Galactic Observer

John J. McCarthy Observatory

Volume 6, No. 2 February 2013

Journey to a Distant Dwarf Planet

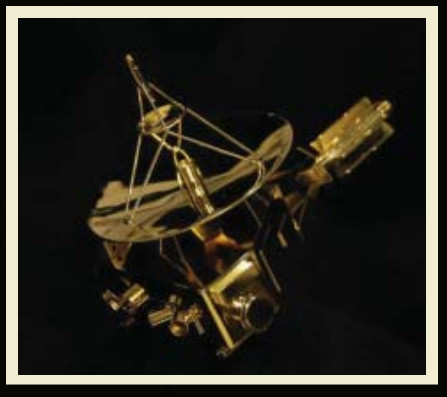
On January 19, 2006, the New Horizons spacecraft was launched on a mission to the planet Pluto and the Kuiper Belt. Seven months later, after the vessel had passed through the orbit of Mars, Pluto was downgraded to a "dwarf planet" by the International Astronomical Union. The IAU decision, made without regard to popular opinion, was grounded on the assumption that Pluto's mass was insufficient to clear remaining orbital debris from its path around the Sun. In the meantime, a fourth moon was discovered orbiting Pluto (S/2011 P1) - more than Earth, Mars, Venus and Mercury.

New Horizons is scheduled to arrive at Pluto on July 14, 2015, the 229th anniversary of Bastille Day, when French citizens rose up to assure that power emanated from the people, not from the anointed few.

Below is an artist's concept of the New Horizons spacecraft arriving at Pluto; bottom right, a scale model created by JJMO volunteer Don Ross.

For more information, see pages 11-12 inside.

Image source: NASA/JHUAPL



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

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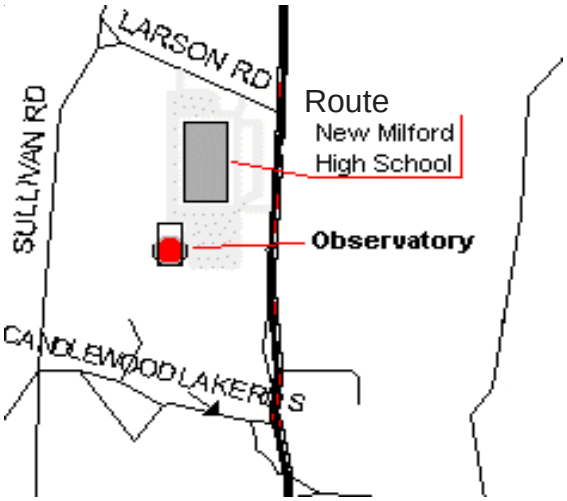
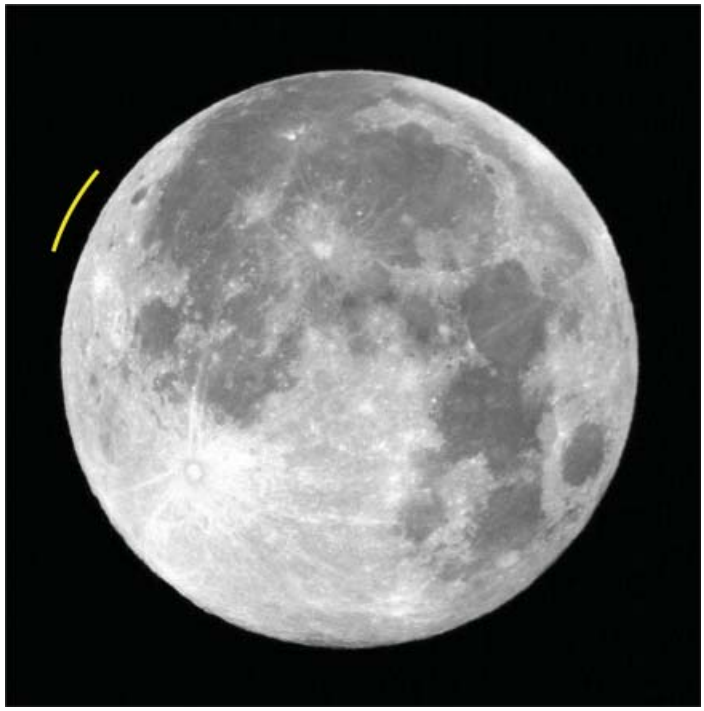


In This Issue

February Astronomy Calendar and Space Exploration Almanac

"Out the Window on Your Left"

IT'S BEEN OVER 40 YEARS since we left the last footprint on the dusty lunar surface. Sadly, as a nation founded on exploration and the con quest of new frontiers, we appear to have lost



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

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).

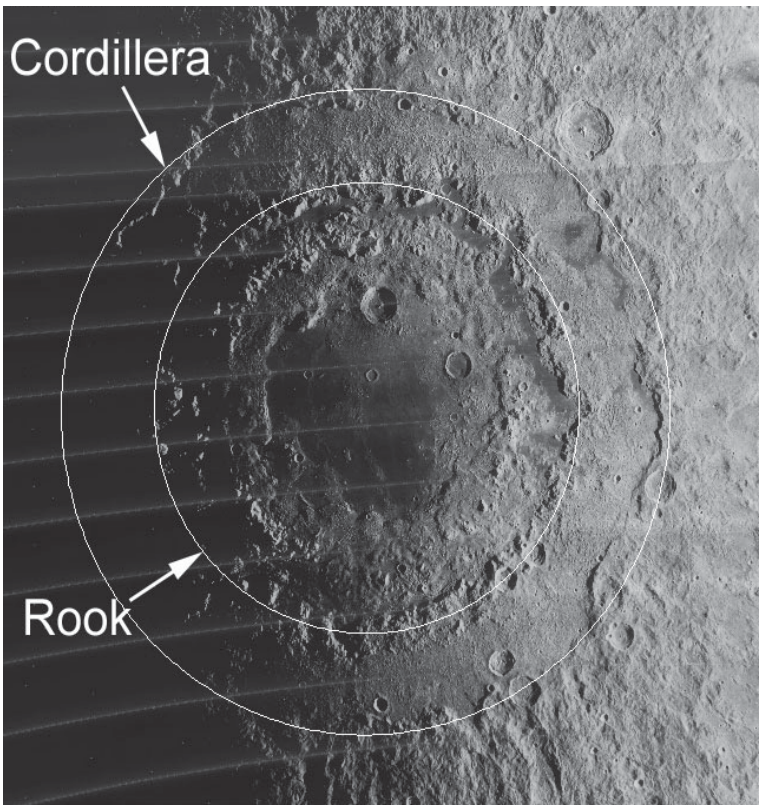
In the January article, we discussed craters that straddle the near/far side that can be observed from Earth. This is possible due to lunar libration or an apparent oscillation of the Moon as viewed from Earth that allows the observer to see as much as 59% of the Moon's surface over time.

The feature this month is Mare Orientale or the "Eastern Sea." Although located on the western limb, lunar maps prior to 1961 designated the limb facing the observer's eastern horizon "East" and the western horizon "West." In 1961, the International Astronomical Union adopted a lunar coordinate system consistent with terrestrial maps with "West" on the left and "East" on the right. As a result, the Moon's Eastern Sea is now on the western limb.

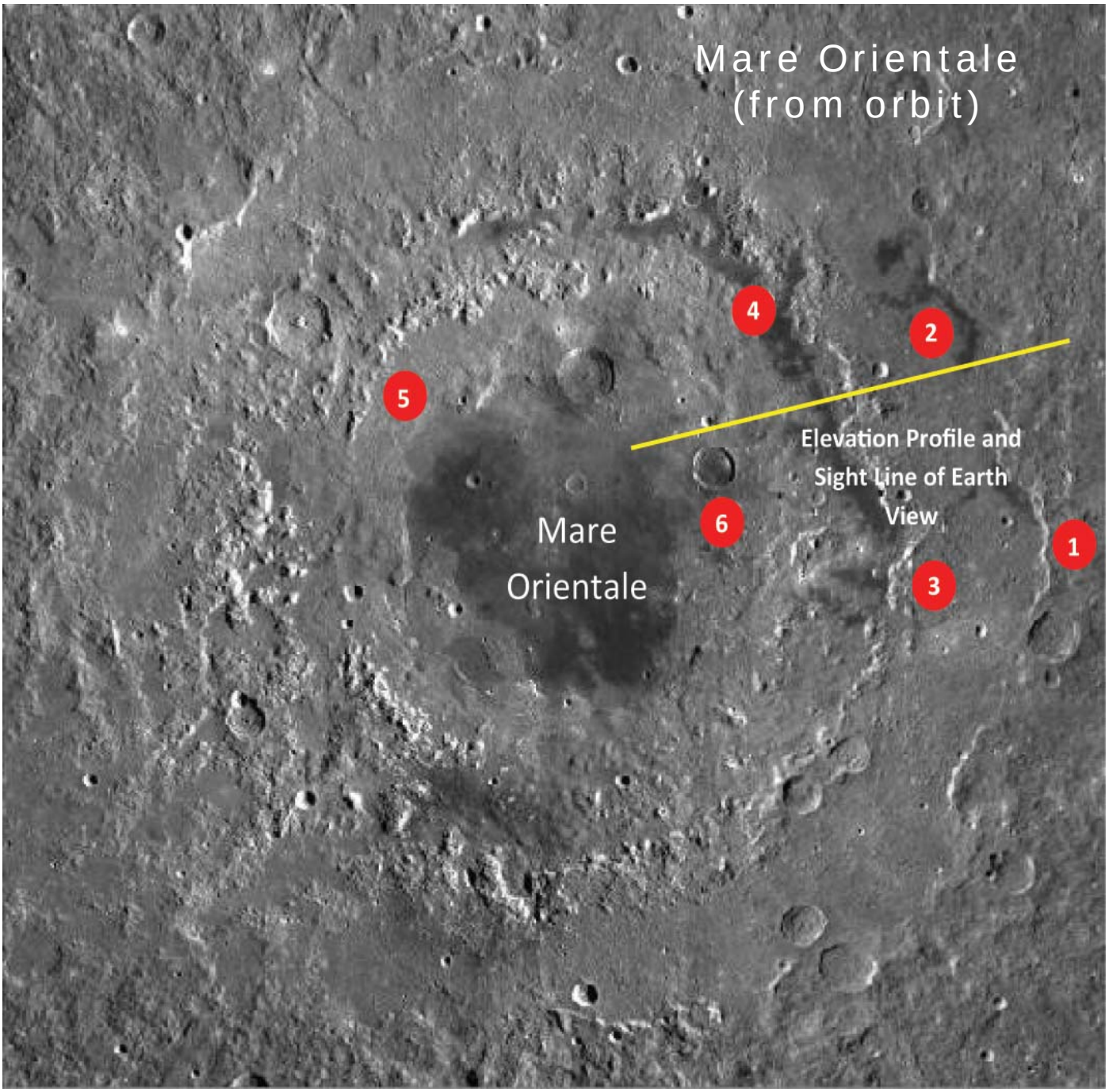
Mare Orientale is a relatively young impact basin (3.84 billion years) with little intrusion of the lava flows that fill most near-side basins. Consequently, the concentric mountain rings that give an impact basin its bulls-eye appearance are clearly visible (having been eradicated around older basins by subsequent impacts and volcanism). The center of the basin is located on the far side of the Moon; however, favorable librations allow Earth-bound observers to glimpse into the mare's confines, although its position on the limb creates a distorted view (known as foreshortening).

The Cordillera Mountains, approximately 575 miles (930 km) in diameter and rising 3.7 miles (6 km) above the basin floor, form the outer ring of the impact basin. Dark lava pools are visible along the inner edge (Lacus Autumni), presumably formed near deep fractures created by the initial impact. Inside the Cordilleras is another distinct mountain ring, the Outer Rook Mountains at almost 354 miles (620 km) in diameter. A more expansive lava pool (Lacus Veris) hugs the inner edge. Inside the Outer Rook Mountains are smaller, less distinctive mountain ring(s). The only named segment is the Inner Rock Mountains.

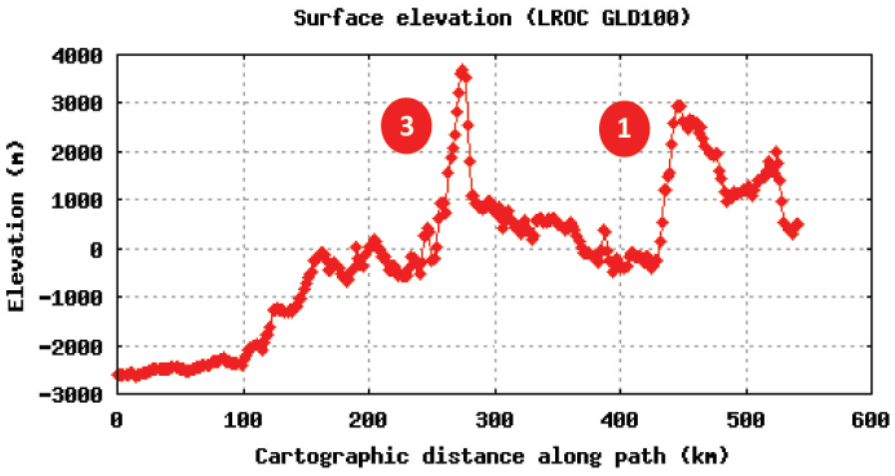
The photos on the following pages show the view from orbit (imaged by the Lunar Reconnaissance Orbiter) and from an 11 inch Earth-bound telescope.

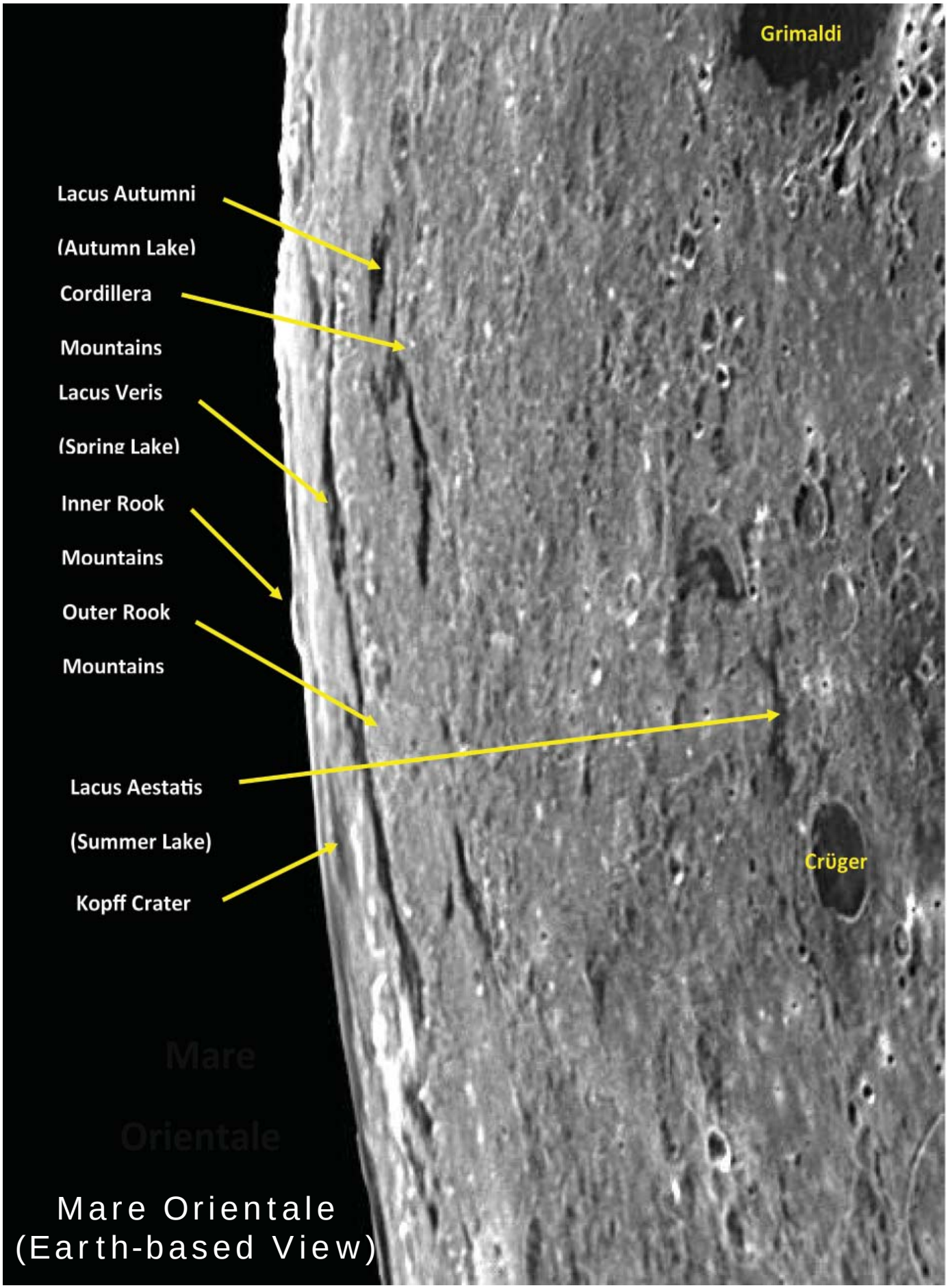


Montes Cordillera. Source: Lunar Reconnaissance Orbiter



1. Cordillera Mountains
2. Lacus Autumni (Autumn Lake)
3. Outer Rook Mountains
4. Lacus Veris (Spring Lake)
5. Inner Rook Mountains
6. Kopff Crater





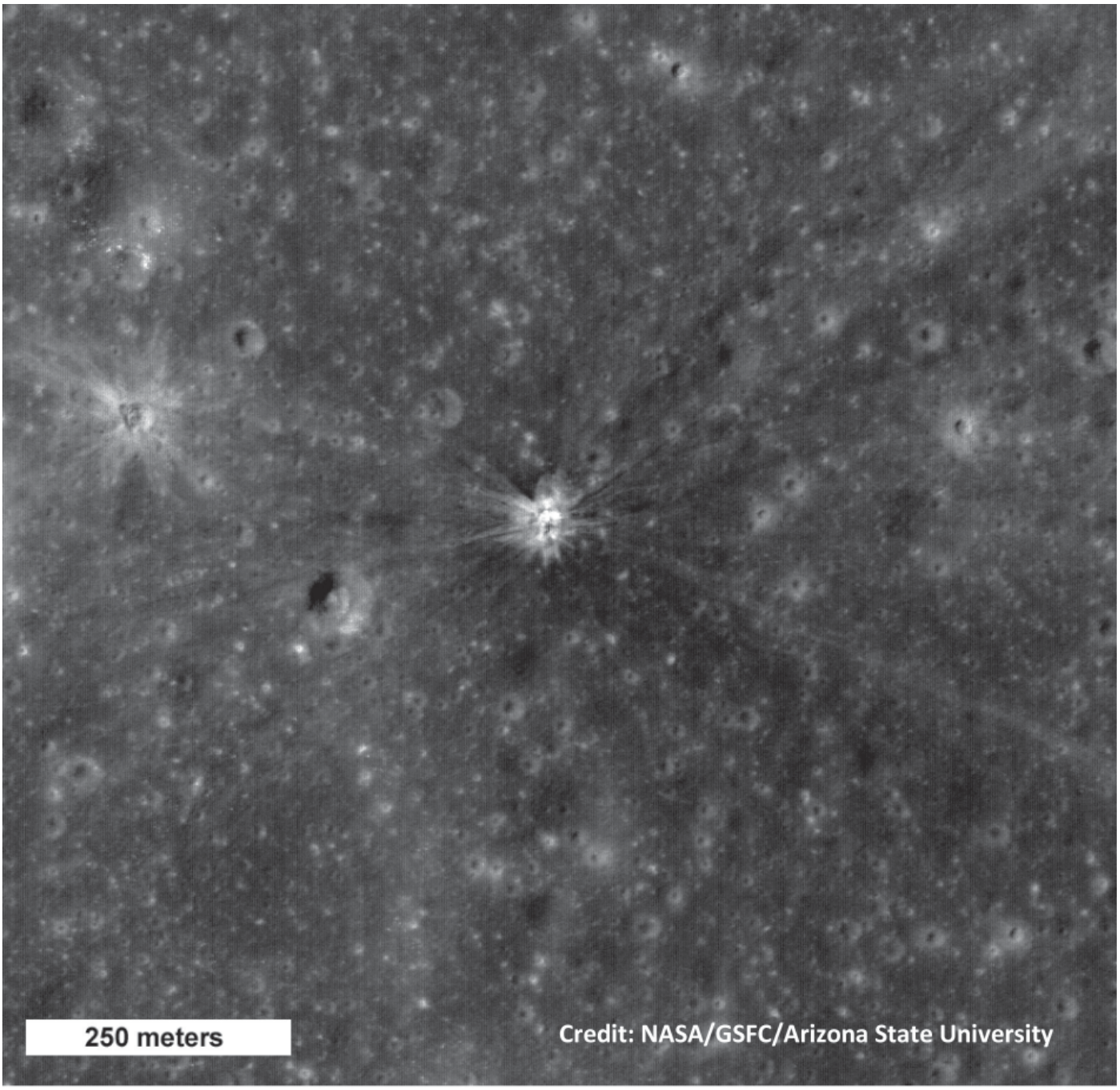
Mare Orientale
(Earth-based View)

Man-made

Not all lunar craters were formed by an impact of an asteroid, meteoroid, or comet or through volcanism. A number of small craters resulted from impacts of man-made objects: spent rocket stages, malfunctioning probes, and discarded spacecraft. In some instances, the impacts provide valuable information.

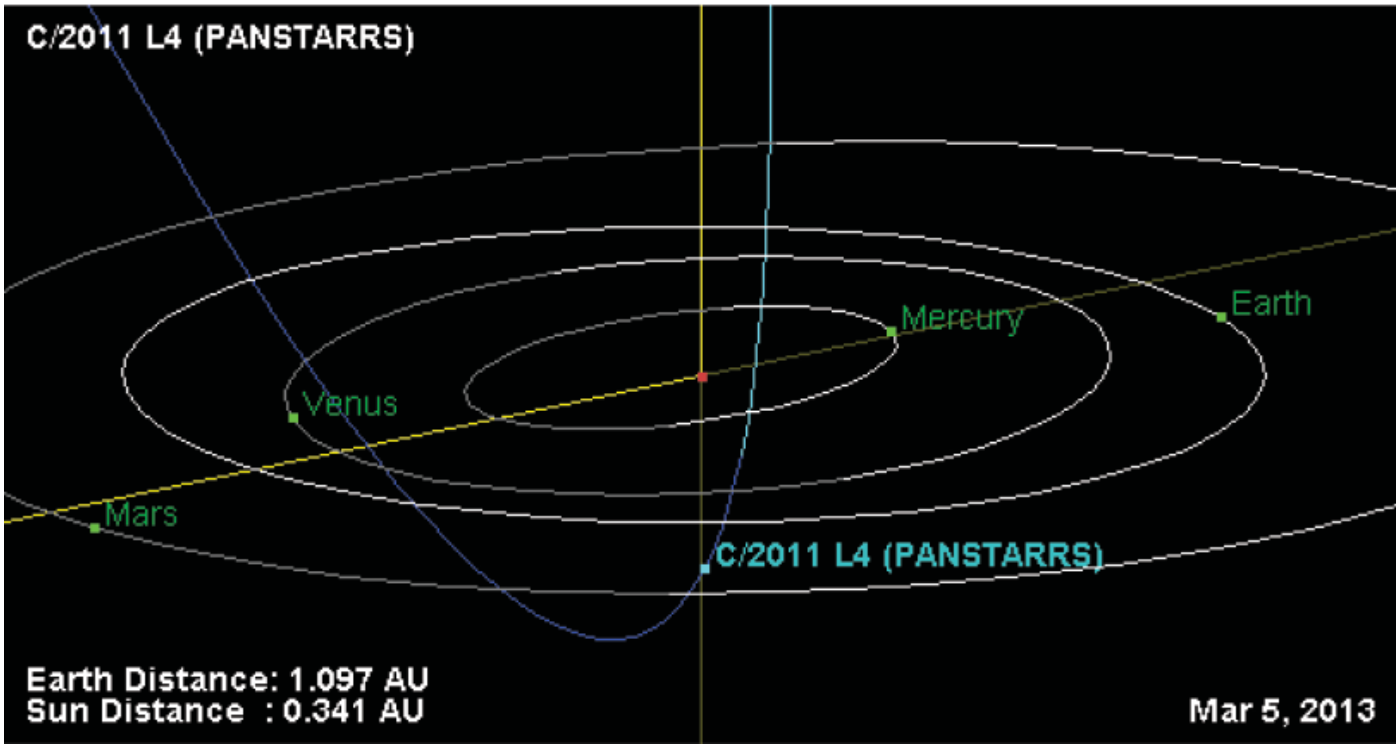
The 115 foot (35 m) diameter crater shown at the center of the image (below) was created by the impact of the third stage of the Saturn V moon rocket that carried the Apollo 14 crew into space.

Once spent, the booster was intentionally placed on a collision course, impacting the surface on February 4, 1971, a day prior to the crew landing. The impact generated minor moon quakes that were detected by the seismometer left on the surface by the Apollo 12 astronauts. Tremors were recorded for three hours after the impact, providing information on the internal structure of the Moon's crust.



First of Two

Two bright comets may grace the skies of 2013. Comet C/2011 L4 (PANSTARRS) is predicted to reach first magnitude (or brighter) in mid-March and be visible near the western horizon shortly after sunset. Expectations for Comet C/2012 S1 (ISON) are even greater ("brightest comet in a century") after it passes less than a million miles from the Sun in November. However, there are no certainties when it comes to comets; each visitor and visit to the inner solar system is unique. Comet hunter David Levy said it best: "Comets are like cats; they have tails, and they do precisely what they want."



PANSTARRS is a hyperbolic comet from outside the solar system. It likely came from the Oort cloud, a vast reservoir of comets that envelopes our solar system. The comet was discovered by the Pan-STARRS telescope in Hawaii in June 2011 at a distance of almost 8 Astronomical Units (AU) or just inside the orbit of Saturn. [An AU is the mean distance from the Earth to the Sun or approximately 93 million miles.]

The comet will make its closest approach to Earth on March 5th at a distance of 1.09 AU. Five days later on March 10th it will make its closest approach to the Sun. Best viewing for northern observers should be during the weeks of March 10th and 17th, when the comet will be located just above the western horizon. At this time, predications of peak brightness are unreliable because it is unlikely that the comet has visited the inner solar system before. First time visitors tend to brighten quickly but fade once the volatile surface sublimates.

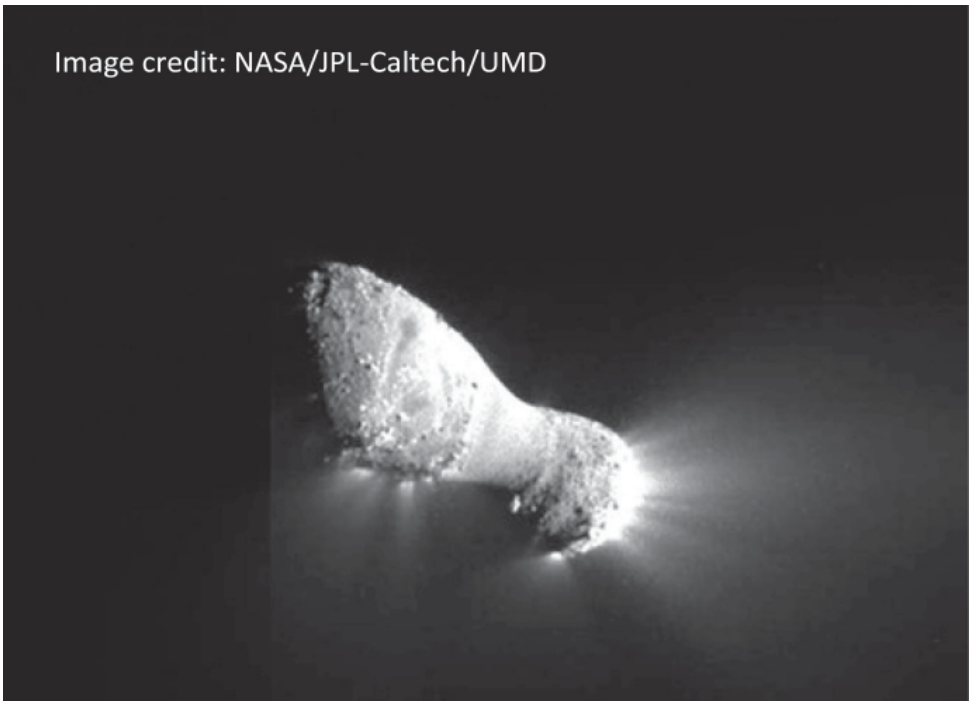
Interaction with the planets and Sun as it travels through the inner solar system (above) will alter PANSTARRS' orbit, bringing it back in approximately 110,000 years. The diagram shows the position of the comet at its point of closest approach to Earth. The dark blue track of the comet indicates a direction of entry from below the ecliptic (the plane of the planets). The orbit diagram was generated by JPL's Small-Body Database Browser (*http://ssd.jpl. nasa.gov/sbdb.cgi*).

Anatomy of a Comet

Up close, comets really do look like astronomer Fred Whipple's theorized "dirty snowballs." Comprised of ice, gas and dust, comets are fragile creatures. Difficult to detect beyond the orbit of Jupiter, comets resemble frozen hulks, primordial remnants of the early solar system. Closer, the Sun's feeble energy begins to warm the nucleus. Closer still, the nucleus erupts as the ice sublimates (going directly from a solid to a gas) and the gas trapped within the ice expands.

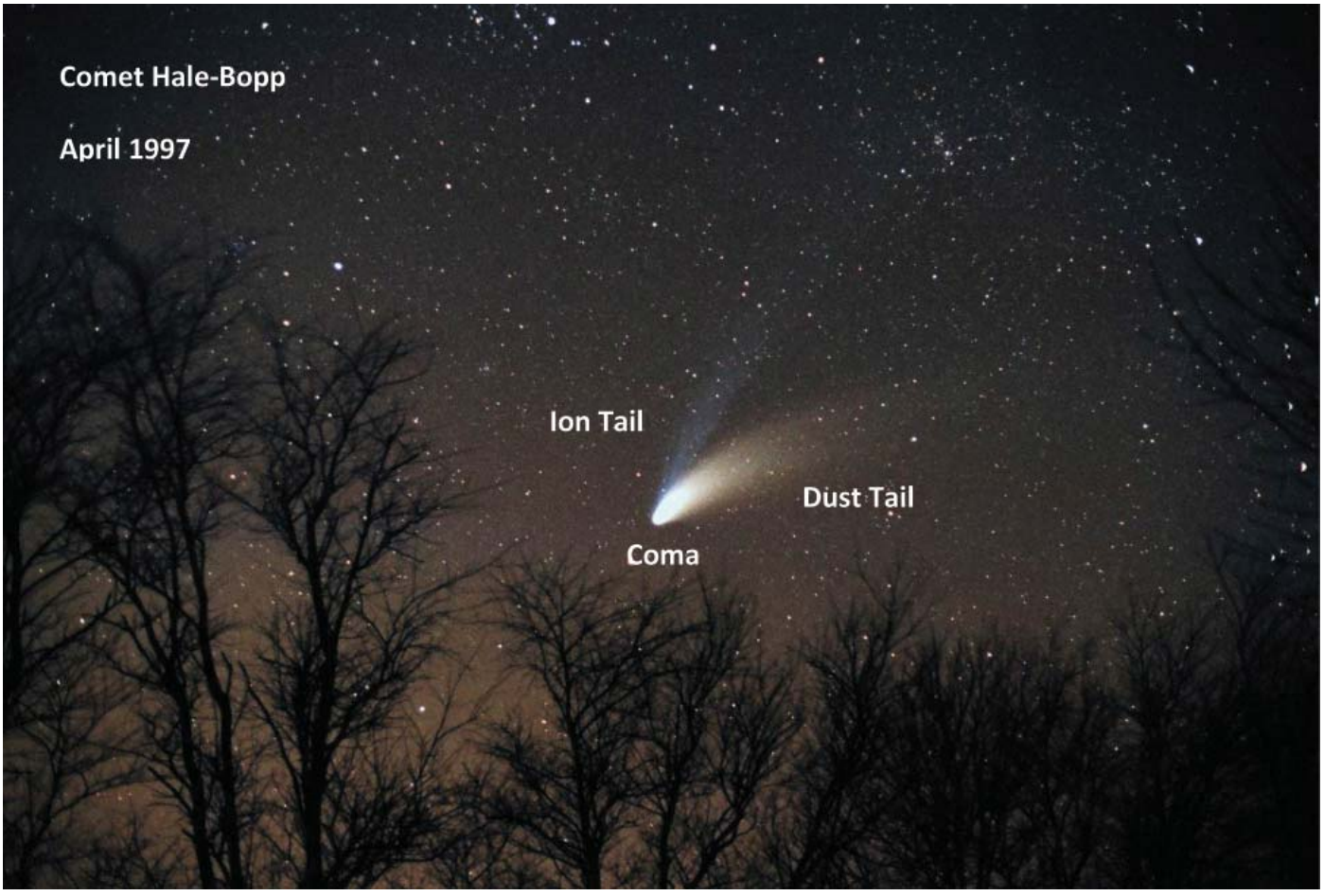
The volatiles form a tenuous atmosphere around the nucleus or coma. Intense radiation and streams of charged particles from the Sun create tails of comet debris that stream behind the comet, several million miles long as it moves through the inner solar system.

Visible in the photo of Comet Hale-Bopp are the two tails that comets can develop as they near the Sun. The brighter tail appears whitish-yellow and is primarily composed of dust particles that reflect the sunlight. The dust tail points back along the comet's path. The second tail, blue in color, is comprised of ionized gas or plasma. Interaction with the Sun's magnetic field orientates the plasma tail such that it points in opposite direction to the Sun. Occasionally, comets can develop a third tail (Hale-Bopp had a third, sodium tail) or antitails that point towards the Sun.



Comet Hartley 2 from NASA's EPOXI mission

There are two sources of comets; the Edgeworth-Kuiper belt (Kuiper belt) and the Oort cloud. Comets that orbit the Sun in less than 200 years, like Comet Hartley, are classified as short period comets and are believed to originate in the Kuiper belt. The Kuiper belt is disk-shaped, in the plane of the solar system and extends from about 30 AU (the orbit of Neptune) to 55 AU (beyond Pluto at 49 AU). Longer period comets like Hale-Bopp are believed to come from the Oort cloud, spherical-shaped, enveloping the entire solar system and extending halfway to the nearest star. As

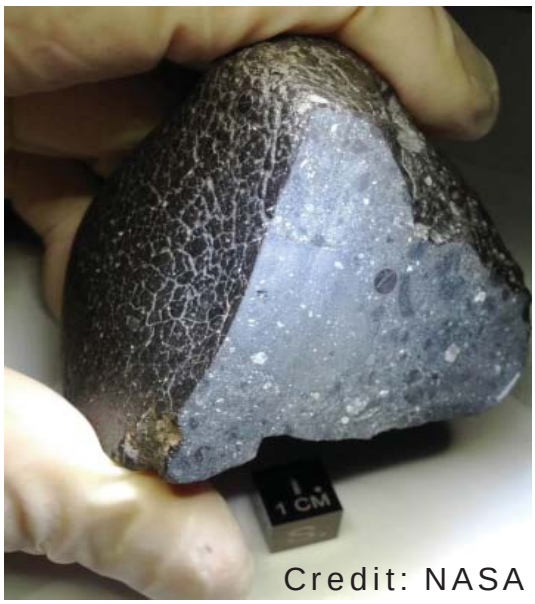


such, long-period comets can enter the inner solar system from any direction while short-period comets travel closer to the plane of the solar system. It is theorized that long-term comets formed in the outer solar system (between Jupiter and Neptune) before being ejected through numerous interactions with the larger planets.

New Martian Meteorite

A meteorite purchased in Morocco in 2011 turned out to be a very unusual find. Not only has the 11 ounce (320 gram) rock been determined to have come from Mars, but it appears to represent a new class of Martian meteorites. The age of the meteorite, nicknamed "Black Beauty" and designated NWA 7034, is approximately 2.1 billion years, older than almost all other Martian meteorites found to date.

Martian meteorites (with the exclusion of Allan Hills 84001, which is believed to have crystalized more than 4 billion years ago) range in age from 150 million to 1.3 billion years. Their Martian origin was confirmed when analysis of the atmospheric gases trapped in several of the rocks corresponded to the findings of the Viking Mars landers.



Credit: NASA

Black Beauty provides a glimpse at a critical time in the geologic history of Mars, the beginning of the current geologic era (the Amazonian Period) or the transition from the "wet" Mars in the past to the "dry" Mars we see today. The most surprising find was the water content; Black Beauty contained ten times more water than other Martian meteorites. The meteorite has a different texture and mixture of oxygen isotopes, leading researchers to theorize that Black Beauty was a near-surface rock that had considerable interaction with near-surface water and Mars' atmosphere. The meteorite also appears similar in composition to the surface rocks studied by NASA's rovers and is consistent with the chemical makeup of Mars' crust, as determined by oriting spacecraft.

Feeding Time for Our Black Hole

At the center of the Milky Way galaxy is a black hole with an estimated mass of four million solar masses (fortunately Earth is located 26,000 light years from the galactic center). While astronomers cannot directly see the black hole, they do see the effects of the black hole's mass/gravity on nearby stars, as well as a stream of radiation around the black hole produced by in-falling material. Unlike many galaxies with active black holes spewing high energy jets of radiation, the Milky Way's black hole is relatively quiet. That may soon change as astronomers have detected a large cloud of gas and dust on a collision course with the black hole. The cloud, three times the mass of the Earth, is accelerating and breaking up as it approaches the black hole. The cloud is projected to reach the black hole's event horizon (the point of no return) sometime in late 2013.

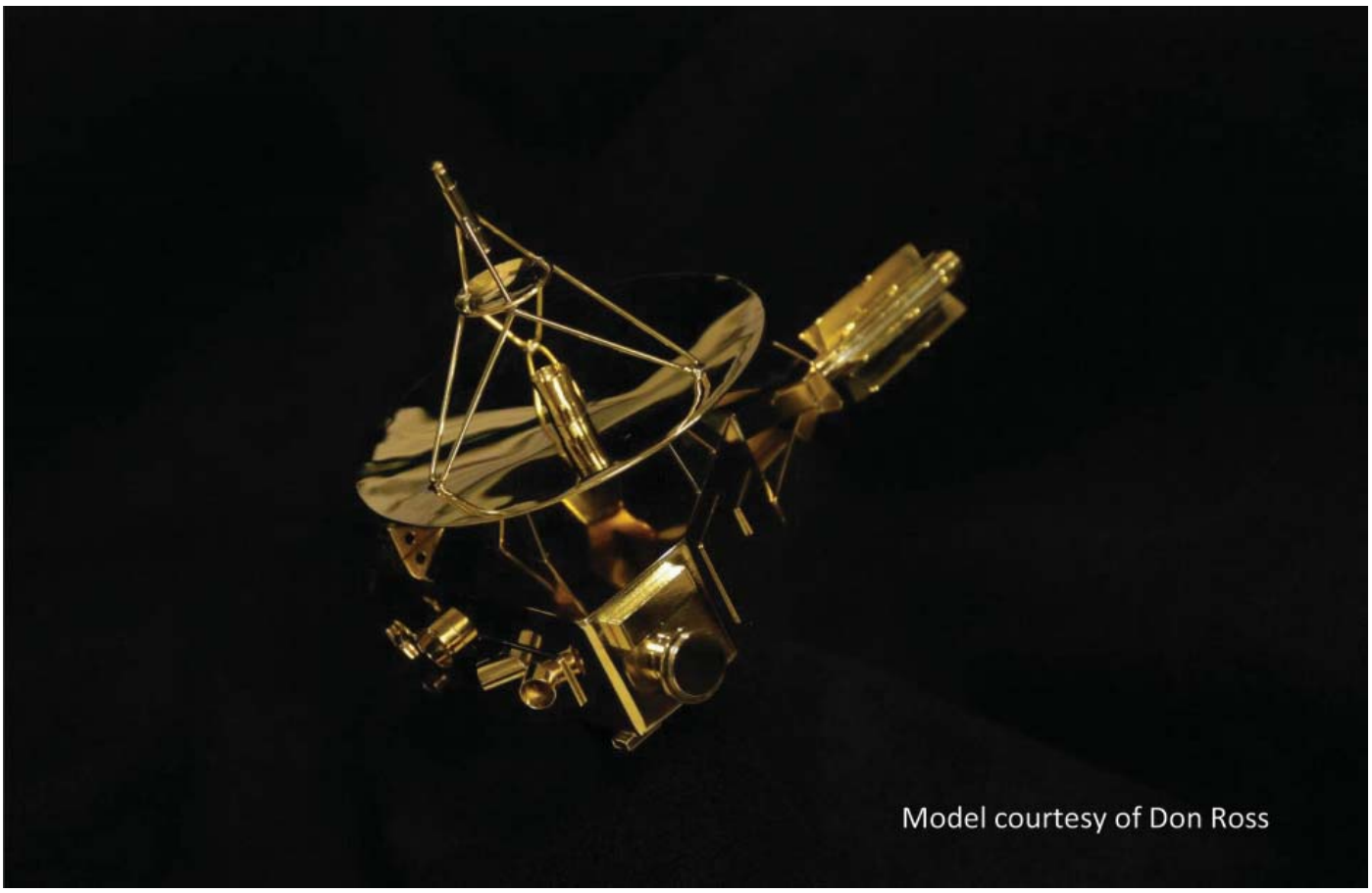
Latest supercomputer models suggest that the cloud (or portions of the cloud) may survive the encounter, but not without losing much of its mass and form. Heating of the gas and dust as the cloud accelerates towards the black hole will emit energy that can be detected by radio and x-ray telescopes. If it does survive, the cloud will be a wisp of its former self. More likely, the material that is not devoured by the black hole will join the disk of material already in orbit around the black hole.

New Horizons

The New Horizons spacecraft still has a way to go before it reaches Pluto in 2015, but it's getting closer (750,000 miles closer each day). The spacecraft crossed the orbit of Uranus in March 2011 and will cross Neptune's orbit in August 2014 before arriving at Pluto and its growing family of moons. Pluto's moons include a newly discovered moon (its fifth), temporarily designated P5, that resides between the orbits of Nix and Charon. Discovered only a year after P4, the increasingly crowded space around Pluto raises concerns about the debris field that the spacecraft could encounter, particularly at its velocity.

The spacecraft left Earth on January 19, 2006. Traveling ten times faster than a speeding bullet, it only took nine hours for the spacecraft to pass the Moon's orbit (a three day trip for the Apollo astronauts in 1969) and another year to Jupiter. Still, with the vastness of the outer solar system, it still had another 8½ years to go after passing Jupiter before it will reach the dwarf planet.

The New Horizons spacecraft is expected to reach Pluto on July 14, 2015 before heading out into the Kuiper Belt, a broad disk of icy worlds left over from



the formation of the solar system. The 1,000 pound spacecraft is about the size of a grand piano, and it is equipped with seven instruments that will photograph and analyze Pluto and its largest moon Charon. Being so far away from the Sun, the spacecraft is powered by the heat from a nuclear generator, solar panels being inadequate.

An Advocate for "Planet" Pluto

Planetary Scientist Alan Stern has been fighting to reinstate Pluto as a planet since it was demoted by a small minority of the members of the International Astronomical Union (IAU) in 2006. Stern is also the principal investigator with NASA's New Horizons mission to Pluto.

His argument targets one of the three new criteria for an object to be classified as a planet (and the one criterion that Pluto doesn't meet): "A 'planet' is a celestial body that … (c) has cleared the neighborhood around its orbit."

Stern contends that none of the remaining planets within the solar system have fully cleared their orbital zones, with many sharing their orbits with asteroids (including the Earth, Mars, Jupiter, and Neptune). He also has a problem with the implication of the IAU's criteria. The further the distance a planet is from the Sun, the larger it needs to be to clear its orbital zone (since the zone becomes larger with distance). The implication is that small planets, such as Mercury, Mars or even Earth, couldn't clear their orbital zone, if placed at Pluto's distance from the Sun. Conversely, would Pluto be considered a planet if it orbited close enough to the Sun to clear its orbital zone?

Stern believes that an object shouldn't be classified based upon its size, location or an unscientific need to limit planetary membership. He likes to use the "Star Trek" test for planethood: as you approach a celestial body in your spacecraft and it looks like a planet (and not a rock, moon, comet, another spacecraft, or star), it's a planet.

In July 2015, as the New Horizons spacecraft will make its closest approach to Pluto. I expect that many of us will apply that same test.

February History

Eighty-three 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 that he had made of Mars and Jupiter 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).

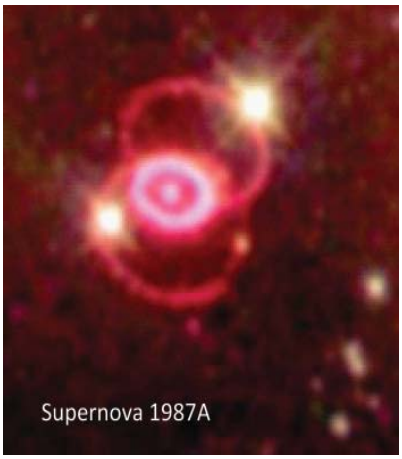
Compared to the size of the parent planet, Pluto has the largest moon in the solar system (the pair is sometimes referred to as a "double planet"). Charon was discovered in 1978 by the American astronomer James Christy and named for the boatman who ferried dead souls across the river Styx to Hades (Pluto's 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).



Source:Hubble Heritage Team (NASA/STScI/AURA)

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.

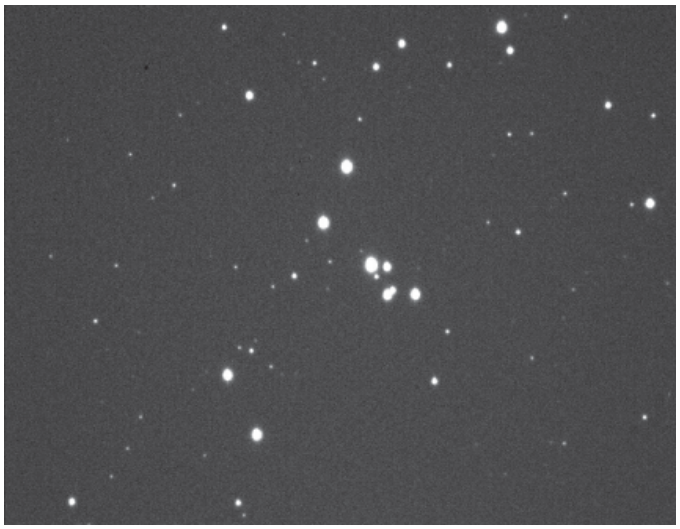
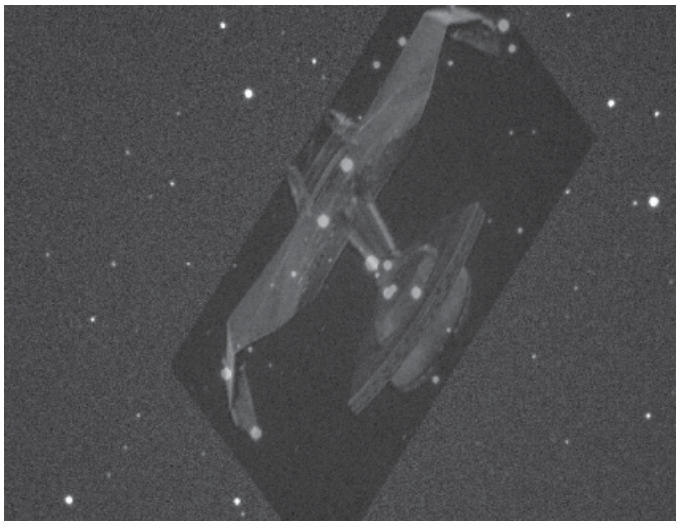
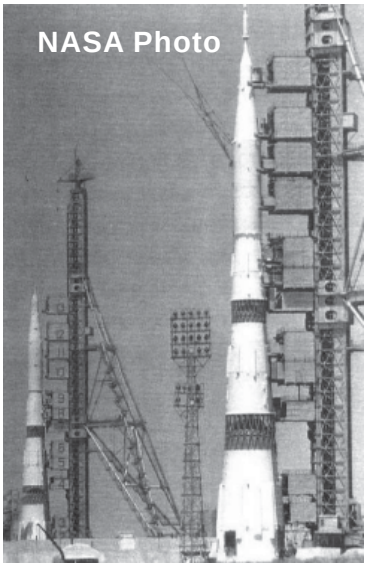


Image of the NGC 1662 taken at the McCarthy Observatory


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.

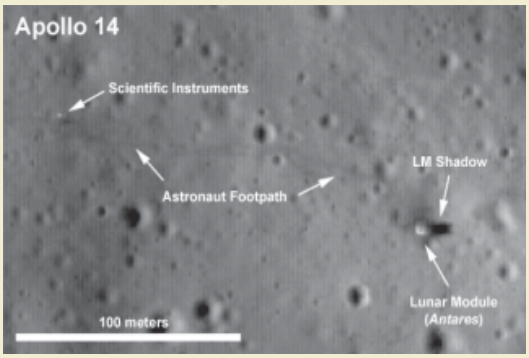
With the setting Sun comes an opportunity to see an interesting atmospheric phenomenon: Sun pillars. As the Sun sets (or rises) hexagonal shaped ice crystals falling through the cold air can reflect the sunlight and produce dramatic and colorful columns of light. The photo below was taken at sunset in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

Sunrise and Sunset

Sun	Sunrise	Sunset
February 1st (EST)	07:05	17:10
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)
3rd Last Quarter Moon
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 Winter Star Party in the Florida Keys (through the 10th)
4th History: launch of Lunar Orbiter 3; photographed potential Apollo landing sites (1967)
4th History: Clyde Tombaugh born; discovered the dwarf planet Pluto (1906)



Source: NASA/Goddard Space Flight Center/Arizona State University

Astronomical and Historical Events for August (*continued*)

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

7th Moon at perigee (closest distance from Earth)

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 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)

9th Second Saturday Stars – Open House at the McCarthy Observatory

10th New Moon

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 on the planet (1990)

10th History: flyby of Mars by the Soviet Mars 4 spacecraft; failed to enter orbit but did detect nightside 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)

11th Scheduled launch of a Russian Progress cargo-carrying spacecraft from the Baikonur Cosmodrome, Kazakhstan to the International Space Station (ISS)

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)

13th Kuiper Belt Object 55565 (2002 AW197) at Opposition; trans-Neptunian object (TNO) discovered in 2002 by Michael Brown et al., classified as a cubewano (45.112 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 recovered and repaired by the Space Shuttle Challenger in April 1984; operated successfully until burning up in the Earth's atmosphere in December 1989

Astronomical and Historical Events for August (*continued*)

- 14th History: launch of Luna 20, Soviet Moon sample return (1972)
- 14th History: launch of Syncom 1, the first geosynchronous satellite (1963)
- 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 Mercury at its Greatest Eastern Elongation (18°): apparent separation from the Sun in the evening sky just after sunset
- 16th History: Gerard Kuiper discovers Uranus' moon Miranda (1948)
- 17th Flyby of Saturn's largest moon Titan by the Cassini spacecraft
- 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 First Quarter Moon
- 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 Moon at apogee (furthest distance from Earth)
- 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 Kuiper Belt Object 90482 Orcus at Opposition; discovered on February 17, 2004; has one large moon - Vanth (47.053 AU)
- 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 Mars Winter Solstice (start of winter in the northern hemisphere)
- 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 Full Moon (Full Snow Moon or Hunger Moon)
- 25th Distant flyby of Saturn's largest moon Titan by the Cassini spacecraft
- 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 History: launch of the first Saturn 1B rocket booster (1966)
- 28th History: flyby of Jupiter by the New Horizons spacecraft bound for Pluto (2007)

References on Distances

• The apparent width of the Moon (and Sun) is approximately one-half a degree (½°), less than the width of your little finger at arm's length which covers approximately one degree (1°); three fingers span approximately five degrees (5°)

• One astronomical unit (AU) is the distance from the Sun to the Earth or approximately 93 million miles

International Space Station/Space Shuttle/Iridium Satellites

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

Solar Activity

For the latest on what's happening on the Sun and the current forecast for flares and aurora, check out *www.spaceweather.com.*

Image Credits

Front page design and graphic calendars: Allan Ostergren

Page 1: Halfway Between Uranus and Neptune, New Horizons Cruises On 28 Nov 2012

(Source: NASA/JHUAPL)

Inset: New Horizons Spacecraft, scale model, created in 2009 from polished brass by Don Ross, and displayed at Pettibone Elementary School, New Milford Connecticut as part of the JJMO model solar system. The spacecraft model was twice stolen and replaced, and now is on display at the observatory.

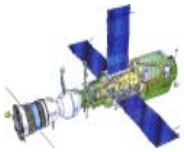
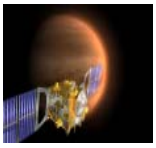
Page 3: Miss Kyle Cloutier shovels off the roof of the McCarthy Observatory so that the dome will move freely when opened for observing

Second Saturday Stars poster: Sean Ross, Ross Designs

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

February 2013

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					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)	**6**  Soviet space station Salyut 7 reenters Earth's atmosphere (1991)	**7** Moon at perigee (closest to Earth) 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** Mars meteorites found - Oman (2001); Antarctica (2000) Jules Verne born (1828) Return of Skylab 3 crew after 3 months on space station (1974)	**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) 2nd Saturday Stars Open House McCarthy Observatory
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** 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)	**15** Galileo Galilei born (1564) Flyby of Moon by Japan's Hiten spacecraft (1992)	**16**  Gerard Kuiper discovers Uranus' moon, Miranda (1948)
17 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** Moon at apogee (furthest from the Earth)  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**  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)		

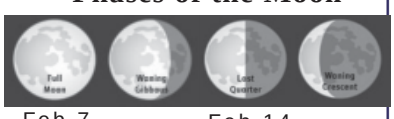
Jan 2013

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Mar 2013

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Phases of the Moon



Feb 7 Feb 14

Feb 21 Feb 29

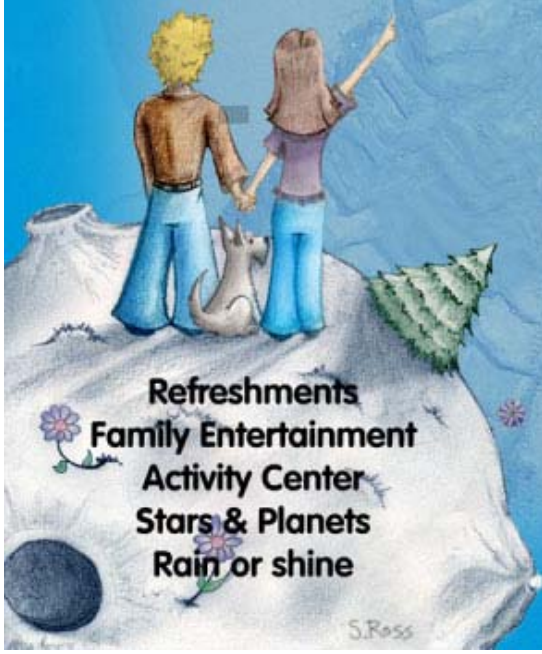
Second Saturday Stars

FREE EVENT

Every Month at the
John J. McCarthy Observatory
Behind the New Milford High School
860.946.0312
www.mccarthyobservatory.org

February 9th
7:00 - 9:00 pm

CRAZY COOL CURIOSITY



Refreshments
Family Entertainment
Activity Center
Stars & Planets
Rain or shine

Map

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