Galactic Observer

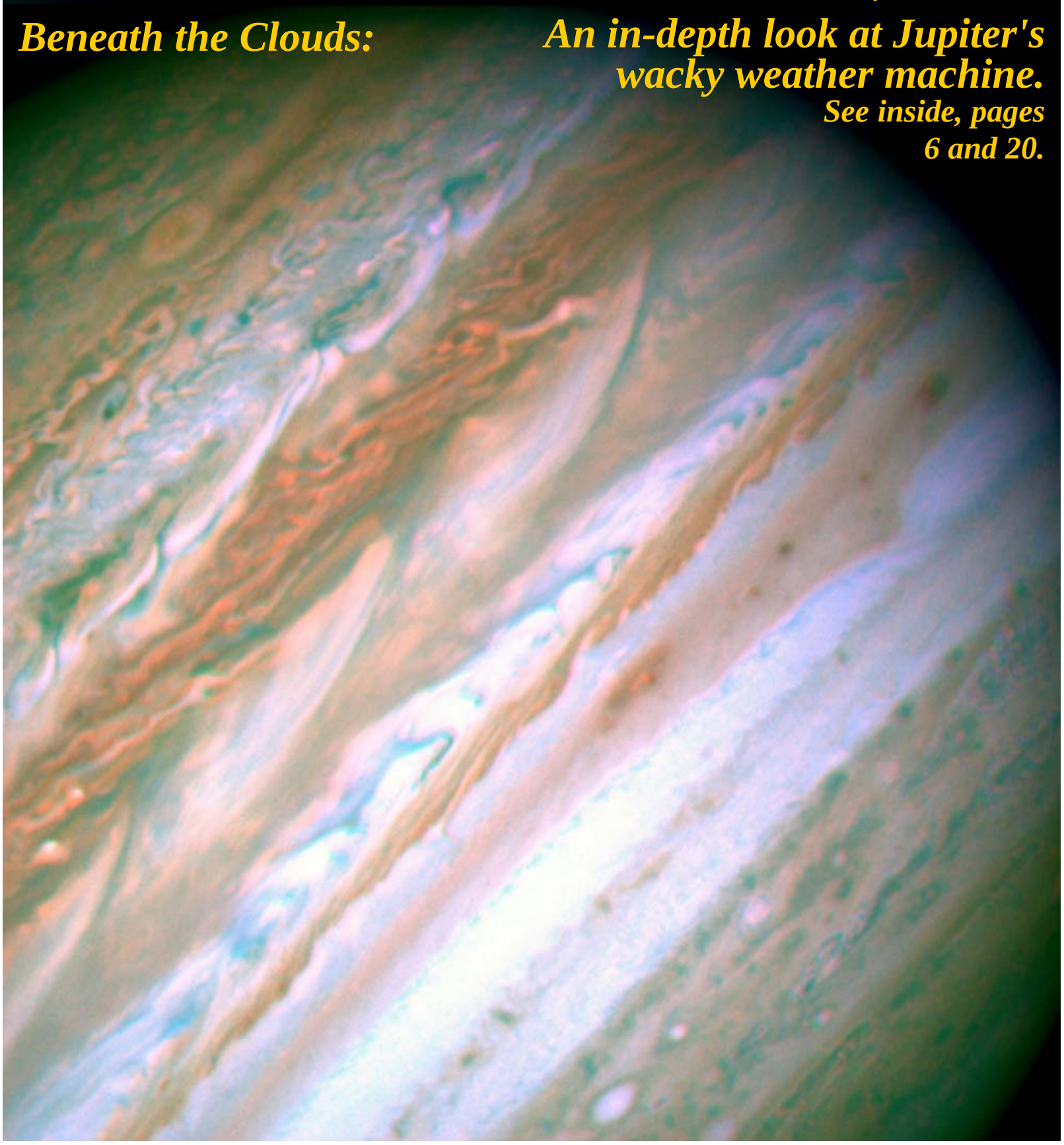
John J. McCarthy Observatory

Volume 7, No. 2 February 2014

Beneath the Clouds:

An in-depth look at Jupiter's wacky weather machine.

See inside, pages 6 and 20.



The John J. McCarthy Observatory

New Milford High School
388 Danbury Road
New Milford, CT 06776

Phone/Voice: (860) 210-4117
Phone/Fax: (860) 354-1595
www.mccarthyobservatory.org

JJMO Staff

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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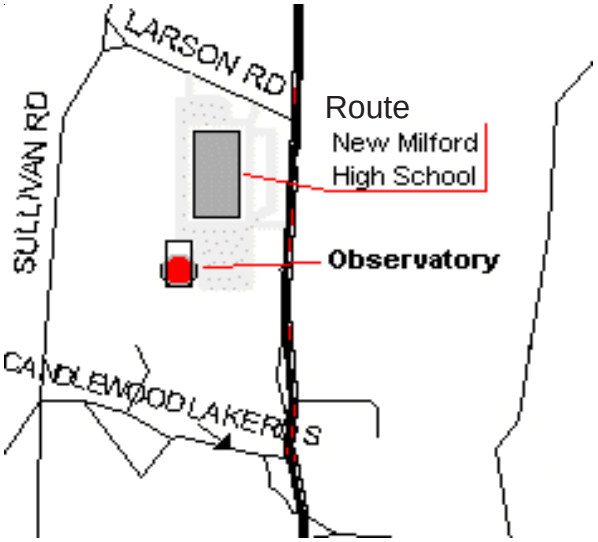

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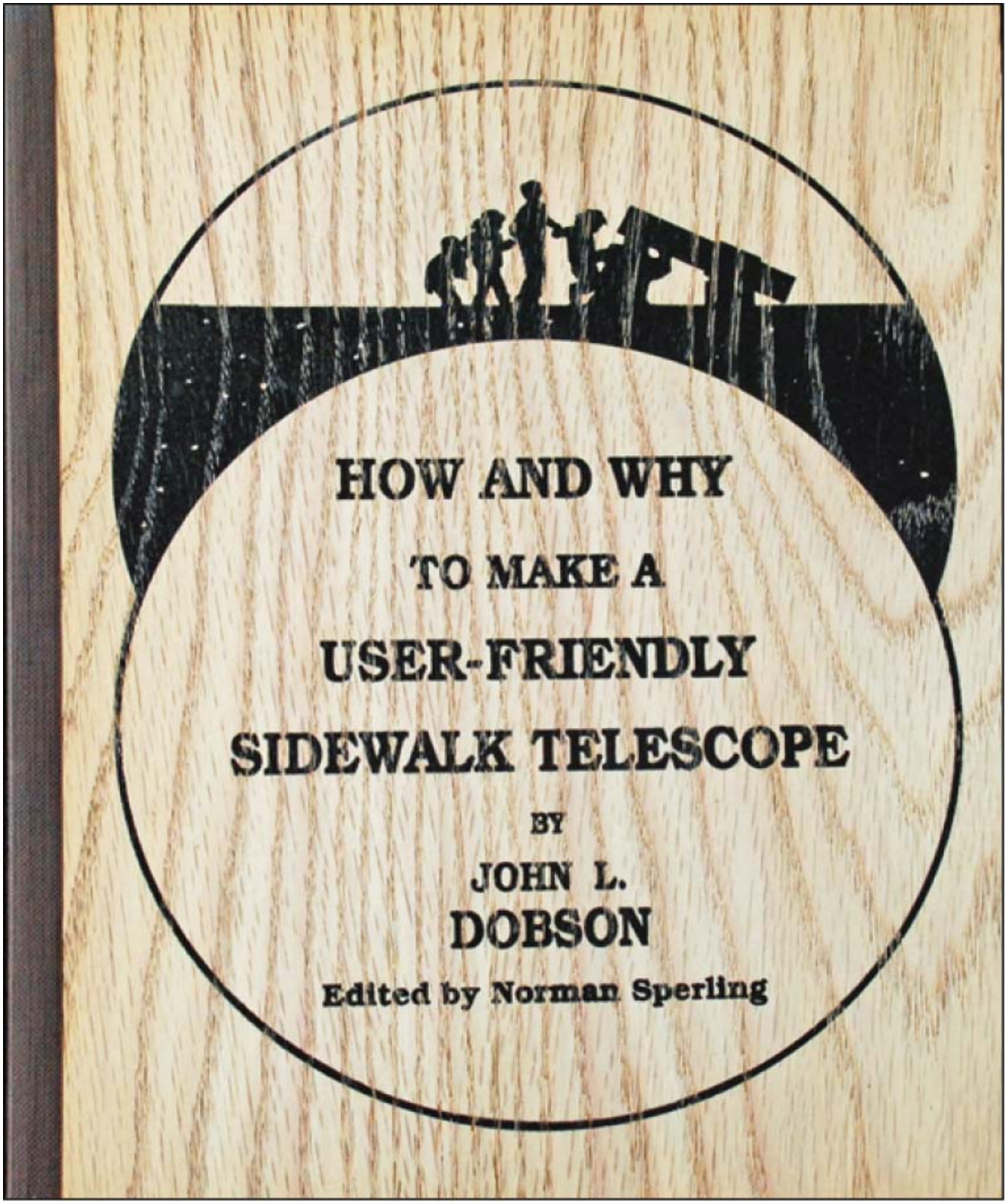
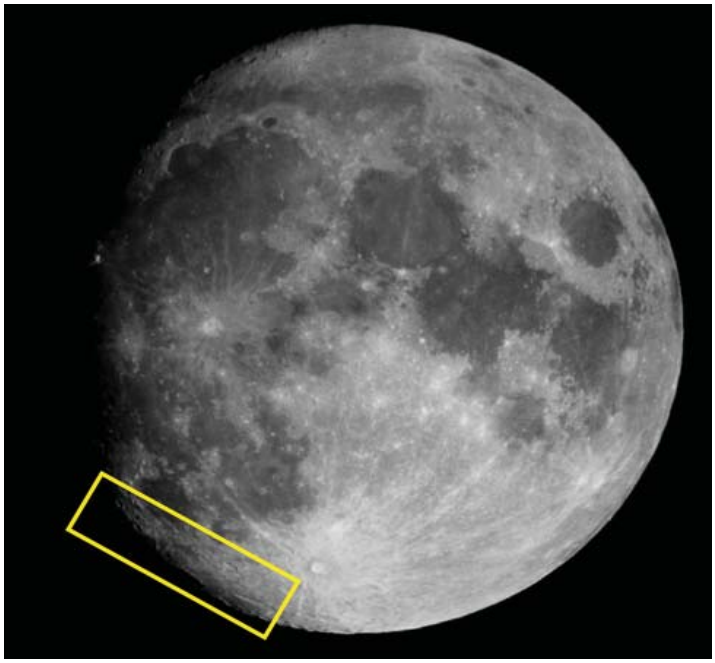


John L. Dobson
1915-2014

"Out the Window on Your Left"

It's been over 40 years since we left the last foot print 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 or lakes are actually expansive low-lying plains formed by ancient lava flows

The sun rises on the Moon's southwestern limb in our photo this month. Our view extends from the elongated crater Schiller in the southern highlands to the crater Hansteen north of Mare Humorum ("Sea of Moisture").

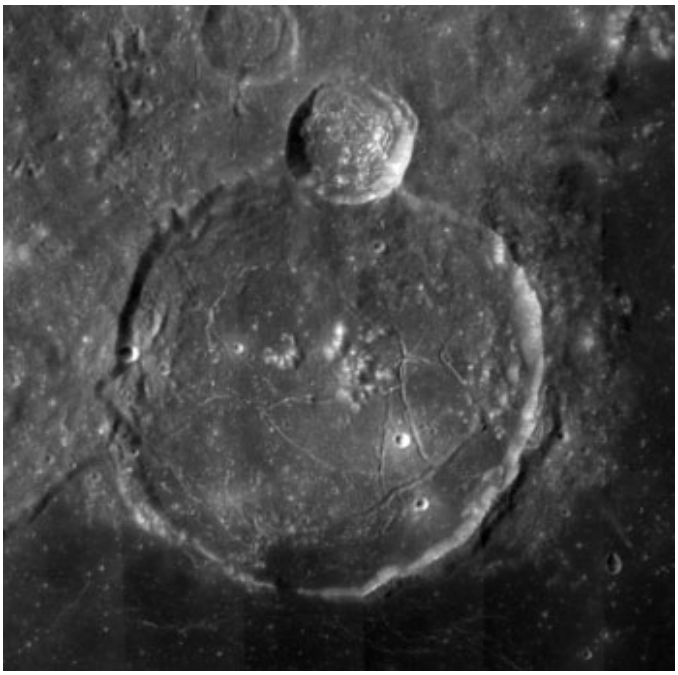
While only partially visible in the image, Mare Humorum is the site of an ancient impact basin, approximately 500 miles (825 km) across and filled with molten rock to a depth of almost 2 miles (3 km). The impact basin may also be older than originally thought, based upon a recent analysis of laser altimeter data from the Lunar Reconnaissance Orbiter (LRO) used to reconstruct an impact event sequence for the Moon's basins.

Breaching the basin's northern wall is the large, fractured floor crater, Gassendi. At 55 miles (90 km) in diameter, its bright central peaks rise more than 4,000 feet (1,200 m) above the surrounding plain.

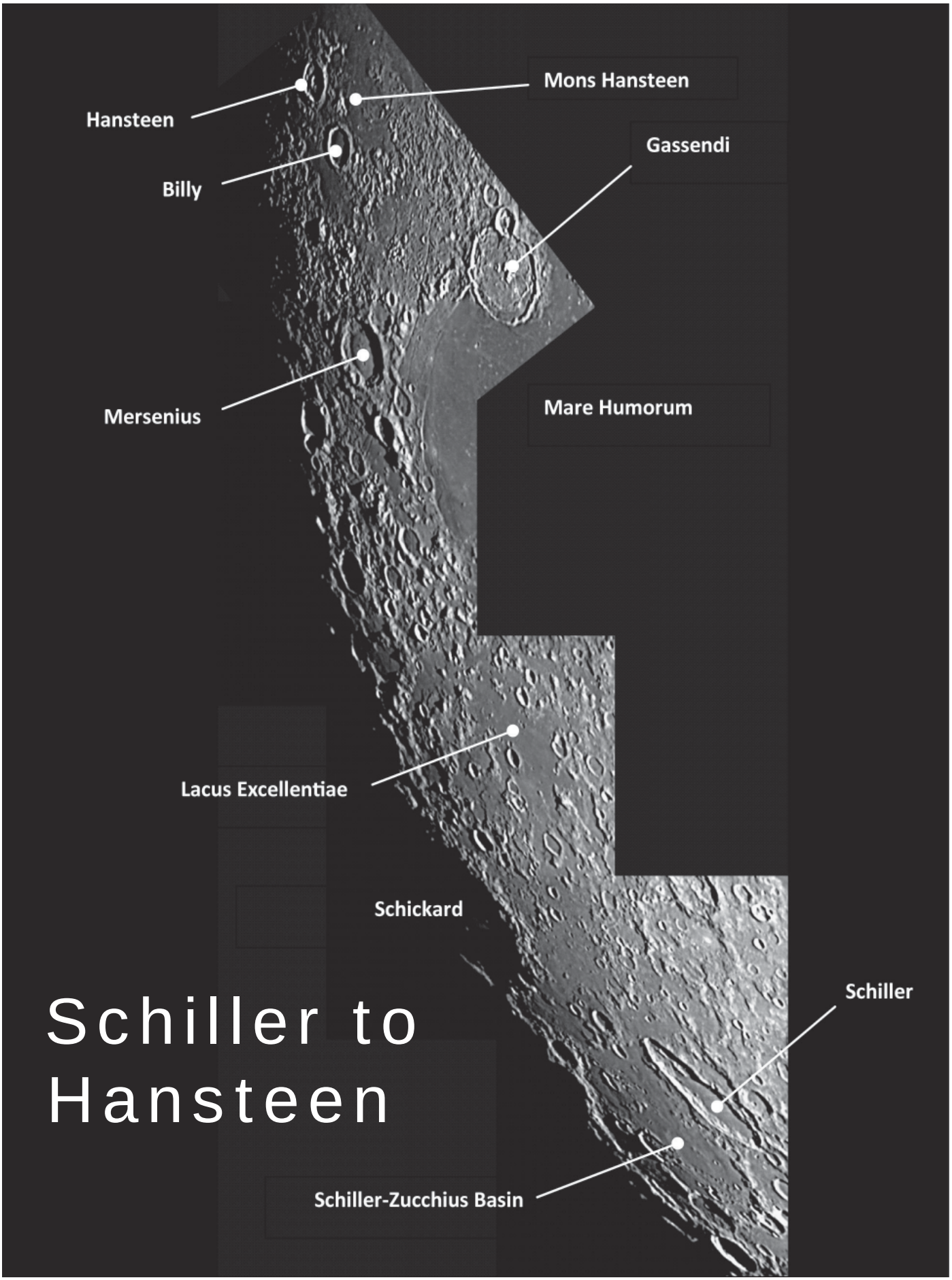
Located between the craters Hansteen and Billy, is a triangular-shaped outcrop: Mons Hansteen, a designated lunar Red Spot. Lunar Red Spots are dome-like features of possible volcanic origin. Unlike other volcanic domes, Red Spots were formed by much more viscous, non-mare (non-basaltic) lavas. It is surmised that volcanoes such as Mons Hansteen were active shortly after the Imbrium basin impact 3.9 billion years ago, but before mare lavas flooded the impact basin 3.5 billion years ago.

South of Mare Humorum is Lacus Excellentiae ("Lake of Excellence"). A relatively small and irregular lunar mare, it is bounded by the rugged lunar highlands, with few distinguishing features. However, the rim of one of the largest craters on the nearside (Schickard) is visible nearby. From edge to edge, Schickard's rim extends approximately 134 miles (215 km).

Spectral analysis of the region around Schickard and Schiller suggests the presence of ancient impact basins and mare lava underlying the overburden layer of highlands material and impact ejecta. The proposed source of the mare lava may be a previously unrecognized basin (Schickard-Mee basin) and cryptomare adjacent to the crater Schickard, as well as from the Schiller-Zucchius impact basin.



Gassendi was a possible destination for the Apollo 17 mission, to sample rocks from the crater's peak for evidence of ancient impacts. The boulder at the top of this LROC image is about 25 meters wide (62 feet). Credit: NASA/GSFC/Arizona State University



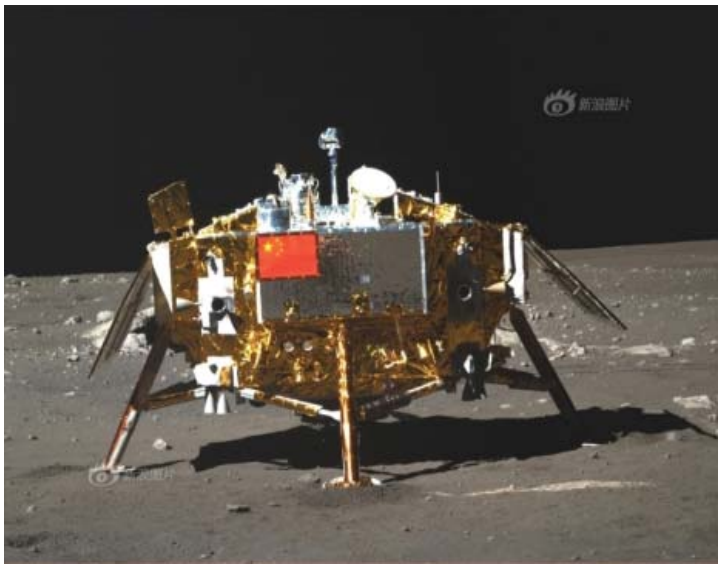
Schiller to Hansteen

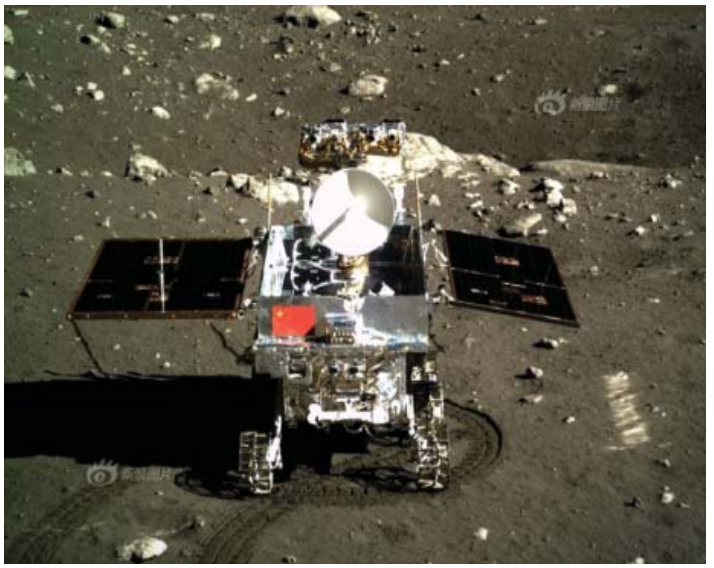
LRO Images Chang'e 3 Landing Site

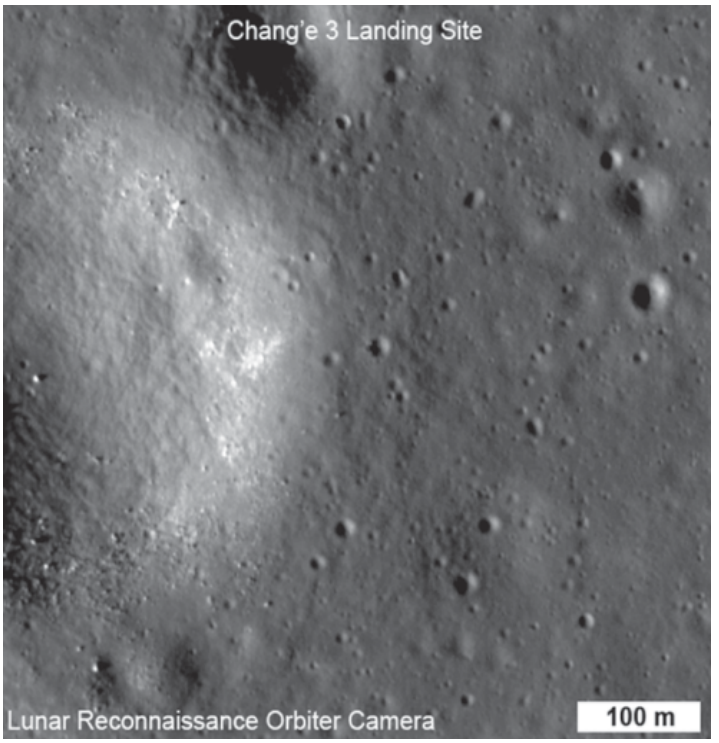
The Chinese soft-landed their Chang'e 3 spacecraft (carrying a rover) on the Moon on December 14, 2013. It set down on the lava plains of Mare Imbrium (Sea of Rains), southeast of Sinus Iridum (Bay of Rainbows) and just east of a 1,500 foot (450 m) diameter impact crater. Images of the Chang'e 3 lander and rover were made available by the Chinese Academy of Sciences.

In late December, the LRO passed over the landing site. At the time, the orbiter was approximately 90 miles (150 km) above the site and the Sun was setting. In the image (below, left), the lander and rover are visible as bright pixels, casting long shadows. For confirmation, the components are not visible in an image of the same area taken in June (below, right), under similar lighting conditions. LRO images were provided by NASA/Goddard Spaceflight Center/Arizona State University.

The rover is only about 5 feet (1.5 m) across; however, its visibility is increased by its reflective solar panels and the shadow cast under a low angle Sun.







Journey to the Center of Jupiter

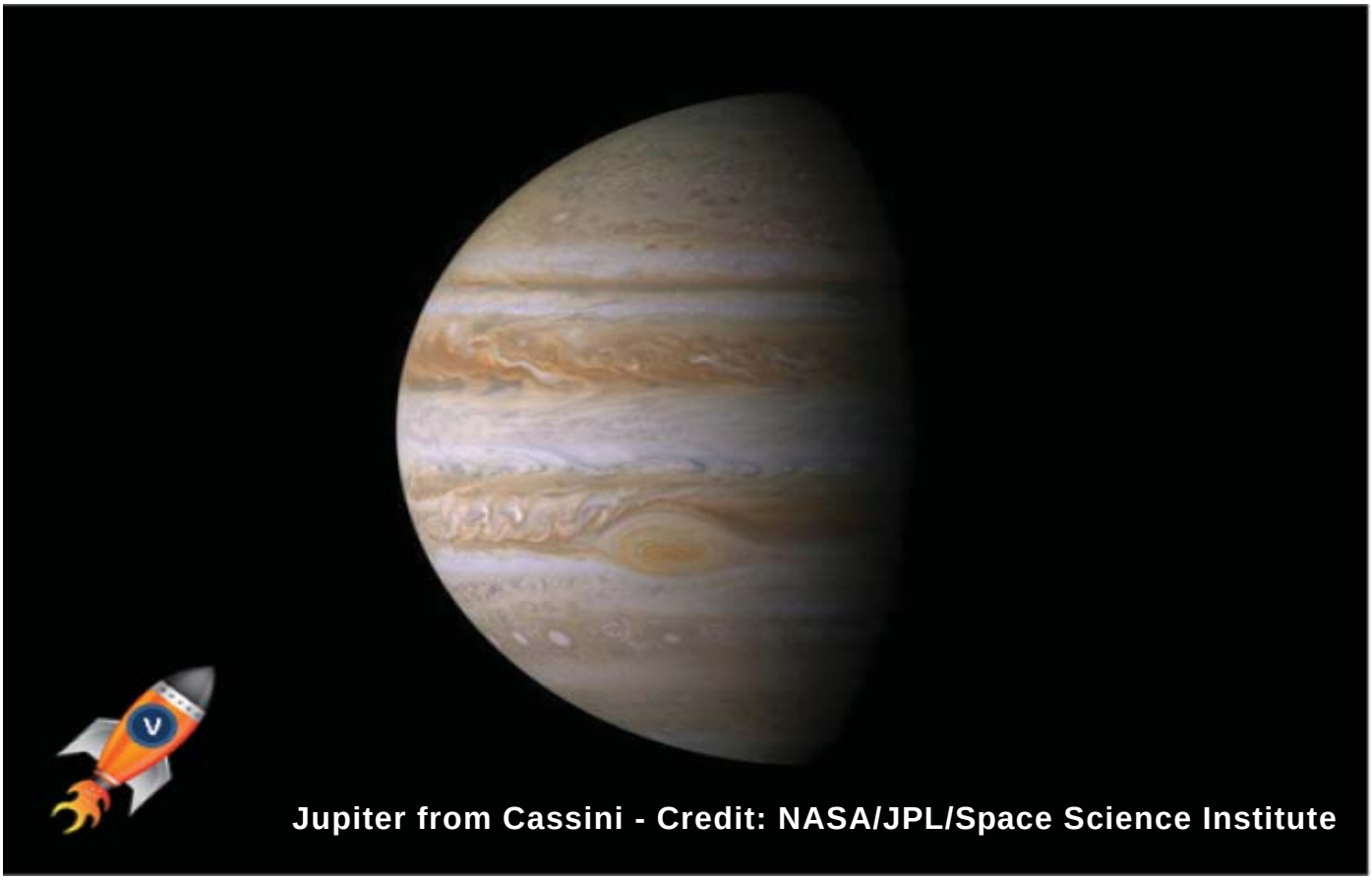
We are currently in the observing season of Jupiter. While the gas giant was closest to Earth in early January, it is now well placed in the early evening sky. The four Galilean moons are clearly visible as companion stars as they travel in synchronous orbits around Jupiter. Prominent on the planet's disk are alternating bands of bright and dark clouds within the gaseous atmosphere.

Cassini was the last spacecraft to visit Jupiter (13 years ago on its way to Saturn), and it will be another two years before the Juno spacecraft arrives in July 2016. While robotic spacecraft may one day explore Jupiter's moons, exploring the gas giant is more challenging (the Galileo atmospheric probe was destroyed by Jupiter's crushing atmospheric pressure less than 100 miles below the cloud tops).

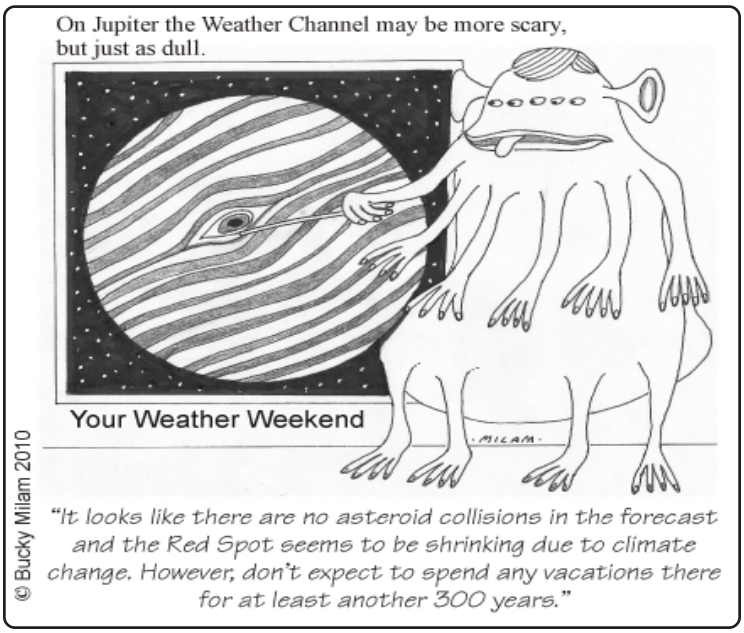
But what if you could explore the depths of the gas giant, what would you experience? For this imaginary journey, we will travel with a neutrino (í), a fundamental particle without charge that rarely interacts with matter.

At more than 11 times the diameter of the Earth, Jupiter will command our attention well before our "neutrino transfer vehicle" or NTV arrives. Jupiter's presence is first detected at a distance of almost 2 million miles, with a steady increase in radiation levels. Jupiter's magnetic field has an intrinsic strength 20,000 times greater than Earth's and is saturated with a sea of charged particles. The Sun facing side of the field is shaped and compressed by the solar wind, while the far side extends out past the orbit of Saturn.

Inside the magnetosphere, our NTV encounters several small and irregular moons possible remnants from ancient collisions or captured debris left over from the solar system's formation, before crossing the orbits of the four large, Galilean moons. Visible on the Jupiter facing side of the outer moon Callisto are a series of large concentric ridges surrounding Valhalla, an ancient impact basin. Ganymede is the next moon encountered. Larger than the planet Mercury, its icy surface is masked by large dark regions, impact craters and intersecting ridges and grooves. Closer to Jupiter is the enigmatic world, Europa. Its relatively smooth surface is crisscrossed with a network of cracks in its icy shell. Its youthful appearance and lack of impact craters suggests that the surface has been periodically renewed, possibly by a subsurface ocean that might extend more than 60 miles in depth. The possibility of a vast ocean beneath Europa's surface makes it one of the most likely candidates for extraterrestrial life and, therefore, targets for future missions, such as the Europa Clipper.



Jupiter from Cassini - Credit: NASA/JPL/Space Science Institute



Before reaching Jupiter's cloud tops, we pass by Io, the closest of the Galilean moons and the most active. Densest of the four moons, Io's surface is mottled in colors of red, yellow and orange from recent eruptions of its active volcanoes. Io's geological activity is a result of its proximity to Jupiter and Jupiter's tidal forces.

Thirty thousand miles above the outer layers of Jupiter's atmosphere is a faint ring that encircles the planet at its equator. Unlike Saturn's bright ice ring that is easily visible from Earth, Jupiter's dark, dusty ring is more difficult to see and was first detected by the Voyager 1 spacecraft during its flyby of the planet in 1979. Embedded within the ring are two small moons, Adrastea and Metis, that may be the source of the ring's dust.

Inside the ring, the churning, banded atmosphere takes center stage. Jupiter rotates once every 10 hours, causing the clouds and embedded cyclonic storms to rush by our probe. Wind speed at the equator averages 200 miles an hour (mph), although it can reach as high as 400 mph. The cloud layer extends to a depth of 50 to 60 miles (100 km) from the top of the troposphere and is comprised of three different layers with distinct types of clouds. Below the high haze are wispy white clouds of ammonia. Several miles beneath, we find a layer of ammonium hydrosulfide ice and other elemental compounds, exhibiting colors of yellows, reds and browns. At the lowest level, clouds are comprised of water ice and bluish in color. At this point in our journey, the pressure is almost 10 times that on Earth (at sea level).

The temperature and pressure continues to increase the deeper we descend. Hydrogen and helium comprise over 99 percent of Jupiter's atmosphere (with hydrogen being the most abundant) and with the increasing pressure, the gases slowly transition to liquid. Illumination, if any, at this depth is provided by lightning in the layers above.

At a depth of 10,000 miles, the pressure is 3 million times the atmospheric pressure on Earth. Under these conditions the molecular hydrogen ocean begins its transition to a metallic state. A liquid metal ocean extends all the way down to a rocky core, almost 40,000 miles below the cloud tops.

The conditions at the core of Jupiter are extreme, with a pressure 50 million times, or more, than the atmospheric pressure on Earth and a temperature between 60,000 to 70,000° F. With internal heat generated by gravitation energy, Jupiter radiates almost twice as much heat as it receives from the Sun.

As our probe reaches the center of the core, we begin our journey back out through the dark and lifeless oceans of hydrogen, through the overlying layers of clouds and back into the void beyond.

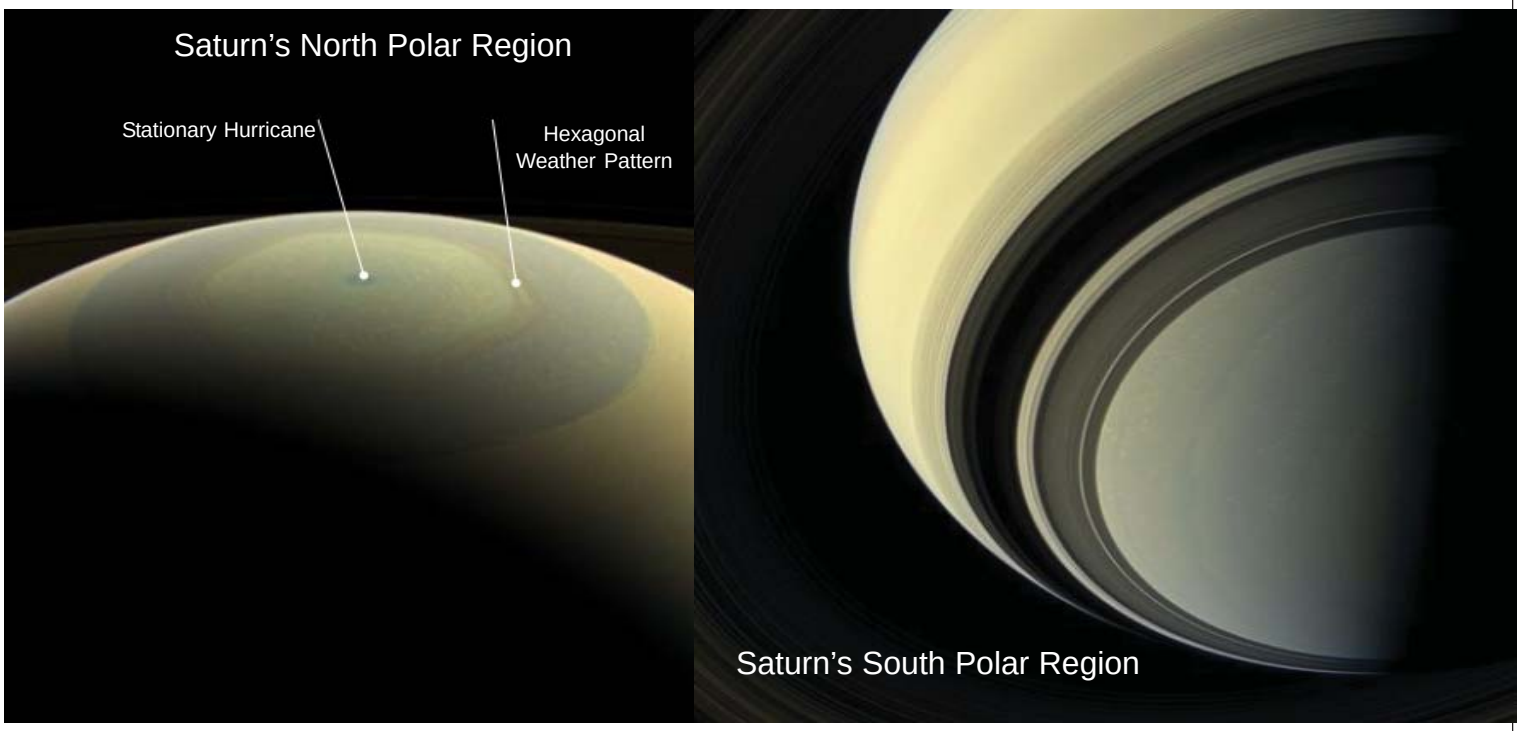
Changing Seasons on Saturn

Summer is coming to the northern hemisphere of Saturn and the Cassini spacecraft is there to capture the seasonal changes. While Cassini has been observing the hexagonal weather pattern at the north pole, the center had been shrouded in darkness. Now that Saturn's axis is tilted towards the Sun, a stationary hurricane is visible in the center of the vortex. Winds have been measured at 300 miles an hour. The image was taken from a distance of approximatley 611,000 miles (964,000 km) using a combination of red, green and blue filters to create a natural color view.

Conversely, winter is coming to the southern polar regions. The blue hue is thought to be the result of clearer skies and less haze in the atmosphere due to dimishing sunlight. The image was taken from a distance of approximately 1.003 million miles (1.615 million kilometers), and captures the unlit underside of the rings and the shadows cast by the rings upon the clouds.

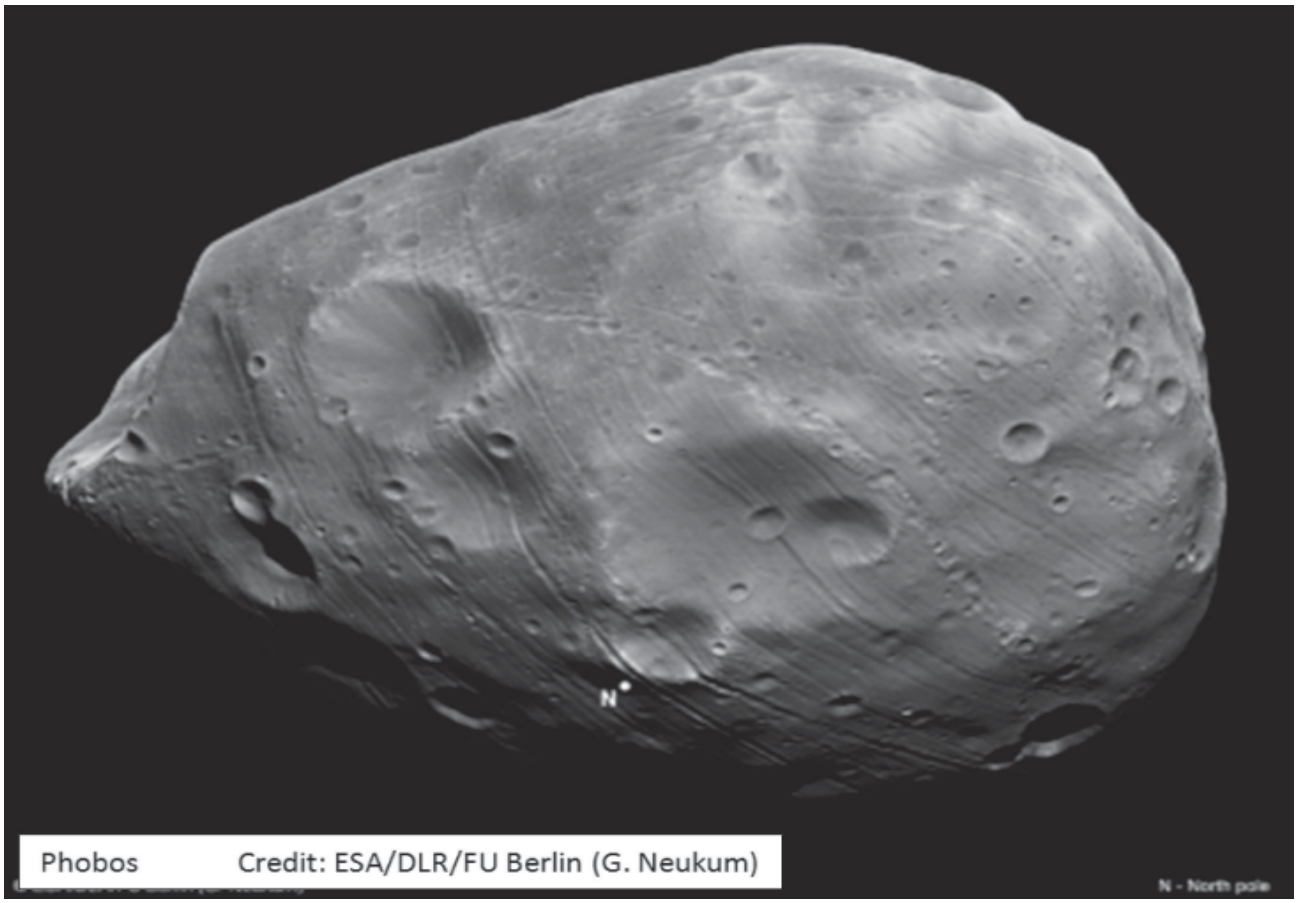
Phobos Revisited

On December 29, 2013, the Mars Express spacecraft completed a high speed, close approach of Phobos, the larger of Mars' two moons. The encounter (passing within 28 miles or 45 km of the moon's surface) was designed to estimate the gravitation field of the moon by measuring its slight pull on the spacecraft. The measurements will allow scientists to calculate the mass and density of the moon with greater precision. An earlier, more distant, flyby suggested that the moon is highly porous and may be nothing more than a debris pile held together under a weak gravitation field.



Credit: NASA/JPL-Caltech/Space Science Institute

The recent flyby may provide some insight as to Phobos' origin. Competing theories include: 1) Phobos as a captured asteroid and 2) the formation of Phobos in Mars orbit (from impact material). The former theory is supported by its spectral similarity to D-type asteroids. The later theory is supported by its near circular orbit and very low density.



Passing of a Telescope-Making Legend

John Dobson passed away on January 15th at the age of 98. Dobson was best known for his tireless promotion of popular astronomy and the use of simple materials to build inexpensive, user friendly telescopes to enable anyone to view the wonders of the universe. The austere, but effective design has come to be known as the "Dobsonian."

Dobson was born on September 14, 1915 in Peking, China. His father taught zoology at Peking University and his mother was a musician. He was 12 years old in 1927 when his parents, fearing for their safety, moved to the United States, settling in San Francisco without the financial means to go any further.

Dobson was a maverick. He went to the University of California at Berkeley for two years before dropping out. He was an avowed atheist until he met Swami Ashokananda, who challenged his core beliefs. (The Swami would later recommend that Dobson return to college, where he would get his degree in chemistry and mathematics). Dobson would eventually enter the Vedantic monastery (in 1944), preoccupied with the nature of the universe. He was given the assignment by the Swami of reconciling the teachings of religion with those of science. He eventually became interested in making a telescope to see the universe for himself. His first telescope (12- inch diameter mirror) was made in 1956 from a slab of porthole glass. The view of a third quarter Moon through that telescope motivated Dobson to share that experience with others.

Dobson was transferred to Sacramento in 1958 to establish a retreat for the Vendanta Society. Despite his monastic vows, he found the means to spread the word on his new found calling. Friends secretly delivered supplies that could be used to build rudimentary telescopes. He would go over the fence at night to work on the mirrors or grind the mirrors underwater to deaden the sound. Porthole glass was acquired from the American Salvage Company in San Francisco. He made his own grits from granite sand and polishing rouge from garden supplies. Dobson favored 12 inch glass because 12 inch cardboard tubes were available from the hose reels discarded by the Sacramento Rubber Company. Joining four segments together produced an optical tube with an 88 inch focal length. The telescope assembly would then be moved around on discarded wagon wheels. Like a piped piper, Dobson began attracting crowds of children and their parents as he introduced them to the wonders of the night sky and the means by which to view them.

By the time he was asked to leave the monastery in 1967 (after refusing to give up his astronomy outreach activities), Dobson had worked on building 15 twelve-inch telescopes and 2 eighteen-inch telescopes. (His original 12-inch telescope was purportedly tossed into San Francisco Bay along with some other belongings.)

While an outcast, it was not long before Dobson was setting up a telescope he called *Stellatrope* on the streets of San Francisco and giving workshops on telescope making. In 1968, Dobson joined Jeff Roloff and

Bruce Sams to form the San Francisco Sidewalk Astronomers. As the organization attracted more members, they began to make larger scopes and transport them to Bay area observing sites. In 1952, the group acquired a 40 passenger school bus they called *Starship Centaurus A* to haul telescopes and volunteers to even more remote observing sites.

John Dobson can be credited with bringing astronomy to the masses. While his primal design was originally rejected by the mainstream astronomical community, the lure of large "light buckets" at an affordable price started a grassroots movement that spread from local star parties to the showroom floors of leading telescope manufacturers.

Dobson was frequently in attendance at star parties across the country. The photo on the previous page was taken on the steps of the Pink Clubhouse at Stellafane in 2002, the annual gathering of the Springfield Telescope Makers. Dobson (on the left) and Carolyn Shoemaker (the prolific discoverer of asteroids and comets on the right) take time out to chat with young Ms. Kyle Cloutier.

The photo on the next page is the writer's 10-inch Dobsonian reflecting telescope built in 1981. It was christened "Betelgeuse" from the large orange, plastic dinner plates used as altitude bearings.

Typical of early designs, the cardboard tube (painted) was mounted on a plywood box that rotated on a Formica base (sink cutout) with Teflon pads.

The telescope is sitting on a Poncet equatorial platform. The platform uses a simple polar pivot and an inclined plane for star tracking.

John Glenn and the Flight of Freedom 7

On the morning of February 20, 1962, John Glenn became the first American to orbit the Earth aboard a Mercury space capsule that Glenn named Friendship 7. Originally scheduled for the previous December, the launch was delayed by several technical and mechanical issues, including a fuel leak, and by weather.

Glenn's capsule was placed into orbit by an Atlas rocket, a rocket originally developed as an Intercontinental Ballistic Missile. While the advantages of a multi-stage rocket were well known in the 1950s (dropping off spent stages reduces the fuel required to place the payload into orbit), starting engines in mid-flight had not been perfected. As such, vehicle weight was reduced during flight of the Atlas by dropping off the two outer engines while its center engine continued to burn until orbit was achieved. The Atlas was also unique in that it relied upon a "balloon" design to minimize its weight. This required pressurization of the fuel tanks so that the booster wouldn't collapse in upon itself.

While no longer a balloon design, the Atlas rocket remains an active expendable launcher today, carrying payloads for NASA, the Air Force and other customers.

John Glenn served with the Marine Corps prior to being selected by NASA in the first group of seven astronauts (the Mercury Seven). As a fighter pilot, he flew 59 combat missions in the South Pacific during World War II. Following service in the Korean War (baseball Hall of Fame legend Ted Williams was one of his wingmen), he set a speed record for a transcontinental flight on July 16, 1957 when he flew a Vought F8U Crusader from California non-stop to New York in 3 hours 23 minutes in a test of a new Pratt & Whitney engine (it did require 3 mid-air refuelings).

Glenn's trip around the Earth lasted 4 hours and 55 minutes and 23 seconds, completing 3 orbits before splashing down in the Atlantic Ocean southeast of Bermuda. While a public relations success, the flight was not without problems, the most serious of which was an indication that the capsule's heat shield had come loose and its landing bag deployed. Not knowing whether it

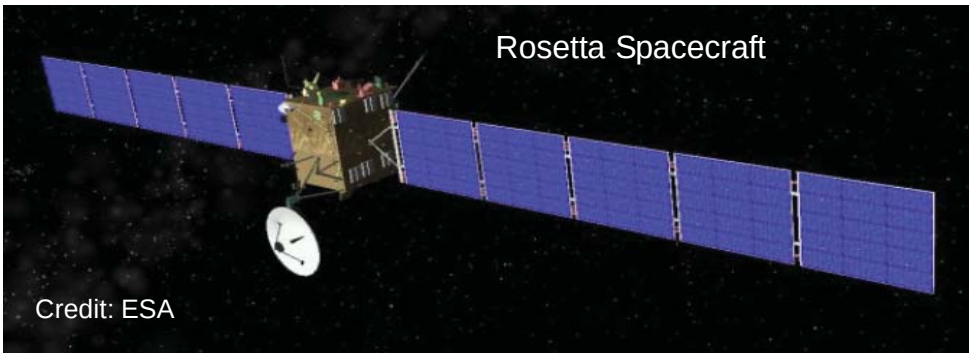
Astronaut John Glenn entering the Mercury capsule in preparation for his flight on February 20, 1962 Credit: NASA

was a faulty indicator, mission control asked Glenn to leave the retro-pack on during reentry. (The retro-pack consisted of three small rockets that were used to slow the spacecraft down. It was attached to the spacecraft by three straps that extended over the heat shield.) Fortunately, the indicator was faulty and the flaming debris that Glenn saw streaming by his window during reentry was from the retro-pack and not the heat shield.

John Glenn would not return to space for another 36 years. In 1998, at the age of 77, Glenn joined the crew of the space shuttle Discovery for a nine day mission.

Out of Hibernation

The Rosetta spacecraft was launched on March 2, 2004, aboard an Ariane rocket from the spaceport in Kourou, French Guiana. During the past ten years, the spacecraft has completed three flybys of Earth and one flyby of Mars as it adjusted its trajectory to inter-



cept and rendezvous with Comet 67P/ Churyumov-Gerasimenko. If all goes according to plan, Rosetta will catch up with the comet and follow it around the Sun as the comet returns to the outer solar system. In its travels, the spacecraft has encountered two asteroids: 2867 Šteins in September 2008 and 21 Lutetia in July 2010. It was placed in hibernation in June 2011.

On January 20th, Rosetta awakened from a 31 month deep sleep and sent a signal that was received by NASA's Deep Space Network. The spacecraft has since confirmed that its systems are operational. Rosetta is scheduled to rendezvous with Comet 67P/ Churyumov-Gerasimenko in May, and deliver a lander to the comet's surface in November.

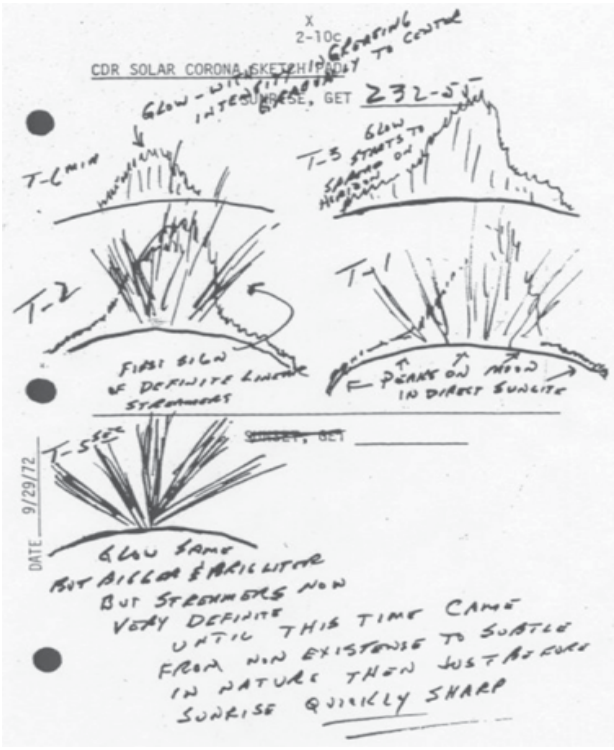
Lunar Mystery Solved?

The composition of the lunar surface has been the subject of speculation even before the telescope was invented. Reports of water, forests, volcanoes and artificial structures have been reported by observers throughout the ages. By the time the space race started, the debate was focused on the Moon's regolith (top surface layer) and its bearing capacity to support spacecraft and, more importantly, astronauts. Unmanned missions demonstrated that while the regolith provided a firm surface, it was also covered in dust (created by the pulverization of rock by micrometeoroids over eons). The dust would prove to be a nuisance during the Apollo missions, adhering to equipment and spacesuits, irritating the astronaut's eyes and lungs, and causing equipment to overheat and break down. The dust would also become involved in a mystery that endures today.

The Apollo astronauts were the first to report a strange glow above the Moon's horizon at sunrise. Dust scattered sunlight was suspected, but, without an atmosphere, there was no known mechanism to levitate the dust.

In October, the LADEE spacecraft entered lunar orbit with a mission to study the interaction of the Moon's dusty surface with its exosphere (comprised of free gas molecules with little or no interaction). While data from LADEE may provide a definitive explanation as to what the astronauts saw, a recent analysis of old Apollo records may provide a clue.

Brian O'Brien was the principal investigator for the Dust Detector Experiment (DDE), which flew on four Apollo missions. The rate of dust accumulation recorded by those experiments was 10 times higher than expected. Meteoroid impacts could not account for the amount of material measured. O'Brien now theorizes that dust from the surface was being levitated by electrical forces, temporarily suspended in the atmosphere before falling back to the surface. According to his theory, dust particles exposed to radiation from the Sun could acquire a slight positive charge while dust particles bombarded by the solar wind on the dark side could acquire a slight negative charge. At the boundary of light and dark, the opposing forces would levitate the dust and cause the scattering of sunlight that the astronauts observed. It remains to be seen whether LADEE can validate his theory.



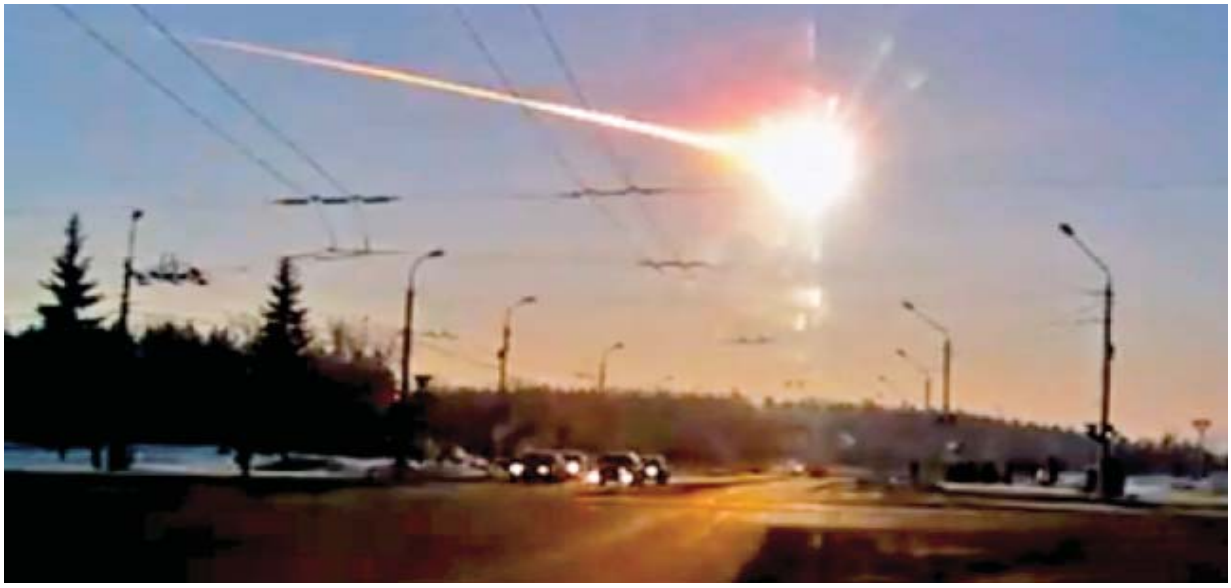
Sketch of the lunar sunrise as seen from orbit by Eugene Cernan (Apollo 17) in 1972.
Credit: NASA

Cosmic Wake-up Call

Just after dawn on February 15, 2013, a meteor streaked over the Ural Mountains and across the brightening sky before detonating near the city of Chelyabinsk. The shock wave from the air blast shattered windows, damaged buildings, and injured several hundred residents. The streaking meteor was captured by dashboard cameras in several cars as residents headed to work that morning and by security cameras in and around the city.

While fragments of the meteor were suspected to have fallen into a nearby lake, it wasn't until the following October that a large piece was recovered from the mud-covered bottom. The piece weighed approximately 1,256 pounds (570 kg) before it broke into several smaller pieces. The LL chondrite is thought to have been about 65 feet (20 meters) across when it entered the Earth's atmosphere.

Analysis of the meteorite tells a story that begins over 4.5 billion years ago with the formation of the solar system. Shock veins within the meteorite recorded numerous impacts to a larger, parent body (the Chelyabinsk fragment was exposed to space only 1.2 million years ago). Retracing its trajectory is also being used to recreate the asteroid's journey inward from the asteroid belt.



Dashboard camera view of the Chelyabinsk meteor

Large Fragment of the Chelyabinsk meteorite recovered
Credit: RIA Novosti: Alexander Kondratyuk

Martian Mystery

The Mars Exploration Rover Opportunity continues to surprise scientists, even a decade later. During the ten year celebratory broadcast on January 16th, lead scientist Steve Squyres announced the news that a rock had mysteriously appeared in front of the rover. The rock, named Pinnacle Island, is the size of a jelly donut and was not present when the area was imaged 12 days earlier.

While Squyres surmised that Opportunity probably dislodged the rock with its non-working right front wheel when rover was maneuvering nearby, further analysis may provide a clue to its origin. If the bright portion of the rock was previously buried or part of a larger outcrop, scientists will now have the chance to study a fresh sample of the rock formation that comprises the rim of Endeavour Crater.

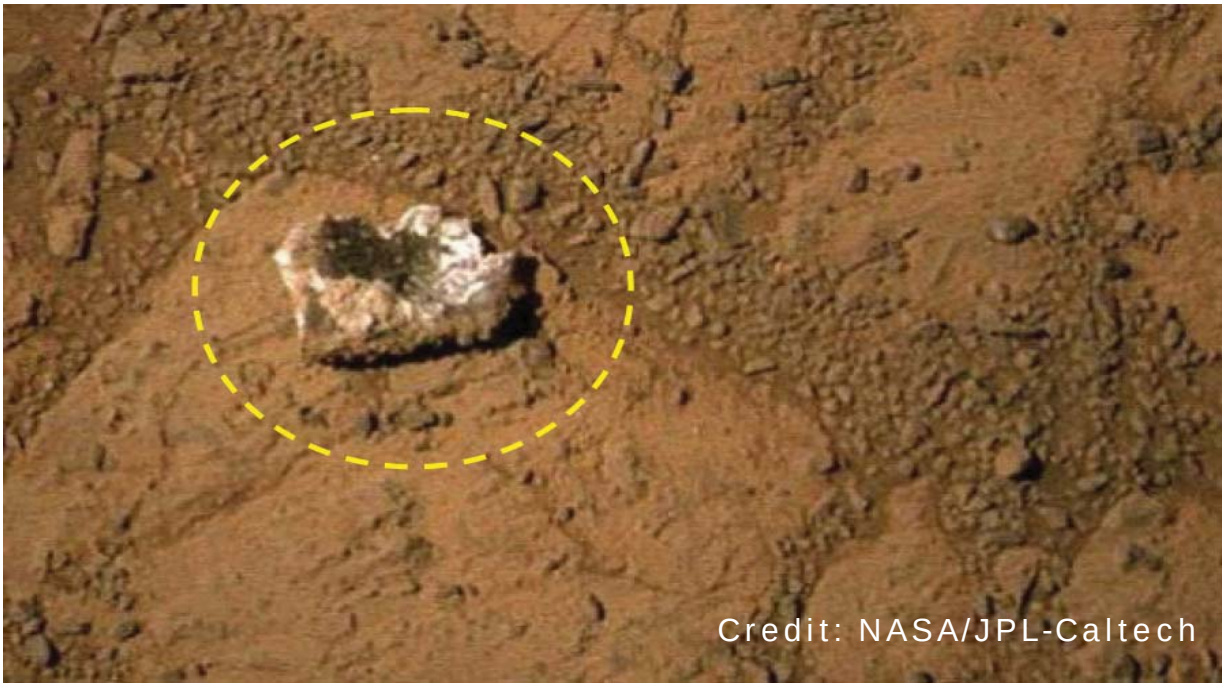


Photo of Pinnacle Island

February History

Eighty-four years ago on February 18th, a young American astronomer named Clyde Tombaugh discovered the solar system's ninth planet while working at the Lowell Observatory in Flagstaff, Arizona.

Clyde Tombaugh was born on an Illinois farm in February 1906, the eldest of six children. His family moved to a wheat farm in Kansas in 1922. At age 22, with only a high school diploma, Clyde spent most of his time working the family farm. In his spare time he would grind and test telescope mirrors in the farm's underground cellar. In 1928, Clyde sent several of his drawings of Mars and Jupiter from images seen through his homemade telescope to the Lowell Observatory. By chance, the observatory had just acquired a 13-inch telescope and was looking for a dedicated amateur to conduct photographic surveys of the night sky. With only enough money for a one-way ticket, Clyde left Kansas for Arizona in January of 1929. Thirteen months later, and after photographing millions of stars, he would discover Planet X (its designation before being officially named).

Clyde Tombaugh died in 1997. His wife and his family attended the launch of New Horizons. Making the journey to Pluto along with the spacecraft are the ashes of the astronomer.

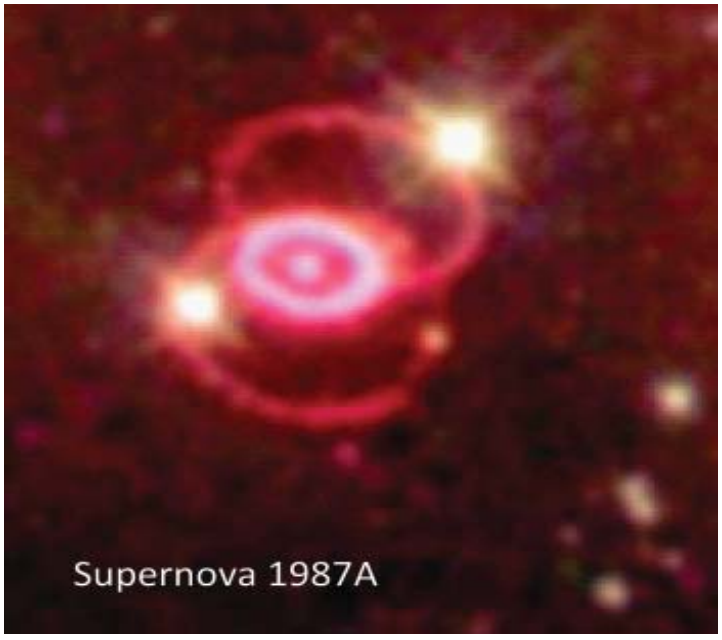
Venetia Phair, an 11 year old girl from England, suggested the name Pluto for the newly discovered planet. Her grandfather, who was the head librarian at Oxford University, passed the suggestion along to the American astronomers. Venetia, a retired school teacher, passed away in 2009 at the age of 90, but remains the only woman in the world to have named a planet (even if it's only a Dwarf Planet today). Venetia wasn't the only family member to have

named a celestial object; her great uncle named the moons of Mars (Phobos and Deimos).

Compared to the size of the parent planet, Pluto has the largest moon in the solar system (the pair is sometimes referred to as a "double planet"). Charon was discovered in 1978 by the American astronomer James Christy and named for the boatman who ferried dead souls across the river Styx to Hades (Pluto's domain). Charon is more than half the size of Pluto. It is also only 12,000 miles from Pluto (compared to 238,000 miles for Earth's moon). As such, in the dark and frozen sky at the edge of our solar system, Charon would appear more than 7½ times larger in Pluto's sky than our moon appears in the Earth's sky.

Supernovas

A supernova is an explosion produced when a massive star exhausts its fuel and collapses. These collapsing stars are typically red supergiants at least 8 times more massive than our Sun. If the original star is less than 20 solar masses, the supernova leaves behind a neutron star, approximately 10 to 17 kilometers (6 -10 miles) across, a teaspoon of which weighs 200-400 million tons. (More massive stars can collapse into black holes.) One of the more famous remnants of a supernova is the Crab Nebula, visible with a moderate telescope in the winter sky in the constellation Taurus.



Many of the supernovas that occur in the Milky Way Galaxy are obscured from our view by gas and dust. On average, one supernova is detected in our galaxy every century (undetected supernovas may occur every 25 to 50 years, based upon our observations of other galaxies). Supernovas can become so bright that they overwhelm their host galaxies for weeks. In the last thousand years, there were four supernovas in the Milky Way that were well documented: a star in the constellation Lupus in the year 1006, one in the constellation Taurus in 1054 (described by Chinese astronomers), one in Cassiopeia in 1572 (observed by Tycho Brahe), and another in Ophiuchus in 1604 (studied by Johannes Kepler).

One of the most scrutinized supernovas occurred within the Large Magellanic Cloud, a satellite galaxy to the Milky Way. In February 1987, a star exploded near the Tarantula nebula some 169,000 light years away. It was the first time that astronomers had detailed observations, not only of the supernova, but of the star before it exploded. The most unusual feature of Supernova 1987A is the circumstellar rings of material seen expanding from the dying star. Since the rings are only moving at a speed of 70,000 to 100,000 miles per hour (much slower than the material ejected in the supernova explosion), scientists theorize that the material was expelled before the supernova when the star was still a red giant.

As Dr. Carl Sagan reminded us: "We are star-stuff." Almost all of the elements in our universe were created inside stellar factories (nucleosynthesis). However, elements heavier than iron are only created in the final moments of the collapse of a massive star and detonation of the core. So the next time that you admire your gold jewelry, remember that though it may have come from your favorite jeweler, those gold atoms were created by a nearby supernova.

A Star Cluster for Trekkies

The constellation Orion dominates the winter sky and provides many rich observing targets for even the smallest telescope. It also contains some lesser known (and viewed) celestial gems. Just northwest of Orion's bow or shield is a small open star cluster (NGC 1662). With only a few stars (less than 20) it is often overlooked in favor of the more spectacular clusters in nearby Auriga.

This 6th magnitude cluster was discovered and cataloged by William Herschel in 1794. What Sir William couldn't have imagined was that some observer, hundreds of years later, would associate this seemingly random pattern of stars as the running lights on a Klingon battle cruiser as it decloaked. It really doesn't matter how you connect the dots, just that you enjoy the wonders of the night sky, however small or trivial. Using your imagination can make that experience even more rewarding.

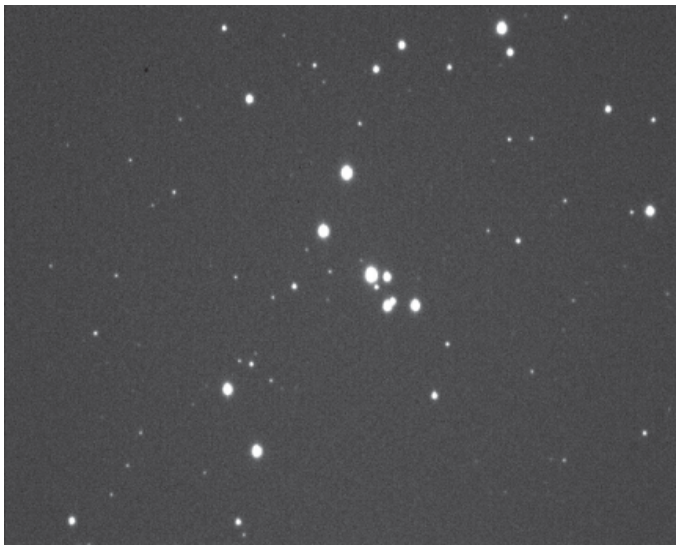
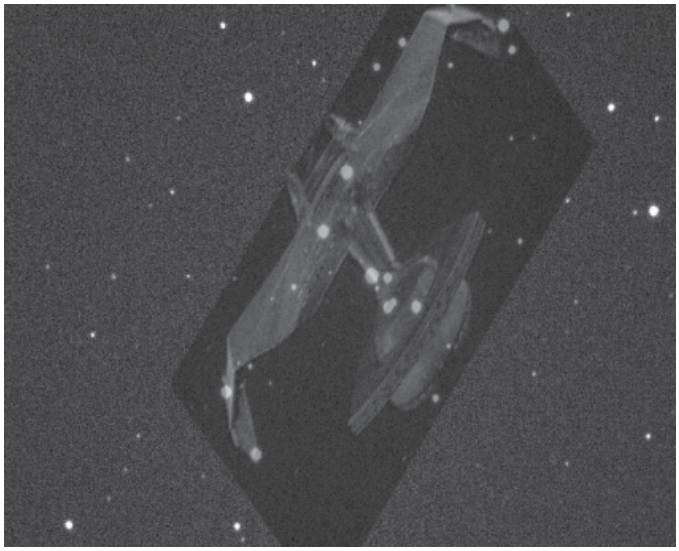


Image of the NGC 1662 taken at the McCarthy Observatory



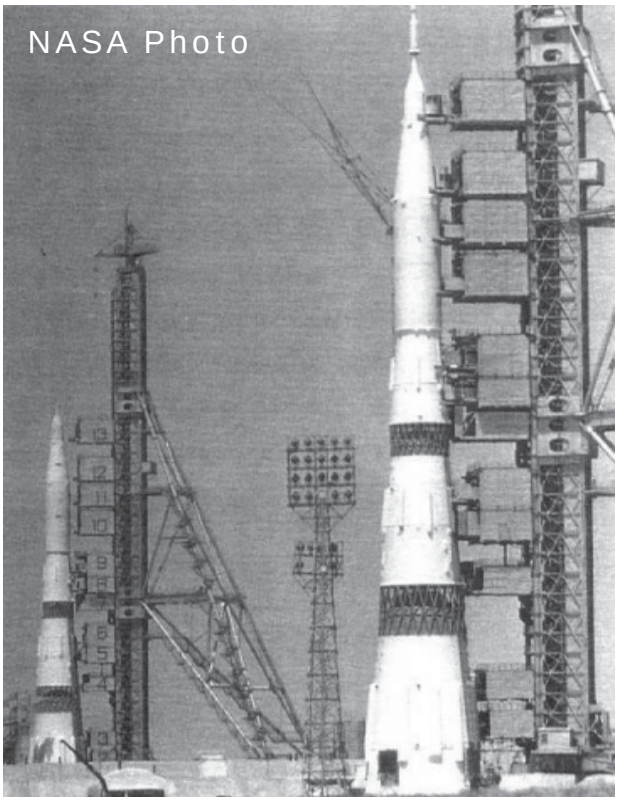
Overlay of Klingon battlecruiser

Soviet Moon Program

February marks the beginning of the end of the Soviet Moon program. While publicly denying its intentions to send cosmonauts to the Moon during the 1960s, Russia was secretly constructing rockets of mammoth proportions (rivaling the Saturn V). On February 21, 1969, the first N1 Moon rocket exploded during its test flight.

The launch of three more N1 rockets would fail before the Soviet government would abandon their manned-Moon program.

The historic photo on the right shows two N1 rockets on the pad at the Soviet Union's launch site at the Baikonur Cosmodrome (also known as Tyuratam) in Kazakhstan. The five stage rockets stood approximately 340 feet high with a first stage powered by 30 individual engines.

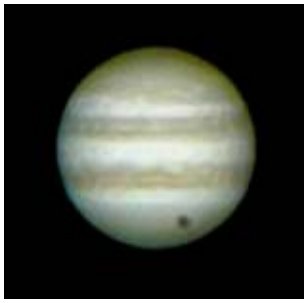


February Nights

The days grow longer in February, although the cold seems to linger. With the longer days comes a setting sun that can now be appreciated by that portion of the working population that has spent the last two months driving back and forth to work in the dark.

With the setting Sun comes an opportunity to see an interesting atmospheric phenomenon: Sun pillars. As the Sun sets (or rises) hexagonal shaped ice crystals falling through the cold air can reflect the sunlight and produce dramatic and colorful columns of light. The photo on the right was taken at sunset in February 2002 from a ridge in Bridgewater, CT.

Jupiter and its Moons



Jupiter reached Opposition on January 5th and is well placed in the evening sky in February. 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
1st	Ganymede	5:10 pm	8:22 pm
5th	Io	6:48 pm	9:03 pm
8th	Ganymede	9:09 pm	12:23 am (9th)
9th	Europa	6:41 pm	9:23 pm
12th	Io	8:43 pm	10:58 pm
16th	Europa	9:17 pm	11:59 pm
19th	Io	10:38 pm	12:53 am (20th)
22nd	Callisto	10:09 pm	1:54 am (23rd)
23rd	Europa	11:53 pm	2:35 am (24th)

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 (EST):

Date	Transit Time	Date	Transit Time
1st	11:48 pm	14th	7:34 pm
2nd	7:40 pm	16th	9:12 pm
4th	9:18 pm	18th	10:50 pm
6th	10:56 pm	21st	8:20 pm
9th	8:26 pm	23rd	9:59 pm
11th	10:04 pm	25th	11:37pm
13th	11:42 pm	26th	7:29 pm

Sunrise and Sunset

Sun	Sunrise	Sunset
February 1st (EST)	07:05	17:09
February 15th	06:49	17:27
February 28th	06:30	17:43

Astronomical and Historical Events

1st History: loss of the space shuttle Columbia upon reentry (2003)

1st History: launch of Explorer 1; first artificial satellite by the United States (1958)

2nd History: Soviet space station Salyut 4 reenters the Earth's atmosphere (1977)

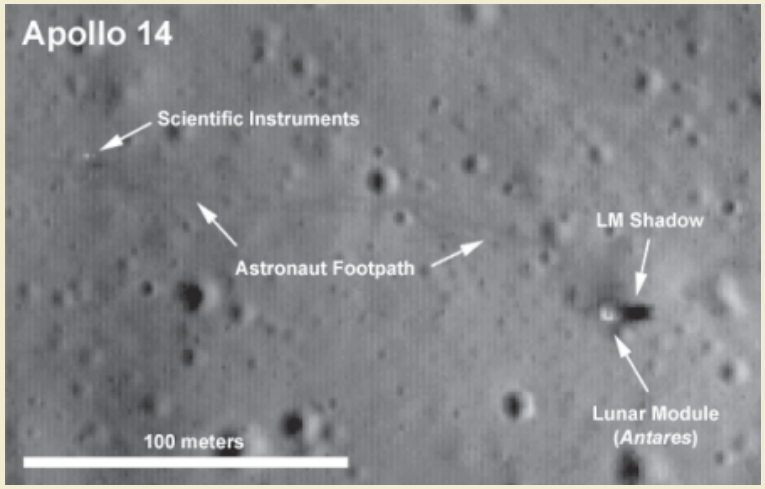
2nd Scheduled flyby of Saturn's largest moon Titan by the Cassini spacecraft

3rd History: Apollo 14, with astronauts Alan Shepard, Stuart Roosa and Edgar Mitchell, lands in the Moon's Fra Mauro region; 3rd manned Moon landing (1971)

3rd History: Soviet spacecraft Luna 9 becomes first spacecraft to soft land on the Moon (1966)

4th History: launch of Lunar Orbiter 3; photographed potential Apollo landing sites (1967)

4th History: Clyde Tombaugh born (1906); discovered the dwarf planet Pluto in 1930



Astronomical and Historical Events (continued)

- 5th Scheduled launch of a Russian, cargo-carrying Progress spacecraft from the Baikonur Cosmodrome in Kazakhstan to the International Space Station (ISS)
- 5th History: flyby of Venus by the Mariner 10 spacecraft on its way to Mercury; first U.S. spacecraft to photograph Venus, first to use gravity of one planet to propel itself to another, and the first spacecraft to visit Mercury (1974)
- 6th First Quarter Moon
- 6th Asteroid 3530 Hammel closest approach to Earth (1.908 AU); named after Dr. Heidi Hammel, winner of Sagan Medal in 2002 for outstanding communication by an active planetary scientist to the general public
- 6th History: Soviet space station Salyut 7 reenters Earth's atmosphere (1991)
- 7th History: launch of the Stardust spacecraft for a rendezvous with Comet Wild 2 (1999)
- 7th History: Astronomical Society of the Pacific founded (1889)
- 7th History: William Huggins born, pioneered work in astronomical spectroscopy and first to differentiate nebular and galactic spectra (1824)
- 8th Second Saturday Stars – Open House at the McCarthy Observatory
- 8th History: discovery of the SAU 094 Mars meteorite in Sayh al Uhaymir, Oman; one of the largest Mars meteorites recovered and the only one with a documented strewn field (2001)
- 8th History: discovery of GRV 99027 Martian Meteorite on the ice sheet near the Grove Mountain region of Antarctica; the 9.97 gram meteorite was later characterized as a shergottite (2000)
- 8th History: flyby of Jupiter by the Ulysses spacecraft on its way to study the polar regions of the Sun (1992)
- 8th History: return of Skylab III crew (astronauts Gerald Carr, William Pogue and Edward Gibson) to Earth after a 3 month stay on the space station (1974)
- 8th History: Jules Verne born, author and futurist (1828)
- 10th Scheduled distant flyby of Saturn's largest moon Titan by the Cassini spacecraft
- 10th History: flyby of Venus by the Galileo spacecraft (for a gravity assist) on its way to Jupiter; the encounter provided the first views of mid-level clouds on Venus and confirmed the presence of lightning (1990)
- 10th History: flyby of Mars by the Soviet Mars 4 spacecraft; failed to enter orbit but did detect night-side ionosphere (1974)
- 11th History: launch of NASA's Solar Dynamics Observatory from Cape Canaveral, Florida; the first mission in the space agency's "Living with a Star" program; five-year mission to study the Sun's energy and its influence on space weather (2010)
- 11th History: launch of the space shuttle Discovery (STS-82), second Hubble Space Telescope servicing mission; **shuttle tire** on display at the Observatory is from this mission (1997)
- 11th History: launch of first Japanese satellite: Oshumi (1970)
- 12th Moon at apogee (furthest distance from Earth)
- 12th History: landing of the Near Earth Asteroid Rendezvous (NEAR) spacecraft on the asteroid Eros (2001)
- 12th History: Soviet spacecraft Mars 5 enters orbit around Mars, providing information on surface temperatures, CO_2 concentrations, and detecting a thin ozone layer and water vapor concentrations near the Tharsis region (1974)
- 12th History: Sikhote Alin meteorite fall in Russia, one of the largest modern falls at 28 tons (1947)
- 14th Full Moon (Full Snow Moon or Hunger Moon)
- 14th Kuiper Belt Object 55565 (2002 AW197) at Opposition; trans-Neptunian object (TNO) discovered in 2002 by Michael Brown et al., classified as a cubewano (44.996 AU)
- 14th History: flyby of Comet Tempel 1 by the Stardust spacecraft (2011)
- 14th History: Voyager 1 points its camera back towards the Sun and takes a family portrait, capturing six planets (Venus, Earth, Jupiter, Saturn, Uranus and Neptune) from a distance of approximately 4 billion miles; Mercury was too close to the Sun to be seen and Mars was lost in the scattered sunlight (1990)
- 14th History: launch of the Solar Maximum Mission (1980) to study the Sun during the peak of the solar cycle; a malfunction less than a year later cut the mission short. However, the satellite was recov-

Astronomical and Historical Events (continued)

ered and repaired by the Space Shuttle Challenger in April 1984; operated successfully until burning up in the Earth's atmosphere in December 1989

14th History: launch of Luna 20, Soviet Moon sample return (1972)
14th History: launch of Syncom 1, the first geosynchronous satellite (1963)
15th Mars Summer Solstice (start of summer in the northern hemisphere)
15th History: meteor explodes over the Russian city of Chelybinsk causing hundreds of injuries (2013)
15th History: flyby of the Moon by the Hiten spacecraft; Earth orbiting satellite designed by the Japanese Space Agency to test technologies for lunar and planetary missions (1992)
15th History: Galileo Galilei born (1564)
16th History: Gerard Kuiper discovers Uranus' moon Miranda (1948)
17th History: launch of Ranger 8; Moon impact mission (1965)
17th History: launch of NEAR spacecraft, asteroid orbiter/lander; first of NASA's Discovery missions and the first mission to go into orbit around an asteroid (1996)
17th History: launch of Vanguard 2; designed to measure cloud-cover distribution over Earth (1959)
18th History: American astronomer Clyde Tombaugh discovers Pluto (1930)
19th History: Nicolas Copernicus born (1473)
20th History: Clementine spacecraft enters lunar orbit and starts photographic survey; joint project between the Strategic Defense Initiative Organization and NASA, first of a new class of small spacecraft to enable long-duration, deep space missions at low cost using lightweight satellite technology (1994)
20th History: launch of the core module of the Soviet space station Mir (1986)
20th History: launch of Mercury-Atlas 6 and Friendship 7 with astronaut John Glenn; first American in orbit (1962)
21st History: Soviet moon rocket (N-1) explodes during first test flight (1969)
22nd Last Quarter Moon
22nd Scheduled launch of a SpaceX, cargo-carrying Dragon spacecraft from the Cape Canaveral Air Force Station in Florida to the ISS
22nd History: launch of Soviet spacecraft Kosmos 110, with dogs Veterok and Ugolyok (1966)
22nd History: Max Wolf discovers asteroids 587 Hypsipyle and 588 Achilles (1906)
23rd Kuiper Belt Object 90482 Orcus at Opposition; discovered on February 17, 2004; has one large moon - Vanth (47.079 AU)
23rd Winter Star Party in the Florida Keys (through March 2nd)
23rd History: Supernova 1987A detected in the Large Magellanic Cloud (1987)
24th History: launch of the Space Shuttle Discovery (STS-133) on its final mission. The shuttle delivered space parts and critical components to the ISS (2011)
24th History: launch of Mariner 6; Mars flyby mission returned images showing the south polar cap as being composed predominantly of carbon dioxide; refined estimates of the mass, radius and shape of Mars (1969)
24th History: Jocelyn Bell announces discovery of rapidly rotating radio sources, later determined to emanate from neutron stars or pulsars (1968)
24th History: launch of Bumper WAC, first two-stage liquid-propellant rocket and the first human-made object to achieve hypersonic speeds (1949)
25th History: flyby of Mars by the Rosetta spacecraft (2007)
25th History: Soviet spacecraft Luna 20 returns lunar soil sample (30 grams) to Earth (1972)
26th Asteroid 2 Pallas at Opposition (6.3 Magnitude)
26th History: launch of the first Saturn 1B rocket booster (1966)
27th Moon at perigee (closest distance from Earth)
28th History: flyby of Jupiter by the New Horizons spacecraft bound for Pluto (2007)
28th History: launch of Discoverer 1 (1959); first of a series of satellites which were part of the Corona reconnaissance satellite program and first satellite launched into polar orbit (1959)

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.*

Front Page

Snowbirds anxious to escape the polar vortex would have to travel far to get away from these continent-sized storms on Jupiter, depicted here in a mosaic of infrared images from the Hubble telescope and supported by a network of Earth-based observatories. Even these monster storms are dwarfed by the Jovian Great Red Spot, which exceeds three Earths in breadth and has been tracked by Earth-based observers for more then 300 years.

Source: NASA, ESA, IRTF, and A. Sánchez-Lavega and R. Hueso (Universidad del País Vasco, Spain)

Image Credits

Front page design and graphic calendars: Allan Ostergren

Page 3 John Dobson's book on how to build your own telescope was bound in plywood, the material of choice in early Dobsonian telescope designs. Photo by Bill Cloutier

Second Saturday Stars poster: Sean Ross, Ross Designs

Cartoon - Jupiter Weather by Bucky Milam, Danbury Area Computer Society

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

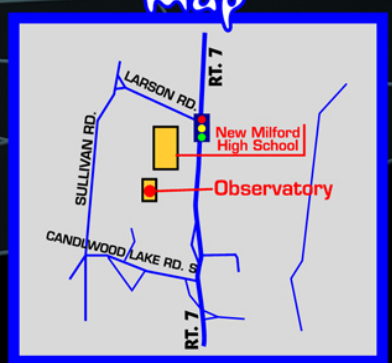
February 8th
7:00 - 9:00 pm

OUR GALACTIC NEIGHBORS
THE LOCAL GROUP OF GALAXIES

Leo A
Leo I
Leo II
Ursa Major I
Sextans Dwarf
Ursa Major II
Ursa Minor Dwarf
Draco Dwarf
Boötes Dwarf
Milky Way Galaxy
Sagittarius Dwarf
NGC 185
NGC 147
M110
Andromeda Galaxy (M31)
M32
Andromeda II
Andromeda III
(M33)
Pisces Dwarf
IC 1613
Aquarius Dwarf
SagDIG
Cetus Dwarf
WLM

Refreshments
Family Entertainment
Activity Center
Stars & Planets
Rain or shine

Map



art & design • sean ross • rossdesign@charter.net

S.Ross

February 2014

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

Phases of the Moon

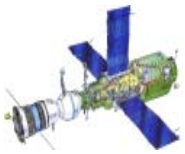
Feb 6 — Feb 14 — Feb 22 — Mar 1

1

Launch of Explorer I (1958)

Space Shuttle Columbia breaks up on reentry from orbit (2003)

2



Soviet space station, Salyut 4 reenters Earth's atmosphere (1977)

3

Chinese New Year

Soviet Luna 9 lands on Moon (1966)

Apollo 14 - 3rd Moon landing- Shepard, Roosa, Mitchell (1971)

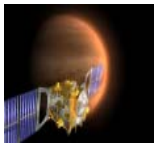
4

Clyde Tombaugh born (1906)

discoverer of Pluto

Launch of Lunar Orbiter 3, to locate Apollo landing sites (1967)

5



Flyby of Venus by Mariner 10 spacecraft en route to Mercury (1974)

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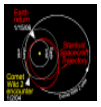
Soviet space station Salyut 7 reenters Earth's atmosphere (1991)

7

William Huggins born, pioneer of astronomical spectroscopy (1824)

Astronomical Society of the Pacific founded (1889)

Launch of Stardust spacecraft for rendezvous with comet Wild 2 (1999)



8

Jules Verne born (1828)

Mars meteorites found - Oman (2001); Antarctica (2000)

Return of Skylab 3 crew after 3 months on space station (1974)

2nd Saturday Stars Open House McCarthy Observatory

9

Astronaut Bernard A. Harris becomes first African-American to perform extra vehicular activity, during shuttle mission STS-63 to Mir spacecraft, flown by first woman shuttle pilot, Eileen Collins (1995)

10

Flyby of Venus by Galileo spacecraft on way to Jupiter (1990)

Flyby of Mars by Soviet Mars 4 spacecraft (1974)

11

Launch of Japanese satellite Oshumi (1970)

A solar eclipse inspires Nat Turner to launch slave revolt in Virginia (1831)

Launch of NASA Solar Dynamics Observatory 2010

12

Moon at apogee (farthest from Earth)

NEAR spacecraft lands on asteroid Eros (2001)

Sikhote Alin meteorite falls in Russia (1947)

Soviet Mars 5 spacecraft in orbit (1974)

13

John Louis Emil Dreyer born, Danish/Irish astronomer and biographer of Tycho Brahe; continued Herschel's work by publishing catalogue of nebulae and clusters (1852)

14

Flyby of Comet Tempel 1 by the Stardust spacecraft (2011)

Launch of Solar Maximum Mission to study Sun during peak of cycle (1980)

Launch of Syncom 1, first geosynchronous satellite (1963)

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Galileo Galilei born (1564)

Flyby of Moon by Japan's Hiten spacecraft (1992)

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Gerard Kuiper discovers Uranus' moon, Miranda (1948)

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Launch of Vanguard 2, to measure Earth cloud cover (1959)

Launch of Ranger 8, Moon impact mission (1965)

18

American astronomer Clyde Tombaugh discovers Pluto (1930)

19

Nicholas Copernicus born (1473)

20

Launch of Mercury Atlas 6 and Friendship 7 with John Glenn, 1st American in orbit (1962)

Launch of core module of Soviet Mir space station (1986)

21

Soviet Moon rocket (N-1) explodes (1969)

Tom Gehrels, astronomer and co-discoverer of over 4,000 asteroids (b. 1925)

22

Launch of Soviet spacecraft Kosmos 110, with dogs Veterok and Ugolyok (1966)

23

Supernova 1987A detected in Large Magellanic Cloud (1987)

24

Launch of Bumper WAC, first two-stage liquid ropellant rocket (1949)

Launch of Mariner 6, Mars flyby (1969)

Jocelyn Bell's discovery of pulsars (1968)

Shuttle Discovery final mission (2011)

25

Flyby of Mars by Rosetta spacecraft (2007)

Soviet spacecraft Luna 20 returns 30-gram soil sample to Earth (1972)

26

Launch of first Saturn 1B rocket booster (1966)

27

Moon at perigee (closest distance to Earth)

Bernard Ferdinand Lyot born, French astronomer and inventor of the coronagraph to observe the sun's corona without waiting for an eclipse, (1897)

28

Launch of Discoverer 1, first of Corona reconnaissance satellite program (1959)

Flyby of Jupiter by New Horizons spacecraft bound for Pluto (2007)