31 million light years, NGC 891 is also called the "Outer Limits" galaxy since its image was used in the closing credits of the classic 1960s science fiction television show of the same name. The galaxy can be found in the constellation Andromeda, in the direction of the constellation Perseus. NGC 891's size and mass are similar to our Milky Way Galaxy. In this nearly edge on view, the dust lanes in the spiral arms can be clearly seen. Still visible in March, look for the galaxy shortly after sunset in the western sky with a moderately-sized telescope.

Photo Credit: Edge-on galaxy NGC 891 from the McCarthy Observatory by Marc Polansky

Zodiacal Light

The solar system is filled with tiny dust particles from the passing of comets and collisions of asteroids. The dust orbits in the same plane as the Earth and the other planets. Shortly before sunrise and just after sunset, sunlight can be seen reflecting off this disk of debris. Called the zodiacal light, it is best observed when the ecliptic (the apparent path of the Sun and planets) is nearly perpendicular to the horizon (on spring evenings and autumn mornings). The best time to glimpse the zodiacal light is when the Moon is absent from the evening sky (for example, between March 23rd and 30th).

March Nights

March, the month named for the planet Mars, denotes the end of the long winter nights. The Sun crosses the celestial equator at 12:57 pm (EDT) on the 20th marking the Vernal Equinox and the beginning of the spring season in the northern hemisphere. If you have the opportunity to be in the Yucatan on this day, take a trip out to Chichen Itza to watch the Sun cast the shadow of a plumed serpent on the pyramid of Kukulcan.

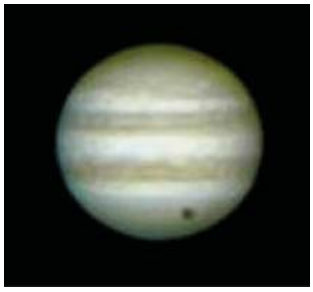
Mars reaches Opposition in early April, so it's not too early to catch a glimpse of the Red Planet in the constellation Virgo, not far from the bright star Spica. The two planets will pass with 58 million miles of each other in April; while not a particularly close ap-

proach, it is 5 million miles closer than the last opposition in March 2012 (the next, best opposition will be in July 2018 when the two planets will be only 36 million miles apart). This year, the northern hemisphere on Mars will be enjoying the summer Sun in March and April, with the north polar ice cap tipped toward the Earth (and Sun).

Sunrise and Sunset

Sun	Sunrise	Sunset
March 1st (EST)	06:28	17:44
March 15th (EDT)	07:05	19:00
March 31st (EDT)	06:38	19:18

Jupiter and its Moons



Jupiter reached Opposition on January 5th and is still well placed in the evening sky in March. As one of the brightest star-like objects in the night sky, Jupiter can be found in the constellation Gemini.

One of the more interesting and easier events to observe through a telescope is the projection of a shadow from one of Jupiter's moons on the Jovian disk as the moon passes in front of (or transits) the planet. The photo on the right shows the shadow of Ganymede on the Jovian disk. On nights of good visibility the following events should be visible through a moderately-sized telescope (between approximately 5 pm and midnight).

Date	Moon	Transit Begins	Transit Ends
Feb 28th	Io	7:02 pm	9:17 pm
7th	Io	8:57 pm	11:12 pm
11th	Callisto	5:11 pm	9:03 pm
13th	Europa	7:23 pm	10:05 pm
14th	Io	11:52 pm	2:08 am (15th)
16th	Ganymede	6:08 pm	9:24 pm
16th	Io	6:21 pm	8:37 pm
20th	Europa	9:59 pm	12:41 am (21st)
23rd	Io	8:17 pm	10:32 pm
23rd	Ganymede	10:08 pm	1:26 am (24th)
30th	Io	10:12 pm	12:28 am (31st)

Transit of Jupiter's Red Spot

The Red Spot is a large cyclone in the upper Jovian atmosphere. The rapid rotation of this gas giant (10 hours) may be responsible for the longevity of this storm, which has been observed for over 300 years. The Red Spot will cross the center line of the planetary disk on the following evenings during the hours between 7 pm to midnight local time.

Date	Transit Time	Date	Transit Time
2nd	10:47 pm	19th	10:53 pm
5th	8:18 pm	21st	11:32 pm
7th	9:56 pm	22nd	8:23 pm
10th	8:26 pm	24th	10:02 pm
12th	10:05 pm	26th	11:41 pm
14th	11:44 pm	29th	9:11pm
17th	9:14 pm	31st	10:52 pm

Astronomical and Historical Events

1st New Moon
1st History: Soviet spacecraft Venera 13 lands on Venus and records first color panoramic views of the surface (1982)
1st History: discovery of Saturn's moon *Helene* by Pierre Laques and Jean Lecacheux from the Pic du Midi Observatory in the French Pyrenees; named after Helen of Troy (1980)
1st History: Soviet spacecraft Venera 3 lands (crashes) on Venus, becoming first spacecraft to impact the surface of another planet (1966)
2nd History: launch of the Rosetta spacecraft (2004); scheduled to rendezvous with Comet 67 P/ Churyumov-Gerasimenko in May 2014 and send a lander to its surface in November 2014
2nd History: launch of Pioneer 10, a Jupiter flyby mission (1972)
3rd History: Chinese National Space Agency announces the Chang'e lunar exploration program (2003)
3rd History: launch of Apollo 9 with astronauts James McDivitt, David Scott and Russell Schweikart in the first manned flight test of the lunar module (1969)
3rd History: launch of the Pioneer 4 spacecraft towards the Moon; first U.S. spacecraft to escape the Earth's gravity (1959)
5th History: launch of the Air Force's second robotic space plane (X-37B) from the Cape Canaveral Air Force Station (2011)

Astronomical and Historical Events (continued)

- 5th History: Soviet spacecraft Venera 14 lands on Venus and uses a screw drill to obtain a surface sample that was determined to be similar to oceanic basalts on Earth (1982)
- 5th History: flyby of Jupiter by the Voyager 1 spacecraft (1979)
- 6th Scheduled flyby of Saturn's largest moon *Titan* by the Cassini spacecraft
- 6th History: launch of the Kepler telescope from Cape Canaveral Air Force Station aboard a Delta II rocket (2009); designed to survey nearby stars for Earth-size and smaller planets; as of February 2014, there are 1,075 confirmed exoplanets orbiting 813 stars
- 6th History: flyby of Comet Halley by Vega 1, a Soviet spacecraft (1986)
- 7th History: John Herschel born, first astronomer to survey the southern hemisphere (1792)
- 8th **Second Saturday Stars - Open House at McCarthy Observatory**
- 8th First Quarter Moon
- 8th History: maiden voyage of Europe's first unmanned cargo ship to the International Space Station; the Jules Verne was launched from Kourou, French Guiana aboard an Ariane 5 rocket; in addition to delivering supplies to the ISS, the cargo ship contained a manuscript by the 19th century French author and science fiction pioneer with computations of distances from Earth to several astronomical destinations, as well as to the center of the planet (2008)
- 8th History: flyby of Comet Halley by Susei, a Japanese spacecraft (1986)
- 8th History: discovery of rings around Uranus by NASA's airborne observatory (1977)
- 9th Daylight Saving Time - set clocks ahead one hour (United States)
- 9th History: flyby of Comet Halley by Vega 2, a Soviet spacecraft (1986)
- 9th History: launch of the Soviet spacecraft Sputnik 9, with dog Chernushka (1961)
- 9th History: Yuri Gagarin born; first person to orbit the Earth in 1961 (1934)
- 10th History: Mars Reconnaissance Orbiter arrives at Mars (2006)
- 10th History: flyby of Comet Halley by Sakigake, a Japanese spacecraft (1986)
- 11th Moon at apogee (furthest distance from Earth)
- 11th History: launch of Pioneer 5 into solar orbit between the Earth and Venus; confirmed the existence of interplanetary magnetic fields (1965)
- 11th History: Urbain Leverrier born, mathematician and astronomer, predicted existence of Neptune (1811)
- 13th History: flyby of Comet Halley by Giotto, a European Space Agency spacecraft (1986)
- 13th History: discovery of Saturn's moon *Calypso* by Dan Pascu, P.K. Seidelmann, William Baum and D. Currie (1980)
- 13th History: Percival Lowell born, established observatory in Flagstaff, AZ to observe Schiaparelli's Martian "canali" and look for other signs of life (1855)
- 13th History: William Herschel discovers the planet Uranus; originally named Georgium Sidus by Herschel in honor of his patron, King George III of England (1781)
- 14th Mercury at its Greatest Western Elongation (28°); apparent separation from the Sun in the morning sky
- 14th History: Stardust passes within 112 miles (181 km) of the nucleus of Comet Tempel 1 (2011)
- 14th History: John J. McCarthy Observatory issued Observatory Code Number 932 by the Minor Planet Center of the International Astronomical Union (2001)
- 14th Gene Cernan's 80th birthday (1934); last man on the Moon (Apollo 17)
- 14th History: Albert Einstein born, developed theories of mass to energy conversion and the curvature of space and time in large gravitational fields (1879)
- 14th History: Giovanni Schiaparelli born, director of the Milan Observatory and first to describe faint features on Mars as "canali" (1835)
- 15th History: San Juan Capistrano Meteorite Fall; the largest piece (50.5 g) penetrated the aluminum roof of a carport in a mobile-home park (1973)
- 16th Full Moon (Full Worm Moon)
- 16th Scheduled launch of Space X's Dragon cargo-carrying spacecraft from the Cape Canaveral Air Force Station, Florida to the International Space Station on a resupply mission

Astronomical and Historical Events (continued)

16th History: third and final flyby of Mercury by the Mariner 10 spacecraft (the last of the Mariner probes); Mariner 10 was also the first spacecraft to use solar radiation pressure on its solar panels and the antenna for attitude control during flight (1975)
16th History: launch of Gemini 8 with astronauts Neil Armstrong and David Scott; first docking with another space vehicle, an unmanned Agena stage (1966)
16th History: launch of the first Titan II Intercontinental Ballistic Missile, also used as the launch vehicle for the manned Gemini spacecraft in the early 1960's (1962)
16th History: Robert Goddard launches first liquid-fuel rocket in Auburn, MA (1926)
16th History: Caroline Herschel born (1750)
17th History: launch of the Gravity Recovery And Climate Experiment (GRACE) spacecraft (2002)
17th History: launch of Vanguard 1, 4th artificial satellite and oldest still orbiting Earth (1958)
17th History: Galileo Galilei publishes "Sidereus Nuncius" (Starry Messenger), the first scientific treatise based on observations made through a telescope; it described Galileo's early observations of the Moon, the stars, and the moons of Jupiter (1610)
18th History: MESSENGER enters orbit around Mercury (2011)
18th History: New Horizons spacecraft (on its way to Pluto) crosses the orbit of Uranus (2011)
18th History: explosion during launch of a Vostok rocket carrying a military spy satellite kills 48 members of the Soviet Missile Troop; likely cause of explosion was an oxygen peroxide leak caused by the poor quality of the rocket's fuel filters (1980)
18th History: Alexei Leonov performs first spacewalk from Soviet Voskhod spacecraft (1965)
19th History: Tenham meteorite fall; fragments of a large meteor rain down on a remote area of western Queensland, Australia (1879)
19th History: Moon flyby by the Hiten spacecraft; Japan's first lunar flyby, orbiter and surface impactor (1990)
20th Vernal Equinox (beginning of the Spring season in the northern hemisphere) at 12:57 pm EDT
20th Dwarf Planet 136472 Makemake at Opposition (51.482 AU); discovered on March 31, 2005 by Michael E. Brown, Chad Trujillo and David Rabinowitz
21st History: launch of Ranger 9, Moon impact mission; transmitted the highest resolution imagery obtained to that date before impacting the floor of Alphonsus crater on the 24th (1965)
22nd Venus at its Greatest Western Elongation (47°); greatest apparent separation from the Sun in the morning sky
22nd History: launch of space shuttle Atlantis (STS-76), third mission to Russian space station Mir and transfer of the first American woman, Shannon Lucid, to the station (1996)
23rd Last Quarter Moon
23rd History: launch of Gemini 3 with astronauts Virgil Grissom and John Young, first manned Gemini flight (1965)
23rd History: Wernher von Braun born, German rocket scientist and leader of the U.S. moon program (1912)
23rd History: first photograph of the Moon taken by American astronomer J.W. Draper (1840)
25th Scheduled launch of a Soyuz spacecraft from the Baikonur Cosmodrome in Kazakhstan to the International Space Station with members of the next expedition crew
25th History: launch of the IMAGE spacecraft, first mission dedicated to mapping the Earth's magnetosphere (2000)
25th History: close approach of Comet Hyakutake (0.10 AU) to Earth (1996)
25th History: launch of Soviet spacecraft Sputnik 10 with dog Zvezdochka (1961)
25th History: Christiaan Huygens discovers *Titan*, Saturn's largest moon (1655)
27th Moon at perigee (closest distance from Earth)
27th Comet 17P/Holmes Perihelion (2.057 AU); temporarily brightened by a factor of ½ million, becoming visible to the unaided eye in October 2007
27th History: launch of the Soviet atmospheric probe and lander Venera 8 to Venus (1972)

Astronomical and Historical Events (continued)

27th History: launch of Mariner 7, Mars flyby mission (1969)
27th History: President Eisenhower approves the military lunar program to be managed by the Advanced Research Projects Agency (1958)
28th History: flyby of Comet Halley by the ICE spacecraft (1986)
28th History: Heinrich Olbers discovers the asteroid 2 *Pallas* (1802)
29th History: First flyby of Mercury by the Mariner 10 spacecraft (1974)
29th History: Heinrich Olbers discovers the asteroid 4 *Vesta* (1807)
30th 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.*

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Front page design and graphic calendars: Allan Ostergren

Photos of Mare Nectaris, Comet Hyakutake and the transit of Ganymede across Jupiter were taken by the author: Bill Cloutier

Second Saturday Stars poster: Sean Ross, Ross Designs

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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

March 8th

7:00 - 9:00 pm

DOUBLE STARS

and

STAR CLUSTERS

Refreshments
Family Entertainment
Activity Center
Stars & Planets
Rain or shine

S.Ross

Map

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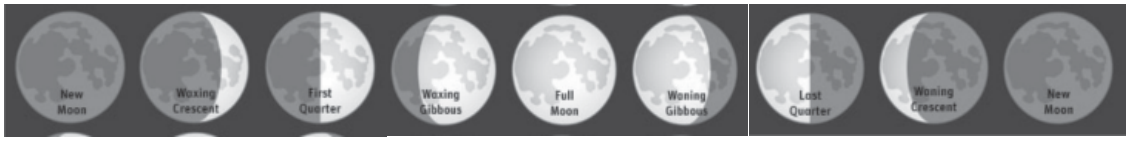
March 2014

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

Phases of the Moon



Mar 1 Mar 8 Mar 16 Mar 23 Mar 30

1

Soviet spacecraft Venera 3 crashes on Venus (1966)

Venera 13 makes successful landing (1982)

Saturn's moon Helene discovered by Pierre Laques and Jean Lecheux (1980)

2

Launch of Pioneer 10 Jupiter flyby mission (1972)

Launch of Rosetta spacecraft to comet 67 P/ Churyumov-Gerasimenko (2004)

3

Launch of Apollo 9; first test of lunar module (1969)

ESA's Mars Express spacecraft close flyby of Martian moon Phobos (2010)

4

Giovanni Schiaparelli, born, first to describe Martian "canali" (1835)

5

Soviet spacecraft Venera 14 lands on Venus (1982)

launch of the Air Force's second robotic space plane (X-37B) from the Cape Canaveral Air Force Station (2011)

Voyager 1 flyby of Jupiter (1979)

Flyby of comet Halley by Soviet Vega 1 spacecraft (1986)

Launch of Kepler telescope, to search for exoplanets (2009)

7

John Herschel born, first astronomer to survey southern hemisphere (1792)

8

Flyby of Comet Halley by Japanese Suisei spacecraft (1986)

Discovery of Uranus' rings by NASA Airborne Observatory (1977)

Maiden voyage of the Jules Verne, Europe's first unmanned cargo ship to International Space station (2008)

2nd Saturday Stars Open House McCarthy Observatory

9

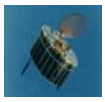
Daylight Saving Time

Flyby of comet Halley by Vega 2, Soviet spacecraft (1986)

Sputnik 9, with dog Chernushka (1961)

Yuri Gagarin born - first to orbit Earth (1934)

10



Flyby of Comet Halley by Japanese Sakigake spacecraft (1986)

Mars Reconnaissance Orbiter arrives at Mars (2006)

11

Moon at apogee (farthest from Earth)

Urbain Leverrier born - Predicted existence of Neptune (1811)

Launch of Pioneer 5 into solar orbit to study interplanetary magnetic fields (1965)

12

Simon Newcomb born - Canadian-American astronomer, studied planetary motion (1855)

13

Percival Lowell born (1855)

Discovery of Uranus by William Herschel (1781)

Flyby of Comet Halley by ESA spacecraft, Giotto (1986)

14

Giovanni Schiaparelli born, first to observe Martian "canali" (1835)

Albert Einstein born (1879)

JJMO earns Observatory Code 932 from IAU's Minor Planet Center for tracking of asteroid Geographos (2001)

15

Abbé Nicolas Louis de Lacaille born, French astronomer, catalogued southern hemisphere stars and constellations (1713)

16

Robert Goddard First liquid fuel rocket (1926)

First Titan 2 ICBM (1962)

Caroline Herschel born. first woman astronomer (1750)

17

Vanguard 1 artificial satellite (1958)

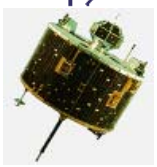
Publication of *Sidereus Nuncius* on Galileo's astronomical observations (later taken on 2008 Hubble repair mission) (1610)

18

Alexei Leonov First Spacewalk (1965)

Soviet Vostok rocket explodes during launch, killing 48 (1980)

19



Moon flyby by Japan's Hiten orbiter and impactor (1990)

20

Vernal Equinox

21

Launch of Ranger 9 Moon impact mission (1965)

22

Shannon Lucid, first American woman on Russian Space Station (1996)

23

Launch of Gemini 3 (Grissom, Young) (1965)

Wernher von Braun born (1912)

First photo of Moon by J.W. Draper (1840)

24

Planet Pluto (now *dwarf* planet) officially named by Lowell Observatory, on suggestion of Oxford schoolgirl, Venetia Burney (1930)

25

Comet Hyakutake 1996

Christiaan Huygens, discovers Saturn's oonTitan (1655)

Launch of IMAGE spacecraft, first to study Earth's magnetosphere (2000)

26

French mathematician and discoverer of Neptune, Urban Jean Joseph Le Verrier, proposes existence of a new planet Vulcan within orbit of Mercury (1859)

27

Moon at Perogee (Closest to Earth)

Eisenhower approves military lunar program (1958)

Launch of Mariner 7 Mars flyby mission (1969)

28

Flyby of Halley's Comet by ICE spacecraft (1986)

29

First flyby of Mercury by the Mariner 10 spacecraft (1974)

Heinrich Olbers discovers the asteroid 4 Vesta (1807)

30

Bernhard Voldemar Schmidt born - German astronomer and inventor of the Schmidt telescope, known for its high definition and wide field of view (1879)

31

Launch of Soviet spacecraft Luna 10, first to orbit Moon (1966)

Feb 2014

S	M	T	W	T	F	S
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2	3	4	5	6	7	8
9	10	11	12	13	14	15
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23	24	25	26	27	28	

Apr 2014

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