

Galactic Observer

John J. McCarthy Observatory

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The Final Flight of Discovery

See page 6 for details

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

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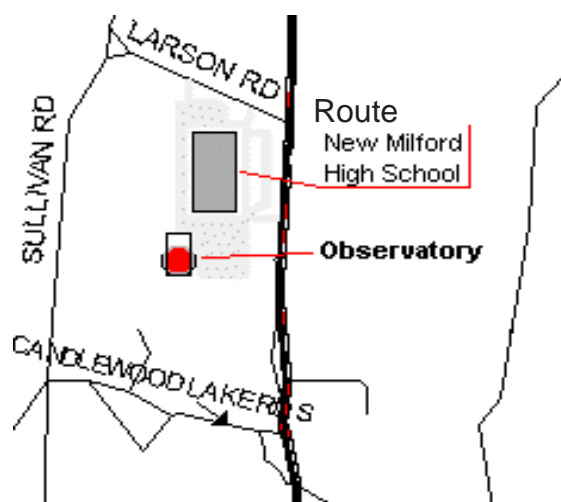
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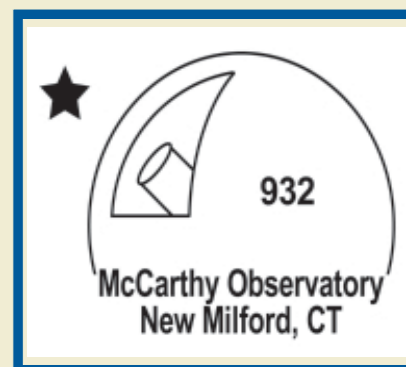
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The Year of the Solar System

NASA announced on Oct. 7, 2010 that the upcoming year would be “The Year of the Solar System.” The “Year,” however, is a Martian year and, as such, 23 months in length. Some of the highlights of the “Year” of exploration are:

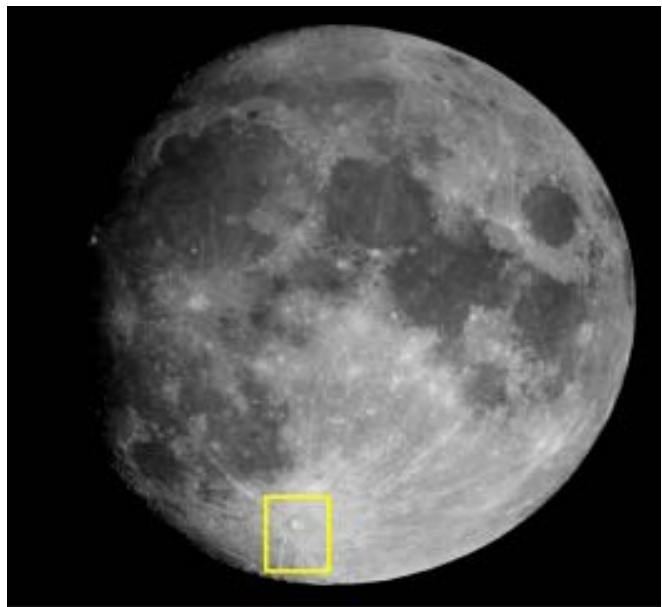
Date	Mission	Status
4 Nov 2010	Deep Impact encounters Comet Hartley 2	Successful rendezvous, see http://www.nasa.gov/mission_pages/epoxi/index.html
19 Nov 2010	Launch of O/OREOS, a shoebox-sized satellite designed to test the durability of life in space	Ground stations receiving data
19 Nov 2010	Launch of experimental solar sail (NanoSail-D)	Mission completed (successfully)
7 Dec 2010	Japan's Akatsuki (Venus Climate Orbiter) spacecraft	Spacecraft fails to enter orbit around Venus - now in orbit around the Sun
14 Feb 2011	Stardust NExT encounters Comet Tempel 1	Successful rendezvous; see http://stardustnext.jpl.nasa.gov/
17 Mar 2011	MESSENGER enters orbit around Mercury	First spacecraft to achieve orbit around Mercury; see http://messenger.jhuapl.edu/
18 Mar 2011	New Horizons spacecraft crosses the orbit of Uranus	see http://pluto.jhuapl.edu/
16 Jul 2011	Dawn spacecraft arrives at the asteroid Vesta	Orbit achieved; see http://dawn.jpl.nasa.gov/
5 Aug 2011	Launch of the Juno spacecraft to Jupiter	Successful launch/deployment; see http://missionjuno.swri.edu/
10 Sep 2011	Launch of twin GRAIL spacecraft to map Moon's gravitational field	Successful launch/deployment; see http://solarsystem.nasa.gov/grail/
8 Nov 2011	Launch of the Phobos-Grunt sample-return mission	Successful launch/failure to leave low-Earth orbit/re-entered Earth's atmosphere on January 15 th
26 Nov 2011	Launch of Mars Science Laboratory (MSL)	Successful launch/deployment; see http://marsprogram.jpl.nasa.gov/msl/
05 Aug 2012	MSL lands on Mars	

Other notable events:

- March 3, 2012 Mars at Opposition
- April 15, 2012 Saturn at Opposition
- May 20, 2012 Annular Solar Eclipse (visible in southwest U.S.)
- June 5, 2012 Venus Transit (visible before sunset on the east coast)
- July 2012 Dawn spacecraft leaves Vesta for Ceres

"Out the Window on Your Left"

IT'S BEEN 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).

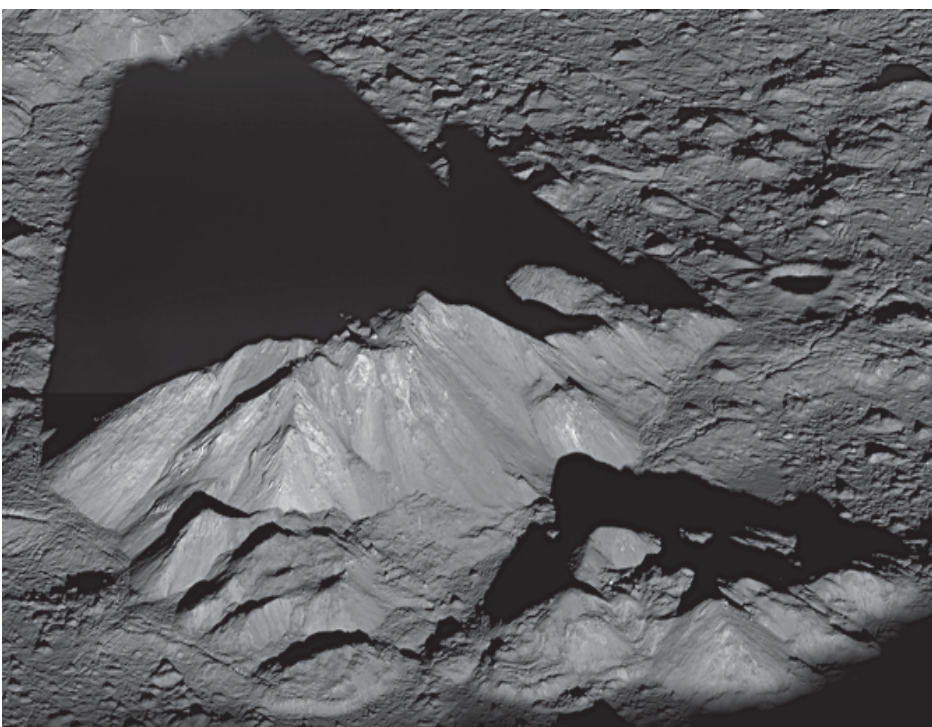
The view this month captures a portion of the southern lunar highlands bounded to the north by the young impact crater Tycho (at right) and to the south by the older and larger impact crater, Moretus. Between the two lies the great walled plain, Clavius.

Tycho Crater is a classic complex impact crater with a prominent central peak, terraced walls and a broad, flat floor. While sometimes difficult to distinguish from the jumble of craters in the southern highlands during the Moon's waxing and waning phases, Tycho's grandeur is on display near and around the full Moon. Its youth is revealed by the bright rays of impact material extending out from the 53 mile (85 km) diameter crater and across the face of the Moon (rays gradually darken and fade with exposure to the solar wind and "gardening" of the soil by micrometeorites).

The Apollo astronauts never visited Tycho, although it was originally targeted for the later (canceled) missions. Its age, however, has been estimated from material collected at the Apollo 17 landing site 1,400 miles (2,300 km) away, as one of Tycho's rays crosses the Taurus-Littrow region on the southeastern rim of the Serenitatis basin. Samples of the impact melt collected by astronauts Gene Cernan and Harrison Schmitt, and believed to have originated from Tycho, are estimated to be 108 million years old. If related, the samples would also date the crater.

A 2007 study suggested that both the Chicxulub crater (65 million years old) on the Yucatan Peninsula, as well as Tycho crater (108 million years old), were created by large fragments from the same parent asteroid (Baptistina). Recent observations by NASA's Wide-field Infrared Survey Explorer (WISE) have now determined that the breakup of Baptistina occurred after the Tycho impact, and most likely too recent to have been the source of the Chicxulub impactor.

Moretus is believed to have formed during the Moon's Eratosthenian age, 1.1 to 3.2 billion years ago. Larger than Tycho at 71 miles (114 km) in diameter, its age and location closer to the lunar limb make Moretus more challenging to locate and it is often overlooked in favor of the nearby and sprawling Clavius and the alluringly bright Tycho. However, the shadow cast by Moretus' 7,000 foot central peak make it worth seeking out this obscure relic.



A sunrise view of Tycho crater's central peak complex, captured on June 10, 2011 by NASA's Lunar Reconnaissance Orbiter (Credit: NASA Goddard/Arizona State University)

Tycho to Moretus

Tycho

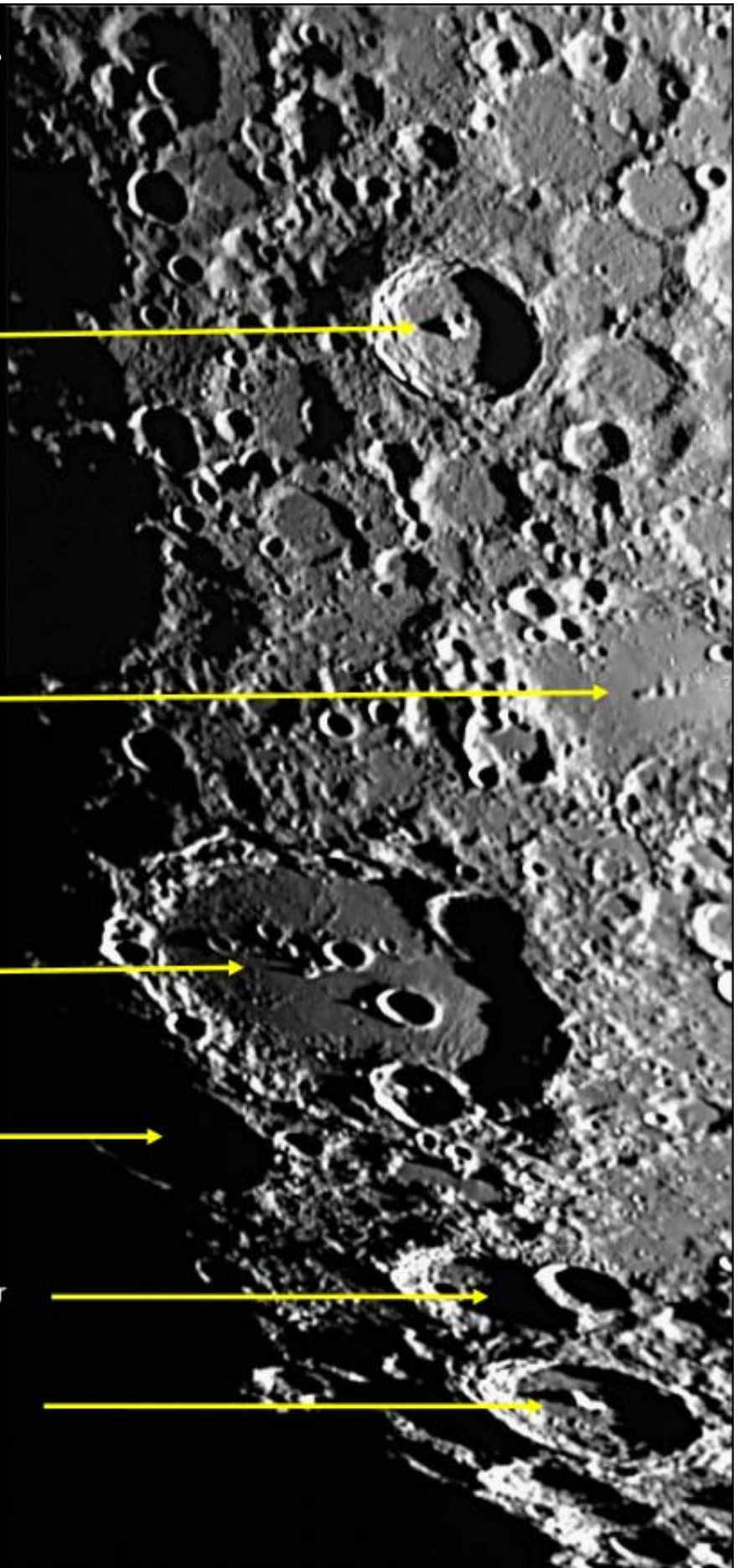
Maginus

Clavius

Blancanus

Gruemberger

Moretus



The Final Flight of Discovery

The modified Boeing 747 jetliner and piggybacked Discovery space shuttle made one last pass over the runway at Washington Dulles International Airport before touching down at 11:05 am on April 17th. The 165,000 pound space shuttle is being delivered to the Smithsonian's National Air and Space Museum, Steven F. Udvar-Hazy Center located just south of the airport. The pair of aircraft had flown over the museum earlier that morning, providing visitors a total of three opportunities to witness the historic event.



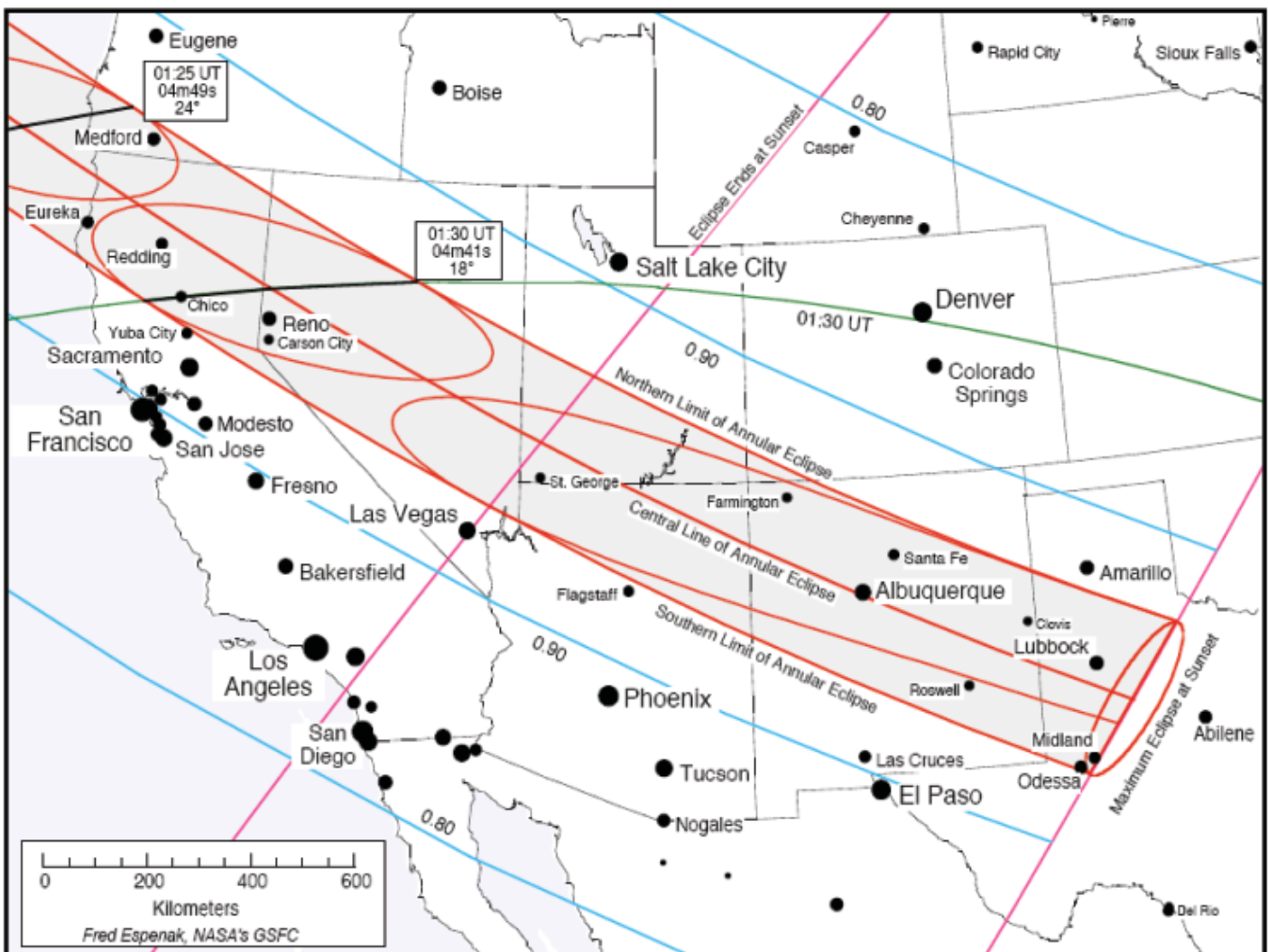
Annular Solar Eclipse

The first solar eclipse of 2012 will occur on May 20th and be visible from locations ranging from extreme southern Oregon to western Texas, as shown in the following figure. A partial eclipse will be visible from a much broader area. The eclipse begins in China and, after crossing the Pacific, will reach the shores of North America in late afternoon.

A solar eclipse occurs when the New Moon passes in front of the Sun, casting a shadow upon the Earth. As indicated in the list of [Astronomical and Historical Events](#), the eclipse takes place just one day after the Moon is at its furthest point from the Earth in its orbit (apogee). At this distance, the Moon will only cover 88 percent of the Sun, leaving a ring of light encircling the Moon at totality. This celestial arrangement is called an Annular Eclipse.

The 150 miles wide path of the eclipse passes over many populated areas. From west to east, the annular phase of eclipse begins at the following times (local) and Sun's altitude: Redding, California (6:26 pm, 20°), Reno, Nevada (6:28 pm, 17°), Page, Arizona (6:32 pm, 10°), and Albuquerque, New Mexico (7:33 pm, 5°). By the time the annular phase of the eclipse reaches Texas, the Sun will be just above the horizon. It is particularly important, with the Sun not completely covered, to protect your eyes when viewing. Totality will last approximately four minutes.

The following figure is from NASA's eclipse web site: <http://eclipse.gsfc.nasa.gov/eclipse.html>



Venus and the Seven Daughters of Atlas (Pleiades)

On April 3rd, Venus was photographed among the stars in the Pleiades star cluster. On that evening Venus was approximately 60 million miles from Earth (approximately 5½ light minutes) while the Pleiades were a distant 440 light years (as determined by the Hubble Space Telescope). Venus, like Earth, is approximately 4½ billion years old, while the stars in the Pleiades cluster are only 100 million years old. At near naked-eye visibility, finding the Pleiades requires a clear, dark night, while Venus is the brightest object in the night sky (after the Moon). Due to the orbit of Venus, this celestial arrangement is repeated every 8 years. Next month (on June 5th), Venus can be seen crossing the face of the Sun (transiting) just before sunset. Among the rarest of planetary alignments, you will have to wait 105 years to see the next Venus transit.



Endeavour

On May 16, 2011, the space shuttle Endeavour lifted off from Pad 39A at the Kennedy Space Center for a 16 day mission to the International Space Station. The STS-134 mission, which included the delivery of the Alpha Magnetic Spectrometer, would be Endeavour's last.

Endeavour first arrived at the Kennedy Space Center on May 7, 1991 as a replacement for the lost Challenger. It was built out of spare parts from the Atlantis orbiter. Endeavour was first launched (STS-49) a year later on May 7, 1992. The orbiter's name was selected through a national competition among students and was named after the ship commanded by British explorer James Cook in his exploration of the

South Pacific in 1768-71. Cook, among other accomplishments, observed the transit of the Sun by Venus from Tahiti in June 1769.

Saturn

May is an excellent time to observe the ringed planet. While faded a bit from its peak brightness in mid-April, Saturn is well placed in the early evening sky. Saturn can be found by star-hopping through several prominent constellations (see below). Follow the arc of the Big Dipper's handle to the orange giant Arcturus in the constellation Boötes. Continue on towards Spica in Virgo. Saturn is located along a sight line just before reaching Spica. Note that Mars is nearby in Leo.



Forgotten Names for an Ancient World

Lunar maps include the names of the prominent features: craters, mountain ranges and the large, expansive lunar seas. Few, if any, include the names of the brighter lunar highlands: the original crust before it was transformed by a cosmic bombardment lasting several hundred million years.



Lunar cartography or mapping was both limited and crude until Galileo first trained his telescope upon the Moon. With the ability provided by the telescope to resolve individual features came the need for a uniform or standard naming convention. The first such detailed map was created by Belgian astronomer Michel Langren in 1645. Features on Langren's map were named for prominent leaders of the Catholic Church, scholars, philosophers and saints. Two years later, Johannes Hevelius, a wealthy Polish brewer, published the first treatise devoted to the Moon. His publication "Selenographia" included maps of every lunar phase developed over several years of observing. Unlike Langren, Hevelius used the names of terrestrial features for his lunar maps, specifically from ancient Greece and Rome. His naming convention was widely used by European astronomers for over a century. However, Hevelius' lunar nomenclature was gradually replaced by a naming convention developed by Jesuit astronomer Giovanni Riccioli.

Riccioli included lunar maps in a dissertation defending the Catholic Church's view of the universe (Earth-centered) against the views being expressed by Galileo, Kepler and Copernicus (Sun-centered). Riccioli's lunar drawings were created by fellow Jesuit Francesco Grimaldi. Riccioli assigned names to the lunar seas associated with weather or other conditions (Sea of Rain, Clouds, Cold, Serenity, and Crises). Other features were given names of scientists and philosophers from ancient Greece, Rome or from medieval Europe. The craters around the Sea of Nectar did include names of Catholic saints, although most were associated with astronomy.

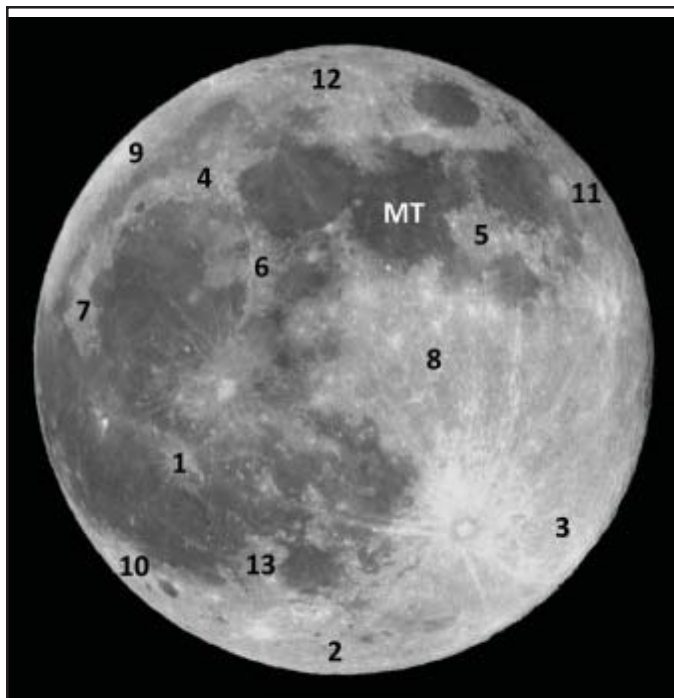
Many of Riccioli's original names remain in use today after being officially recognized by the International Astronomical Union in 1935. What have been lost are the names of the areas between the seas or the Moon's bright crust. Riccioli originally assigned names to these areas in a manner similar (although sometimes opposite) to what he used for the lunar seas (Land of Heat, Hail, Frost, Dryness and Sterility).

Today, references to the lunar crust or "land" are generally non-descript and sterile in comparison (south polar region, eastern limb, Descartes highlands) to Riccioli's imaginative and sometimes poetic labels. Several of the areas described by Riccioli on Grimaldi's maps (shown above) are indicated on the next page.

So, the next time you see the Moon in the sky, take a few minutes and reacquaint yourself with a part of history. Once you have located Mare Tranquillitatis (MT) or the Sea of Tranquility* on the moon's eastern (right) limb, look for Terra Sanitatis or the Land of Healthiness, the adjoining brighter area to the southwest.

May History

On May 25, 1961, President Kennedy, in an address before a joint session of Congress, set forth a challenge to the American people: "I believe this nation should commit itself, before this decade is out, to landing a man on the Moon and returning him safely to the earth." With what started out as an attempt to reverse the political setbacks in Laos, the Congo, the Bay of Pigs in Cuba, and as a response to the first flight into space by cosmonaut Yuri Gagarin, Kennedy's speech set the gears of a technological revolution into motion. The post-Sputnik world of the 1960's would see two great



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

Key to Major Land Features

1. Insula Ventorum (Island of Winds)
2. Terra Colaris (Land of Heat)
3. Terra Fertilitatis (Land of Fertility)
4. Terra Grandinis (Land of Hail)
5. Terra Manna (Land of Manna)
6. Terra Niuiu (Land of Snows)
7. Terra Pruinae (Land of Frost)
8. Terra Sanitatis (Land of Healthiness)
9. Terra Siccitatis (Land of Dryness)
10. Terra Sterilitatis (Land of Sterility)
11. Terra Vigoris (Land of Cheerfulness)
12. Terra Vitae (Land of Liveliness)
13. Peninsula Fulminu (Peninsula of Thunder)

nations compete to control the "high ground," the new frontier in the Cold War.

Lost in the political posturing and often overlooked is that, in less than 10 years, on May 20th, 1969, the 456 foot tall doors on the Vehicle Assembly Building at the Kennedy Space Center opened to reveal AS506, the official designation of the Saturn V rocket that would carry Apollo 11 to the moon. More than 20,000 private firms and hundreds of thousands of workers participated in this program, for a fraction of the cost of the Vietnam War. Not only did the United States reach the Moon, it built a national infrastructure of technology, manufacturing and education that has not been rivaled. In 1969, the United States was truly on top of the world.

May Showers

The *Eta Aquarids* meteor shower peaks in the early mornings of the 5th and 6th. The dust producing the shooting stars is from *Comet Halley*. As with all meteor showers, the Aquarids are named for the constellation (Aquarius) from which they appear to radiate. Normally, you can expect to see up to 20 meteors per hour (more from the southern hemisphere where the radiant is higher); however, the light from the Full Moon on the 5th will wash out all but the brightest.

Sunrise and Sunset

	<u>Sunrise</u>	<u>Sunset</u>
May 1 st (EDT)	05:50	19:52
May 15 th	05:34	20:07
May 31 st	05:22	20:21

May Nights

For those of you who like to do your stargazing early in the evening, a myriad of spectacular objects appear out of the twilight, winking into view as the Earth turns away from the Sun. Leo dominates the southwestern sky with its backward shaped question mark arrangement of stars, punctuated by the star Regulus, forming the front of the lion, and a triangular arrangement of stars forming the back or tail of the creature. To the west of Leo is an open star cluster called the Beehive (M44) in the constellation Cancer. On a dark night it can be seen with the naked eye. East of Leo, towards the constellation Boötes is the globular cluster M3. Boötes is easily identified by its bright star Arcturus. Follow the arc in the handle of the Big Dipper to find Arcturus, at the base of the kite-shaped constellation. M3 is located further away than the center of our galaxy, the Milky Way, and is one of the many outstanding globular clusters that will grace the late spring and summer skies.

Astronomical and Historical Events

- 1st History: discovery of the Mars meteorite *Dar al Gani 476* (1998)
- 1st History: discovery of Neptune's moon *Nereid* by Gerard Kuiper (1949)
- 2nd Flyby of Saturn's moon *Enceladus* by the Cassini spacecraft
- 2nd Distant flyby of Saturn's moons *Polydeuces*, *Atlas* and *Dione* by the Cassini spacecraft
- 3rd Distant flyby of Saturn's largest moon *Titan* by the Cassini spacecraft
- 4th History: launch of the AQUA satellite to study precipitation, evaporation, and the cycling of Earth's water (2002)
- 4th History: launch of the Magellan/Venus radar mapping spacecraft and attached Inertial Upper Stage from the space shuttle Atlantis (STS-30) (1989)
- 5th Full Moon (Full Flower Moon) and closest/largest Full Moon of 2012
- 5th Moon at perigee (closest distance from Earth)
- 5th *Eta Aquarids* meteor shower peak (best viewing: early morning on the 5th and 6th)
- 5th History: launch of Freedom 7 and astronaut Alan Shepard aboard a Mercury-Redstone rocket, first American in space (1961)
- 6th Distant flyby of Saturn's largest moon *Titan* by the Cassini spacecraft
- 6th History: groundbreaking for the John J. McCarthy Observatory, a world-class observatory in New Milford, CT., with a mission to promote science literacy (2000)
- 9th History: launch of MUSES-C (Hayabusa), Japanese sample return mission to asteroid *Itokawa* (2003)
- 9th History: first Earth-based laser aimed at the Moon: crater Albategnius (1962)
- 9th History: launch of first production model of the Project Mercury capsule from Wallops Island, VA. to test the escape system (1960)
- 10th History: President Truman signs Public Law 507, creating the National Science Foundation (1950)
- 11th History: launch of the space shuttle Atlantis (STS-125), final Hubble Space Telescope servicing mission (2009)
- 12th **Second Saturday Stars - Open House at McCarthy Observatory**
- 12th Last Quarter Moon
- 13th History: launch of first Project Bumper rocket from White Sands, NM; the two stage rocket was a combination of a German V-2 and American WAC Corporal rocket (1948)
- 14th History: launch of the Herschel infrared telescope and the Planck microwave observatory (2009)
- 14th History: launch of Skylab (1973)
- 14th History: the American Interplanetary Society (later renamed the American Rocket Society) launches its first liquid fueled (liquid oxygen and gasoline) rocket from Staten Island, N.Y. (1933)
- 14th History: the German Society for Space Travel (Verein für Raumschiffahrt or VfR) launches the Repulsor-1, a liquid fueled (liquid oxygen and gasoline) rocket (1931)
- 15th Scheduled launch of the next expedition crew to the International Space Station aboard a Russian Soyuz spacecraft from the Baikonur Cosmodrome in Kazakhstan
- 15th History: sixth docking of a space shuttle (Atlantis) with Russian space station Mir (1997)
- 15th History: launch of Faith 7 and astronaut Gordon Cooper aboard a Mercury-Atlas rocket, final Mercury mission (1963)
- 15th History: Soviet Union launches Sputnik IV containing a self-sustaining biological cabin and dummy astronaut (1960)

Astronomical and Historical Events (continued)

- 16th History: launch of the space shuttle Endeavor on its final mission (2011)
- 16th History: Soviet spacecraft Venera 5 returns 53 minutes of data while descending by parachute through the atmosphere of Venus and before impacting the surface (1969)
- 17th History: Soviet spacecraft Venera 6 returns 51 minutes of data while descending by parachute through the atmosphere of Venus and before impacting the surface (1969)
- 18th History: launch of Apollo 10 with astronauts John Young, Tom Stafford and Gene Cernan; the lunar module Snoopy was flown within 50,000 feet of the lunar surface while the command module Charlie Brown orbited the Moon (1969)
- 19th Moon at apogee (furthest distance from Earth)
- 19th History: launch of the first Army Hermes A-1 rocket from White Sands, NM (1950)
- 20th New Moon
- 20th Annular Solar Eclipse, visible from the western/southwestern areas of the United States
- 20th Distant flyby of Saturn's moons *Tethys*, *Enceladus*, *Daphnis*, *Prometheus*, *Pan*, *Methone*, *Pallene* and *Telesto* by the Cassini spacecraft
- 20th History: launch of the Pioneer Venus 1 spacecraft (1978)
- 21st History: launch of the Japanese Venus Climate Orbiter Akatsuki or Planet-C spacecraft and the Ikaros solar sail (2010)
- 22nd Flyby of Saturn's largest moon *Titan* by the Cassini spacecraft
- 24th History: launch of Aurora 7 and astronaut Scott Carpenter aboard a Mercury-Atlas rocket; second American to orbit Earth (1962)
- 24th History: launch of Midas 2; first Experimental Infrared Surveillance Satellite (1960)
- 25th History: the Phoenix spacecraft lands in the Martian arctic (2008)
- 25th History: launch of Skylab I crew; astronauts Pete Conrad, Paul Weitz and Joseph Kerwin (1973)
- 25th History: President John F. Kennedy's Moon goal speech to Congress (1961)
- 26th History: launch of the first "Navaho Missile," a pilotless aircraft consisting of a missile and a booster; program goal was to determine the feasibility of an intercontinental missile (1948)
- 28th First Quarter Moon
- 28th History: launch of Mars 3 (USSR) lander and rover; lander became the first spacecraft to attain soft landing on Mars, although transmissions ceased after 15 seconds (1971)
- 28th History: launch of an Army Jupiter missile carrying two primates (Able and Baker) to an altitude of 300 miles; monkeys survived the flight (1959)
- 28th History: Frank Drake born, radio astronomer devised the "Drake Equation" as an attempt to estimate the number of worlds in our galaxy that might harbor intelligent life (1930)
- 29th History: launch of Luna 22 (USSR), lunar orbiter mission that included imaging as well as studying the Moon's magnetic field, the composition of lunar surface rocks, and the gravitational field (1974)
- 29th History: measurements during solar eclipse agree with predictions based on Einstein's General Relativity theory (1919)
- 30th History: launch of Mariner 9, Mars orbiter and first artificial satellite of Mars; mapped Martian surface and imaged moons *Phobos* and *Deimos* (1971)
- 30th History: launch of Surveyor 1, Moon lander; transmitted over 11,000 images from Oceanus Procellarum (1966)
- 31st History: European Space Agency's birthday (1975)

References on Distances

- The apparent width of the Moon (and Sun) is approximately one-half a degree ($\frac{1}{2}^\circ$), 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

The modified Boeing 747 jetliner, transporting the Discovery space shuttle to the Smithsonian's National Air and Space Museum, prepares to land at Washington Dulles International Airport on the morning of April 17th, along with a NASA T-38 escort plane. Photo taken by Bill Cloutier

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

May 12th
8:00 - 10:00 pm

THE GREAT TRANSIT OF VENUS OF 2012



Refreshments
Family Entertainment
Activity Center
Stars & Planets
Rain or shine

S. Ross

Map



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May 2012

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Looking Ahead  June 5: Transit of Venus (We are looking for special viewing sites) June 9: dedication of Galileo's Garden and the Kathleen Fischer Sundial at JJMO (Volunteers welcomed) 		1  Gerard Kuiper discovers Neptune's Moon Nereid 1949  Discovery of Mars meteorite <i>Dar al Gani</i> 1998	2  Cassini, Enceladus Flyby Cassini: Distant Flyby of Polydeuces, Atlas & Dione  Asteroid 1992 JD Near-Earth Flyby (0.024 AU)	3  Edmund Halley observes total eclipse phenomenon "Baily's Beads" (1715)	4  Launch of Magellan spacecraft to Venus by space shuttle Atlantis (1989)  Launch of the AQUA satellite to study precipitation, evaporation, and the cycling of Earth's water (2002)	5  Moon at perigee (closest to earth)  Eta Aquirids meteor shower peak  Alan Shepard first American in space 1961  Space Day
6  Groundbreaking for the John J. McCarthy Observatory (2000)	7  Space Telescope Science Institute Symposium May 7-10  15th Anniversary (1997), Galileo, Ganymede 8 Flyby	8  Flyby of Saturn's largest moon Titan by Cassini spacecraft	9  Launch of MUSES-C (Hayabusa), Japanese sample mission to asteroid Itokawa (2003)  First Earth-based laser aimed at Moon crater Albatregius (1962)	10  Konstantin Eduardovich Tsiolkovsky, Russian Rocketry Pioneer created his calculations about space flight theory - 1897	11  Space Shuttle Atlantis, last Hubble Space Telescope Servicing Mission (2009)	12  2nd Saturday Stars Open House McCarthy Observatory
13  Launch of first Bumper rocket, from White Sands New Mexico (1948)	14  Herschel/Planck Ariane 5 Launch 2009  Launch of Skylab 1973  Early liquid fueled rockets: German Society for Space Travel (1931); American Interplanetary Society (1933)	15  6th docking of a space shuttle (Atlantis) with Russian space station Mir (1997)  Launch of Faith 7 - Final Mercury mission 1963	16  Soviet spacecraft Venera 5, 6 send data on Venus, then impact planet May 16-17, (1969)  Space Shuttle Endeavour final launch (2011)	17  Norman Lockyer born, co-discoverer of helium (1836)	18  Apollo 10 to Moon Young/Stafford/Cernan (1969)	19  Moon at apogee (farthest from Earth)  Launch of first Army Hermes A-1 rocket from White Sands, NM (1950)
20  Launch of Pioneer Venus 1 spacecraft (1978)  Annular Solar Eclipse	21  Launch of Japanese Venus Climate Orbiter Akatsuki or Planet-C spacecraft and the Ikaros solar sail (2010)	22  First Hubble images of Saturn ring plane as the rings are edge-on to the Sun, viewed from Earth (1995)	23  Dr. H. Paul Shuch born, American scientist and engineer who has coordinated radio amateurs to help in the search for extraterrestrial intelligence (1946)	24  Launch of Midas 2, 1st experimental infrared surveillance satellite 1960  Scott Carpenter, second American in space (1962)	25  Launch of Skylab 1 crew 1973  Phoenix spacecraft lands on Martian soil 2008  JFK Moon goal speech (1961)	26  Launch of first "Navaho Missile", ICBM precursor (1948)
27  Lawrence Maxwell Krauss born, Canadian-American theoretical physicist and author The Physics of Star Trek and A Universe from Nothing (1954)	28  Abel and Baker 1st primates in orbit (1959)  Frank Drake born, author of "the Drake Equation" on intelligent life (1930)  Launch of Mars 3 (USSR) lander and rover - 1st spacecraft to attain soft landing on Mars (1971)	29  Launch of Luna 22 (USSR), orbiter mission to study the Moon's magnetic field, the geology, and gravitational field (1974)  Measurements during solar eclipse confirm Einstein's relativity theory - 1919	30  Mariner 9, 1st artificial satellite of Mars (1971)  Launch of Surveyor 1, Moon lander; transmitted over 11,000 images from Oceanus Procellarum (1966)	31  European Space Agency Born 1975	Phases of the Moon  New Moon  Waxing Crescent  First Quarter  Waxing Gibbous May 5  Full Moon  Waning Gibbous  Last Quarter  Waning Crescent May 12 May 20 May 28	