Galactic Observer

John J. McCarthy Observatory

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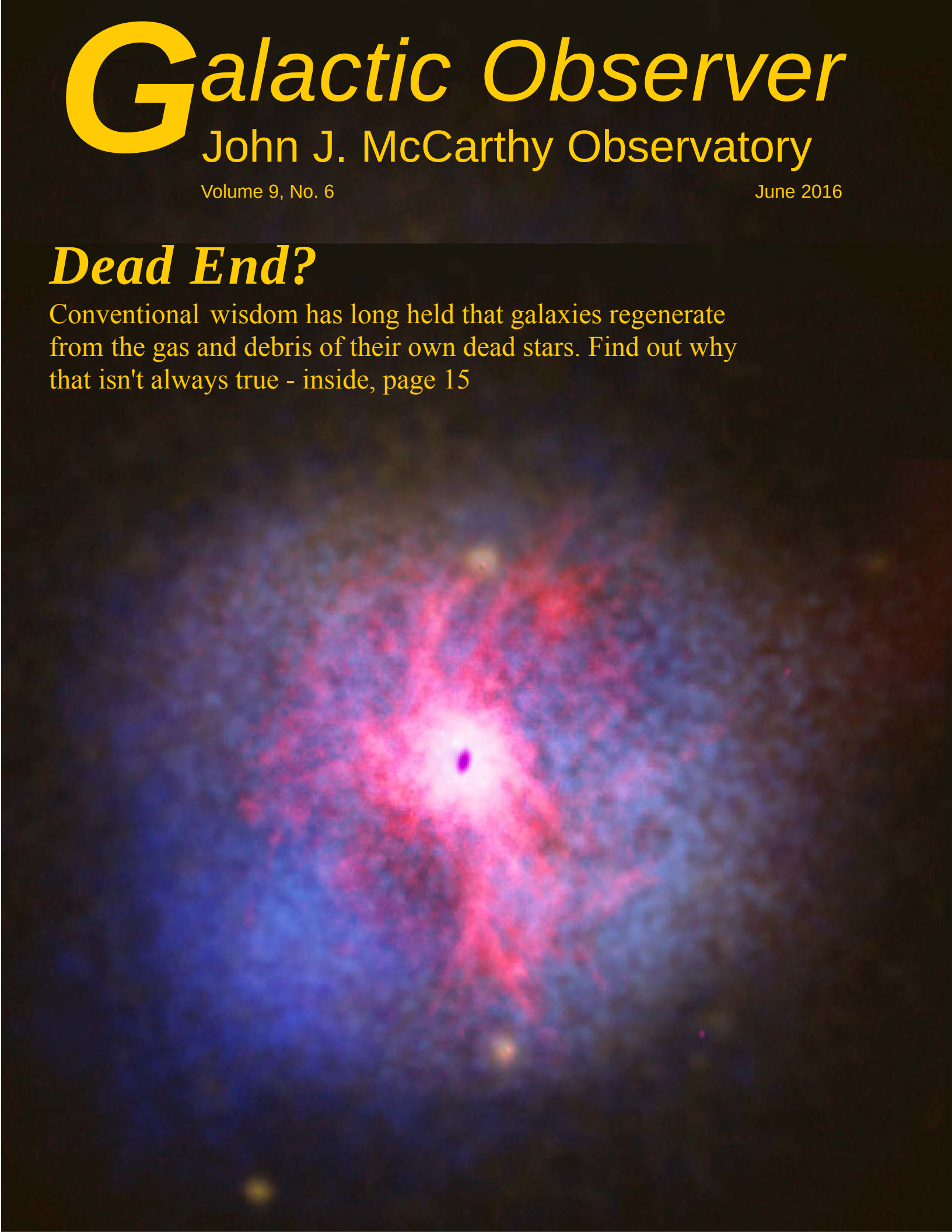
Dead End?

Conventional wisdom has long held that galaxies regenerate from the gas and debris of their own dead stars. Find out why that isn't always true - inside, page 15



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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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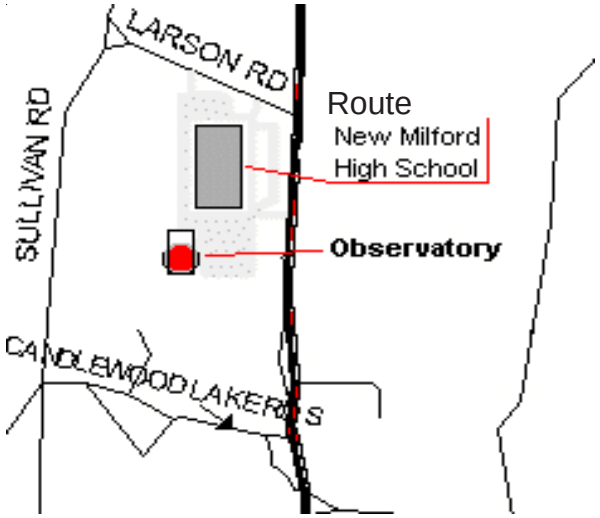

In This Issue

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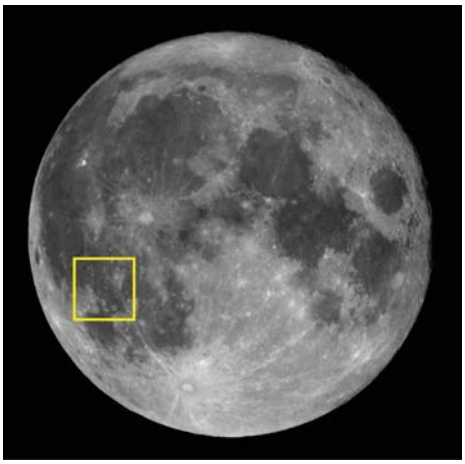
Space Shuttle External Tank

"Out the Window on Your Left"

IT'S BEEN ALMOST 45 years since we left the last footprint on the dusty lunar surface. Sadly, as a nation founded on exploration and the conquest of new frontiers, we appear to have lost our will to lead as a space-faring nation. But, what if the average citizen had the means to visit our only natural satellite; what would



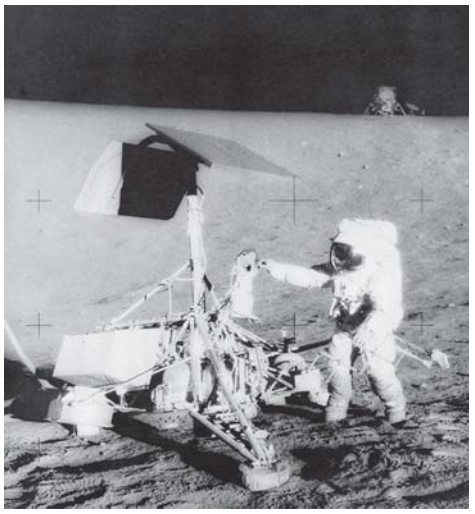
they see out the window of their spacecraft as they entered orbit around the Moon? This column may provide some thoughts to ponder when planning your visit (if only in your imagination).

On February 3, 1966, Luna 9 became the first spacecraft to successfully land on the Moon.The Soviet landing returned data for three Earth days, transmitting the first images from the surface of the Moon. The United States followed up three months later with the successful landing of the robotic Surveyor 1 spacecraft in the southwestern region of Oceanus Procellarum (Ocean of Storms).

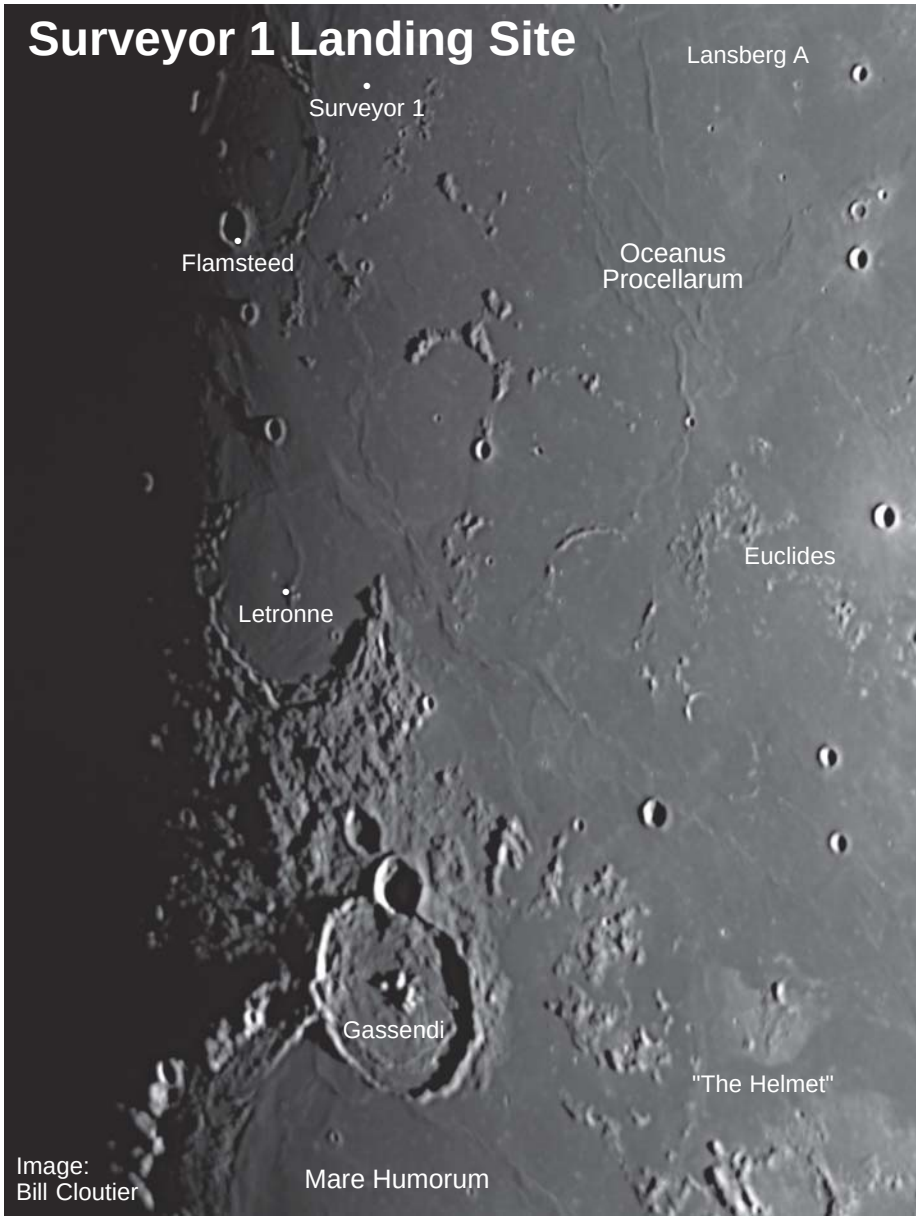
Seven unmanned Surveyor spacecraft were launched between May 1966 and January 1968, five of which were successful. Surveyor was a precursor to the Apollo program, providing data on prospective landing sites and surface conditions, as well as validating deep-space navigation techniques, intercept maneuvers, and long-distance communications.

Surveyor 1 executed a precision landing just north of the crater Flamsteed. The 10-foot (3 meter) tall spacecraft was supported on three legs constructed of aluminum tubing that were folded for launch. Power was provided by two solar panels mounted on top of a central mast.

More than 10,000 photos were returned before night fall. Surveyor 1 survived the lunar night, transmitting an additional 1,000 photos on the second day before succumbing to a precipitous voltage drop.



NASA Photo: Astronaut Alan Bean inspects the Surveyor 3 spacecraft which was within walking distance of the Apollo 12 landing site.



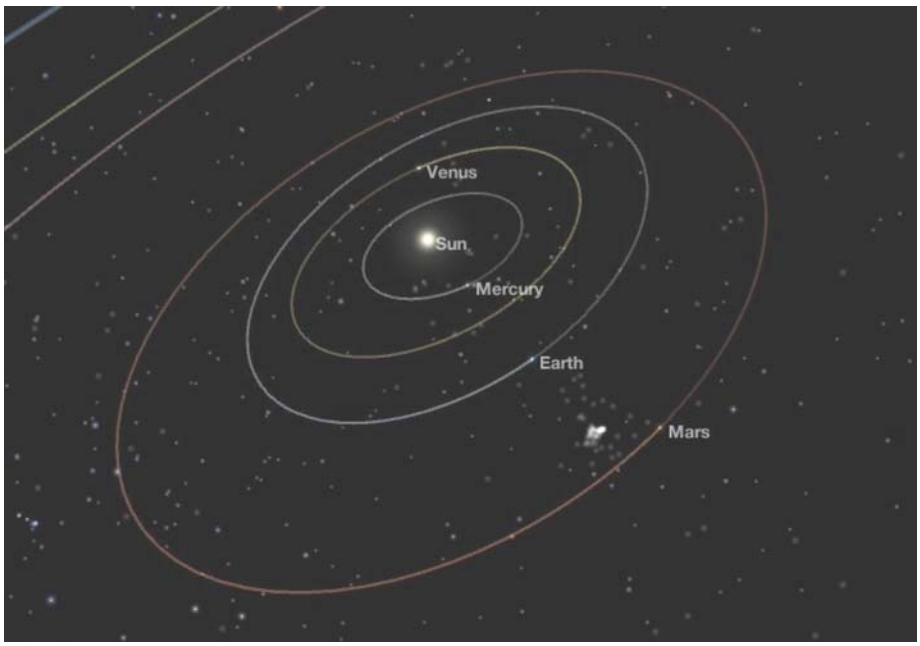
Mercury Transit

MERCURY HAS A highly elliptical orbit, with its distance from the Sun varying as much as 15 million miles (24 million km). Its orbital plane is inclined (7°) to Earth's orbital plane. Twice each year, in May and November, the orbital plane of Mercury intersects the orbital plane of Earth. If both planets are in a favorable position, a transit can be seen. On average, a transit of Mercury occurs 13 times a century. On the morning of May 9, 2016, the planet Mercury crossed in front of the Sun, as viewed from Earth. The next transit will occur on November 11, 2019.

French astronomer Pierre Gassendi was the first to view a transit of Mercury in 1631, but it was Edmond Halley who realized that the transit in 1677 could be used to accurately determine the distance to the Sun (by measuring the parallax shift of the planet as seen from different locations on Earth).

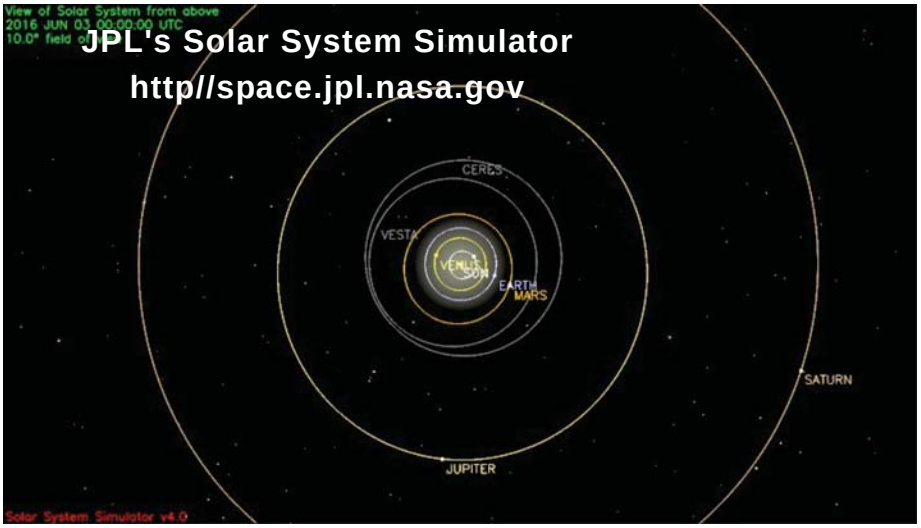
The distance to the Sun is now known with great precision, but transits of Mercury and Venus still have scientific significance. In 2012, the atmosphere of Venus was studied in great detail as it transited the Sun. Scientists were able to identify the elemental composition of the upper layers of the planet's atmosphere from the way different kinds of light were absorbed. While Mercury's ethereal atmosphere is almost non-existent when compared to Venus, the information gathered on its exosphere (ultra-thin atmosphere) will be useful in probing planets around other stars.

Transits are also useful in detecting exoplanets. If a planet crosses another star, in our line of sight, it blocks a small portion of the star's light. The Kepler



Mercury and Earth on May 9, 2016. Credit: NASA's Eyes on the Solar System *https://eyes.nasa.gov/*

Space Telescope used this technique as it monitored 150,000 stars in a patch of sky in the constellation Cygnus over four years. The Kepler mission team recently announced that they had verified an additional 1,284 new planets. This brings the total number of planets found by the space telescope to 2,325, all by the transit method. Of the 1,284 new candidates, 550 may be rocky worlds, nine of which orbit their stars at a distance where liquid water can exist (in the habitable or "goldilocks" zone).



Saturn at Opposition

The Earth will come between Saturn and the Sun on June 3 rd, an arrangement known as "Opposition" (the Earth and Mars were in Opposition on May 22nd). On that day, Saturn will rise with the setting Sun and be visible the entire night. At closest approach, Saturn will be approximately 837.9 million miles (1.35 billion km) from Earth - slightly further away than in 2015. The difference in appearance (diameter) won't be noticeable.

Saturn can be found in the constellation Ophiuchus during the month of June. The planet will be relatively bright (rivaling the brighter stars in the sky) with an apparent magnitude of 0.8 (but not as bright as Mars in Scorpius, just to the east). Saturn and Mars will be less than 5° apart in the evening sky in late August (25th). On June 18th, Saturn and a waxing gibbous Moon will be even closer with a 3.2° separation.

Saturn's axial tilt is almost 27° (as compared to Earth's 23.5° or Jupiter's 3°). The axial tilt produces seasons which last more than 7 years, since it takes Saturn almost 29½ years to complete an orbit around the Sun. It was summer in the southern hemisphere when the Cassini spacecraft arrived in 2004 with the planet' s north pole in perpetual darkness. Saturn's Vernal equinox occurred in August 2009 with both hemispheres experiencing equal amounts of sunlight. At the equinoxes, the rings appear almost edge on. Since that time, our view of the rings has improved. At the northern summer solstice in May of 2017, the rings will be wide open with the planet's north pole sunlit and tipped towards Earth. This year the ring tilt is 26°, for a view almost as good.

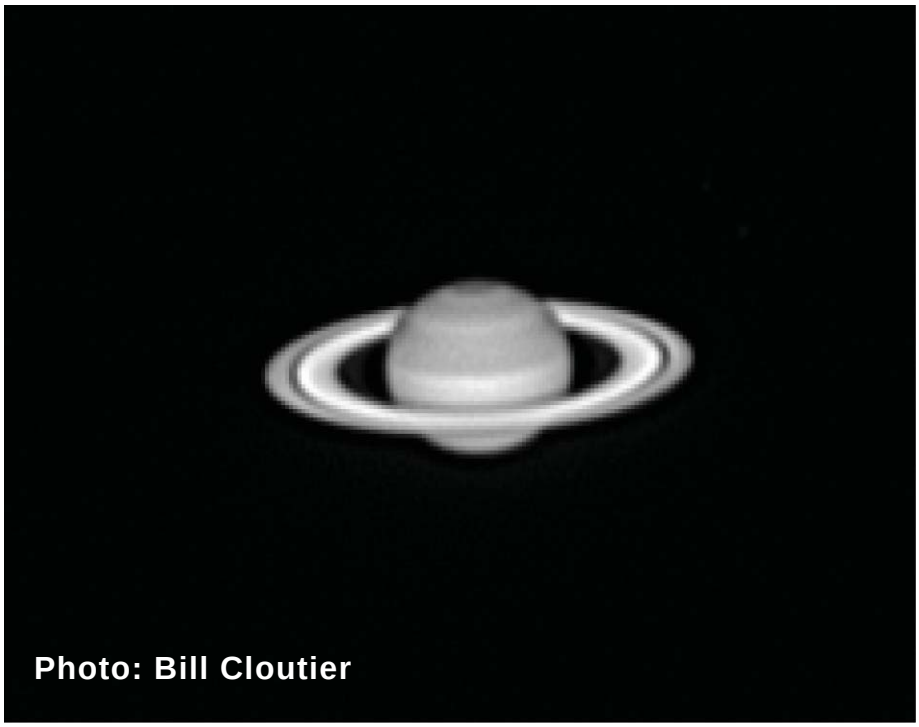


Photo: Bill Cloutier

June 30th marks the 12th anniversary of the arrival of the Cassini spacecraft in the Saturnian system. Its mission will end in 2017, with the spacecraft passing through the gap between the planet and its innermost ring on several orbits before taking a final plunge into Saturn' s atmosphere, a campaign dubbed "The Grand Finale." The close encounters will provide valuable data on the ring's composition, the planet's magnetic field and any variations in Saturn's gravitational field.

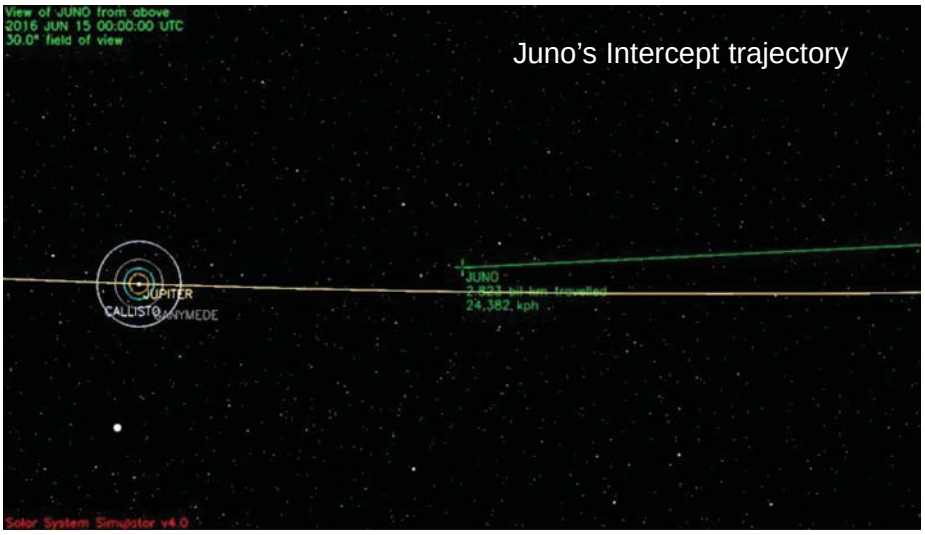
Final Approach

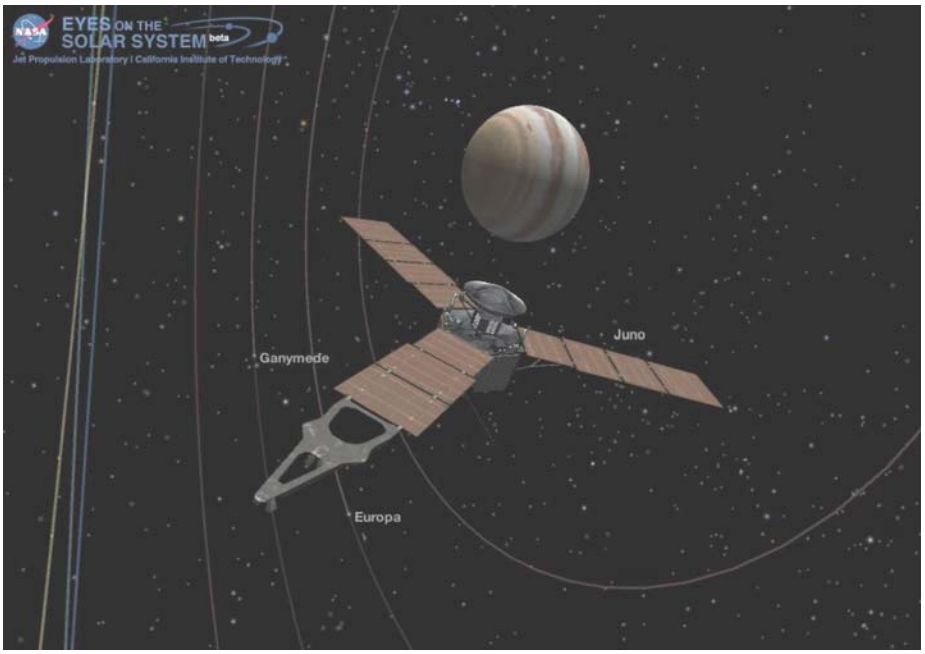
Juno was launched in August 2011 and is scheduled to arrive at Jupiter on July 4, 2016. The diagram produced by the Jet Propulsion Laboratory's Solar System Simulator (*http://space.jpl.nasa.gov/*) for June 15th shows the position of the Juno spacecraft (in green).

Juno will execute 37 revolutions of Jupiter in a polar orbit over a period of 20 months. The orbit minimizes the time the spacecraft spends in the planet's intense radiation belts located around the equator . The spacecraft's electronics are also shielded in a titanium vault to minimize the damage from the high velocity, charged particles trapped within the belt.

At closest approach the spacecraft will pass within 3,100 miles (5,000 km) of the planet's cloud tops. At the end of the mission in February 2018, the spacecraft will be deorbited for destruction within the Jovian atmosphere (preventing potential contamination of Jupiter's Galilean moons).

The mission objectives for Juno include mapping the planet' s magnetic and gravity fields. This information will be used to model Jupiter's core (its mass and whether it is solid). Juno will also measure the amount of water and ammonia in the atmosphere to test various formation theories (Jupiter's mass has allowed it to retain much of its original elemental composition).





Juno on July 3, 2016. Credit: NASA's Eyes on the Solar System *https://eyes.nasa.gov/*

Martian Weather

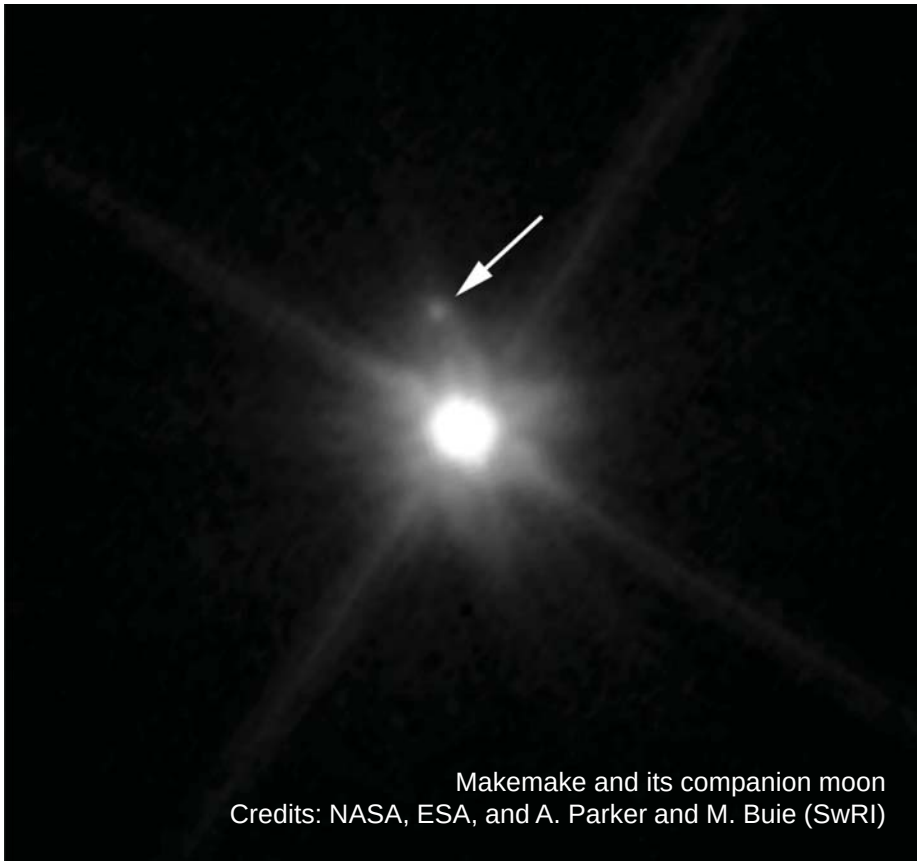
NASA's Curiosity rover recently completed its second Martian year exploring its landing site inside the 96 mile (154 km) diameter Gale crater. The crater is located near the Martian equator (5.4° south) in the Aeolis quadrangle.

Curiosity's Rover Environmental Monitoring Station has provided daily measurements of the air and ground temperature, atmospheric pressure, humidity, ultraviolet radiation and wind speed around the rover. Scientists now have two years of seasonal data to evaluate and correlate with the Martian seasons and elliptical orbit. With its thin atmosphere, the atmosphere of Mars does not retain daytime heating. Air temperature on a summer afternoon can reach 60.5° F (15.9° C) while falling to -148° F (-100° C) on a winter night. The air pressure fluctuates with the changing seasons, increasing in the spring as millions of tons of carbon dioxide are released into the atmosphere by the thawing of the polar ice caps. Daily weather reports can be found on *http://mars.nasa.gov/msl/mission/instruments/environsensors/rems/*.

A Moon for Makemake

Makemake (pronounced mah-kee-mah-kee) is one of the five dwarf planets recognized by the International Astronomical Union (along with Pluto, Ceres, Eris and Haumea). It was first discovered in 2005 by Mike Brown, Chad Trujillo, and David Rabinowitz at the Palomar Observatory. Located in the Kuiper Belt, the 870 mile (1,400 km) diameter dwarf planet takes 310 Earth-years to orbit the Sun. Makemake is named after the fertility god in Rapa Nui (native population of Easter Island) mythology.

Astronomers using the Hubble Space Telescope have now discovered a moon, estimating to be 100 miles (160 km) across, orbiting the dwarf planet. The dark moon (compared to the bright, icy dwarf) was approximately 13,000 miles (21,000 km) from Makemake at the time the photo was taken and had avoided detection in previous searches. The new moon is estimated to orbit the dwarf planet every 12 days, although the exact shape of the orbit (circular or ellipse) hasn't been determined. However, the presence of a companion will enable astronomers to more accurately determine the mass of Makemake.

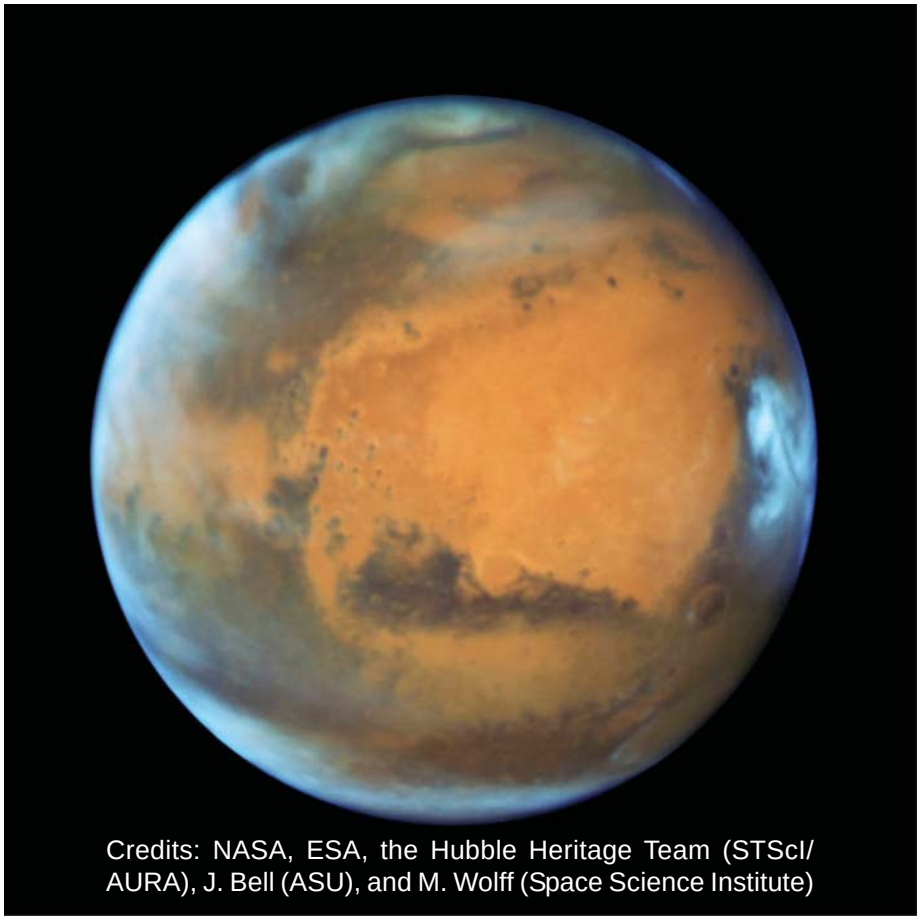


Makemake and its companion moon
Credits: NASA, ESA, and A. Parker and M. Buie (SwRI)

New Mars Portrait

The Hubble Space Telescope's Wide Field Camera 3 (installed during the last servicing mission in May 2009 by the crew of the space shuttle Atlantis) recently captured an image of the Red Planet from a distance of approximately 50 million miles. An annotated version of the photo is provided on the following page.

The large orange region at the center of the image isArabia Terra. It has some of the oldest terrain on Mars, dating back 4 million years and is heavily cratered.

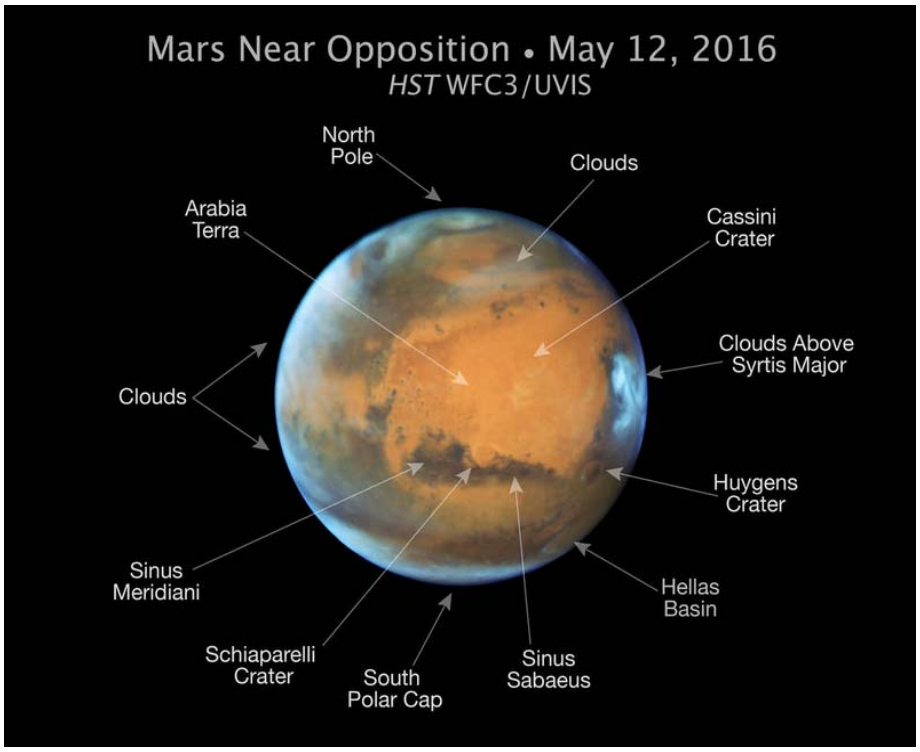


Credits: NASA, ESA, the Hubble Heritage Team (STScI/ AURA), J. Bell (ASU), and M. Wolff (Space Science Institute)

Summer Solstice

On the morning of June 20th the Sun will rise over a prehistoric structure on the Salisbury Plain in southern England as it has for the last 4,000 years. For those individuals standing within the 100 foot diameter circle of 30 sandstone or sarsen-stones (weighing up to 50 tons each), the Sun will appear over a large naturally shaped stone (Heel S tone) located outside and to the northeast of the circle. The alignment signals the start of the longest day, midsummer, or the summer solstice.

The photo (below at left) shows the current state of the stone circle. Many of the original stones are missing or damaged. Over time, they were taken to build houses and roads, chipped away by visitors and taken as souvenirs. What remains represents the last in a progressive sequence of monuments erected at the site between 3,000 and 1,600 B.C. The Heel Stone is adjacent to the access road to the site. The ancient people who constructed this monument left no written record of their accomplishments or the intended use of the stone circle. Its purpose has been widely debated and many groups have attempted to claim ownership. However, archeologists have of Stonehenge predates the appearance of most modern cultures in Britain.



In the 1960s, Gerald Hawkins, an astronomer at the Smithsonian Astrophysical Observatory, found that each significant stone aligns with at least one other to point to an extreme position of the sun or moon ("S tonehenge Decoded," Doubleday & Company). That Stonehenge is an astronomical observatory or celestial calendar is intriguing, as the precision and architectural refinement by which it was constructed certainly suggests a significant purpose for this megalithic monument.


Stonehenge
Photo: Bill Cloutier


Heel Stone
Photo: Bill Cloutier

June History

Women in Space

On June 16, 1963, Valentina Tereshkova became the first woman in space. Shortly afterYuri Gagarin's flight, the Soviets began a search for suitable female candidates for spaceflight. With few female pilots, the majority of the candidates were women parachutists (Valentina had joined an amateur parachuting club at the age of 18). Control of the Vostok spacecraft was completely automatic, so piloting experience was not required. However, since the Vostok was not designed to return its occupant safely to Earth, the cosmonaut was required to eject from the spacecraft after re-entry and parachute to the landing site.

The selection of Valentina Tereshkova for the flight was made by Premier Khrushchev. In addition to experience and fitness, qualifications included being an ideal Soviet citizen and model Communist Party member. On June 16 th, Valentina rode Vostok 6 into orbit with the call sign "Chaika" (Seagull). The mission was not without incident and included space-sickness, leg cramps and other discomforts from being strapped into the capsule for three days. More importantly, the capsule ended up in the wrong orientation and, had it not been corrected, would not have allowed her to return to Earth.

Valentina's three days in space was more flight time than all the American astronauts combined (at that time). After fulfilling her duties to her country, Tereshkova retired to a small house on the outskirts of Star City. The house is topped with a seagull weathervane, the call sign of her flight.

Twenty years later on June 18th, Sally Ride became the firstAmerican woman in space. Launched aboard the space shuttle Challenger, Sally served as the mission specialist on the five person crew.

An Extraordinary Feat

If you have ever seen a Gemini space capsule (there is one on display at the Air and Space Museum in Washington, D.C.) it is difficult to comprehend how two people could have spent any length of time inside its cramped interior (Frank Borman and Jim Lovell spent 14 days orbiting the Earth in Gemini 7). The reentry module, where the two astronauts sat, is approximately 11 feet long with a maximum diameter of 7½ feet and filled with instrumentation, life support systems and controls.

On June 3, 1965, Gemini 4 lifted off on a four day mission. The highlight of the mission was to be a spacewalk by Ed White.

NASA was very concerned with "putting guys in vacuums with nothing between them but that little old lady from Worcester, Massachusetts [the seamstress at the David Clark Company], and her glue pot and that suit." However, the Soviets had challenged the United States with a spacewalk by Cosmonaut Alexei Leonov in March during a Voskhod II mission, and the United States did not want to appear to be falling behind its adversary.

After struggling with a faulty hatch, Ed White finally exited the spacecraft as it passed over the Pacific Ocean. Using a gun powered by compressed oxygen, he was able to maneuver outside the capsule, just avoiding the flaming thrusters of the Gemini capsule. After a 23 minute spacewalk, Jim McDivitt struggled to get the six foot tall Ed White back inside the capsule and close the balky door.

Unfortunately, after making history as the first American to walk in space, Ed White died during a launch pad test of the Apollo 1 spacecraft when the pure oxygen atmosphere exploded, killing all three astronauts inside.

Jupiter and its Moons

Jupiter reached Opposition and its closest approach to Earth in early March. During the month of June, Jupiter is still well placed in evening sky after sunset. Jupiter will be high in the southern sky at sunset on June 1st (8:22 pm). By months end, Jupiter will be closer to the western horizon but still visible for several hours.As the Earth moves ahead of Jupiter on its inside orbit, Jupiter will diminish slightly in brightness and apparent size. As one of the brightest star - like objects in the night sky, Jupiter can be found in the constellation Leo.

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.

The Red Spot is a lar ge 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 8 pm to midnight local time:

Jovian Moon Transits

Date	Moon	Transit Begins	Transit Ends
May 31st	Io	7:20 pm	9:34 pm
7th	Io	9:15 pm	11:29 pm
10th	Europa	6:29 pm	9:11 pm
14th	Io	11:10 pm	1:24 am (15th)
17th	Ganymede	7:38 pm	10:44 pm
18th	Europa	9:05 pm	11:47 pm
23rd	Io	7:34 pm	9:47 pm
24th	Ganymede	11:37 pm	2:42 am (25th)
25th	Europa	11:42 pm	2:23 am (26th)

Red Spot Transits

Date	Transit Time	Date	Transit Time
2nd	9:03 pm	16th	10:40 pm
4th	10:42 pm	19th	8:11 pm
7th	8:13pm	21st	9:50 pm
9th	9:52 pm	23rd	11:29 pm
11th	11:30 pm	26th	8:59 pm
14th	9:01 pm	28th	10:39 pm

Sunrise and Sunset

Sun	Sunrise	Sunset
June 1st (EDT)	05:22	20:22
June 15th	05:19	20:30
June 30th	05:23	20:32

Summer Nights

For the more adventurous and sleep deprived individuals, the summer sky sparkles as twilight deepens and the summer MilkyWay rises. The Milky Way is heralded by the three stars of the summer triangle Vega, Deneb and Altair. Appearing like a gossamer stream of stars, it flows across the night sky , emptying into the constellation Sagittarius. In our light-polluted skies, it may be easier to see on nights when the Moon is absent (in the weeks preceding and following the New Moon on the 4th).

High in the June sky is the constellation Hercules. Shaped like a keystone or trapezoid, Hercules is home to one of the finest globular star clusters in the northern hemisphere. The Great Hercules Cluster (M13) is a collection of several hundred thousand suns located near the galactic core of the Milky Way Galaxy at a distance of approximately 25,000 light years. Hercules rises in the evening after the constellation Boötes with its bright star Arcturus and before the constellation L yra with its bright star Vega. The cluster can be found on the side of the keystone asterism facing Boötes.

Astronomical and Historical Events

1st History: final landing of Space Shuttle Endeavour (STS-134) (2011)
1st History: launch of the ROSA T (Röntgen) X-ray observatory; cooperative program between Ger - many, the United States, and United Kingdom; among its many discoveries was the detection of X-ray emissions from Comet Hyakutake (1990)
2nd Amor Asteroid 2016 HR6 near-Earth flyby (0.084 AU)
2nd History: launch of the Mars Express spacecraft and ill-fated Beagle 2 lander (2003)
2nd History: launch of the Space Shuttle Discovery (STS-91); ninth and final Mir docking (1998)
2nd History: launch of Soviet Venus orbiter Venera 15; side-looking radar provided high resolution mapping of surface in tandem with Venera 16 (1983)
2nd History: Surveyor 1 lands on the Moon (1966)
2nd History: Gemini 5, Gemini 11, Apollo 12 and Skylab 2 astronaut Pete Conrad born (1930)
2nd History: discovery of Comet Donati by Italian astronomer Giovanni Battista Donati; brightest comet of the 19th century and first comet to be photographed (1858)
3rd Moon at perigee (closest distance from Earth)
3rd Saturn at Opposition, rising with the setting Sun and visible all night
3rd Asteroid 624 Hektor (Jupiter Trojan) closest approach to Earth (4.290 AU)
3rd History: launch of Gemini 4; Ed White becomes first American to walk in space (1965)
3rd History: launch of Gemini 9 with astronauts Thomas Stafford and Eugene Cernan (1966)
3rd History: dedication of the 200-inch Hale Telescope at Palomar Mountain (1948)
4th New Moon
4th Jet Propulsion Laboratory open house, Pasadena, California (4th and 5th)
4th History: maiden flight of SpaceX's Falcon 9 rocket; launched from Cape Canaveral, Florida (2010)
5th Mercury at its greatest western elongation (24°), apparent separation from the Sun in the morning sky
5th Kuiper Belt Object 2010 KZ39 at Opposition (45.124 AU)
6th Aten Asteroid 2006 JF42 near-Earth flyby (0.092 AU)
6th Apollo Asteroid 3360 *Syrinx* closest approach to Earth (0.295 AU)
6th Atira Asteroid 2015 ME131 closest approach to Earth (1.632 AU)
6th History: launch of Soviet Venus orbiter Venera 16; side-looking radar provided high resolution mapping of surface in tandem with Venera 15 (1983)
7th Flyby of Saturn's largest moon *Titan* by the Cassini spacecraft
7th Apollo Asteroid 65803 *Didymos* closest approach to Earth (1.742 AU)
8th Kuiper Belt Object 174567 *Varda* at Opposition (46.017 AU)
8th History: New Horizons spacecraft, on its way to Pluto, crosses the orbit of Saturn (2008)
8th History: launch of Soviet Venus orbiter/lander Venera 9; transmitted the first black and white images of the surface of Venus (1975)
8th History: Giovanni Cassini born, observer of Mars, Jupiter and Saturn (1625)
9th Aten Asteroid 2009 KR4 near-Earth flyby (0.094 AU)
9th History: dedication of the Kathleen Fischer Sundial at the McCarthy Observatory (2012)
10th History: launch of Mars Exploration Rover A (Spirit) in 2003
10th History: launch of Explorer 49, Moon orbiter and radio astronomy explorer (1973)
11th **Second Saturday Stars/Open House at the McCarthy Observatory 8:00 to 10:00 pm**
11th History: flyby of Venus by Soviet spacecraft Vega 1 on its way to Comet Halley; dropped of lander and a balloon to study middle cloud layers (1985)
12th First Quarter Moon
12th Aten Asteroid 2002 LY1 near-Earth flyby (0.051 AU)
12th History: launch of Venera 4, Soviet Venus lander; first to enter atmosphere of another planet (1967)
13th Apollo Asteroid 2015 XZ378 near-Earth flyby (0.025 AU)
13th Apollo Asteroid 9162 Kwiila closest approach to Earth (1.238 AU)
13th History: return of the sample capsule from the Hayabusa (MUSES-C) spacecraft (2010)

Astronomical and Historical Events (continued)

14th History: launch of Mariner 5; Venus flyby mission (1967)
14th History: launch of Venera 10; Soviet Venus orbiter/lander (1975)
15th Moon at apogee (furthest distance from Earth)
15th Apollo Asteroid 382758 (2003 GY) near-Earth flyby (0.079 AU)
15th Amor Asteroid 3757 *Anagolay* closest approach to Earth (1.625 AU)
15th Plutino 28978 *Ixion* at Opposition (38.939 AU)
15th History: flyby of Venus by Soviet spacecraft Vega 2 on its way to Comet Halley; dropped off lander and a balloon to study middle cloud layers (1985)
16th Aten Asteroid 2002 LT38 near-Earth flyby (0.070 AU)
16th History: Liu Yang becomes the first Chinese woman in space aboard a Shenzhou-9 spacecraft, joining two other crew members on a thirteen day mission to the orbiting Tiangong 1 laboratory module (2012)
16th History: Valentina Tereshkova; first woman in space aboard Soviet Vostok 6 (1963)
17th Centaur Object 5145 *Pholus* at Opposition (25.904 AU)
17th History: discovery of the Dhofar 378 Mars Meteorite (2000)
18th Apollo Asteroid 7092 *Cadmus* closest approach to Earth (0.905 AU)
18th History: launch of the Lunar Reconnaissance Orbiter (LRO) and Lunar CRater Observation and Sensing Satellite (LCROSS) to the Moon (2009)
18th History: Sally Ride becomes the first American woman in space aboard the Space Shuttle Challenger (1983)
19th History: flyby of Earth by the ill-fated Nozomi spacecraft on it way to Mars (2003)
20th Full Moon (Strawberry Moon)
20th Summer Solstice, 22:34 UT (6:34 pm EDT)
20th Apollo Asteroid 2009 CV near-Earth flyby (0.032 AU)
20th Apollo Asteroid 4034 *Vishnu* closest approach to Earth (1.353 AU)
20th Kuiper Belt Object 50000 Quaoar at Opposition (41.947 AU)
20th History: successful landing of the Viking 1 spacecraft on Mars' Chryse Planitia (Plains of Gold) (1976)
20th History: discovery of Nova 1670 in Vulpeculae (1670)
21st Aten Asteroid 2013 ND15 (Venus Trojan) near-Earth flyby (0.076 AU)
22nd Apollo Asteroid 10563 *Izhdubar* closest approach to Earth (0.642 AU)
22nd History: launch of Soviet space station Salyut 5 (1976)
22nd History: founding of the Royal Greenwich Observatory (1675)
22nd History: discovery of Pluto's largest moon *Charon* by Jim Christy (1978)
23rd Amor Asteroid 3199 *Nefertiti* closest approach to Earth (1.851 AU)
24th Scheduled launch of a Soyuz spacecraft from the Baikonur Cosmodrome, Kazakhstan, with the next Expedition crew to the International Space Station
24th Aten Asteroid 441987 (2010 NY65) near-Earth flyby (0.028 AU)
24th Aten Asteroid 2014 OL339 closest approach to Earth (0.277 AU)
24th Apollo Asteroid 5731 *Zeus* closest approach to Earth (1.273 AU)
24th Centaur Object 10370 *Hylonome* at Opposition (22.364 AU)
24th History: launch of the Salyut 3 Soviet space station (1974)
24th History: Fred Hoyle born; British astronomer and proponent of nucleosynthesis (1915)
24th History: Sir William Huggins makes first photographic spectrum of a comet (1881)
25th History: Rupert Wildt born, German-American astronomer and first to hypothesize that the CO_2 in the Venusian atmosphere was responsible for the trapped heat (1905)
25th History: Hermann Oberth born, father of modern rocketry and space travel (1894)
26th Centaur Object 55576 *Amycus* at Opposition (18.752 AU)
26th History: Charles Messier born, famed comet hunter (1730)
27th Last Quarter Moon
27th Centaur Object 10199 *Chariklo* at Opposition (14.377 AU)
27th Scheduled launch of a Dragon cargo-carrying spacecraft from the Cape Canaveral Air Force Station, Florida, to the International Space Station

Astronomical and Historical Events (continued)

27th History: discovery of the Mars meteorite SAU 060, a small 42.28 g partially crusted grey-greenish stone found near Sayh al Uhaymir in Oman (2001)
27th History: flyby of the asteroid *Mathilde* by the NEAR spacecraft (1997)
27th History: Space Shuttle Atlantis (STS-71) first docking with the Russian space station Mir (1995)
27th History: launch of SEASAT, the first Earth-orbiting satellite designed for remote sensing of the Earth's oceans (1978)
27th History: Alexis Bouvard born, French astronomer, director of Paris Observatory, postulated existence of eighth planet from discrepancies in his astronomical tables for Saturn and Uranus. Neptune was subsequently discovered by John CouchAdams and Urbain LeVerrier after his death where he had predicted (1767)
28th History: discovery of Pluto's moon Kerberos by Mark Showalter, et al., using the Hubble Space Telescope (2011)28th History: Nakhla meteorite fall in Egypt (Mars meteorite), a piece of which was claimed to have vaporized a dog; first direct evidence of aqueous processes on Mars (1911)
29th History: George Ellery Hale born, founding father of the Mt. Wilson Observatory (1868)
30th Apollo Asteroid 4257 *Ubasti* closest approach to Earth (1.758 AU)
30th Kuiper Belt Object 307261 (2002 MS $_4$) at Opposition, a Trans-Neptunian object discovered in 2002 by Chad Trujillo and Michael E. Brown (45.827 AU)
30th History: discovery of Haumea's moon Namaka, the smaller, inner moon of the dwarf planet, by Mike Brown, Chad Trujillo, David Rabinowitz, et al. (2005)
30th History: crew of Soyuz 11 dies upon return from the Salyut space station when capsule depressurizes (1971)
30th History: Tunguska Explosion Event (1908)

Commonly Used Terms

- **Apollo**: a group of near-Earth asteroids whose orbits also cross Earth's orbit; Apollo asteroids spend most of their time outside Earth orbit.
- Aten: a group of near-Earth asteroids whose orbits also cross Earth's orbit, but unlike Apollos, Atens spend most of their time inside Earth orbit.
- **Atira**: a group of near-Earth asteroids whose orbits are entirely within Earth's orbit
- **Centaur: icy planetesimals with characteristics of both asteroids and comets**
- **Kuiper** Belt: region of the solar system beyond the orbit of Neptune (30 AUs to 50 AUs) with a vast population of small bodies orbiting the Sun
- **Opposition**: celestial bodies on opposite sides of the sky, typically as viewed from Earth
- **Plutino**: an asteroid-sized body that orbits the Sun in a 2:3 resonance with Neptune
- **Trojan**: asteroids orbiting in the 4th and 5th Lagrange points (leading and trailing) of major planets in the Solar System

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 and Iridium Satellites

Visit ***www.heavens-above.com*** for the times of visibility and detailed star charts for viewing the International Space Station 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

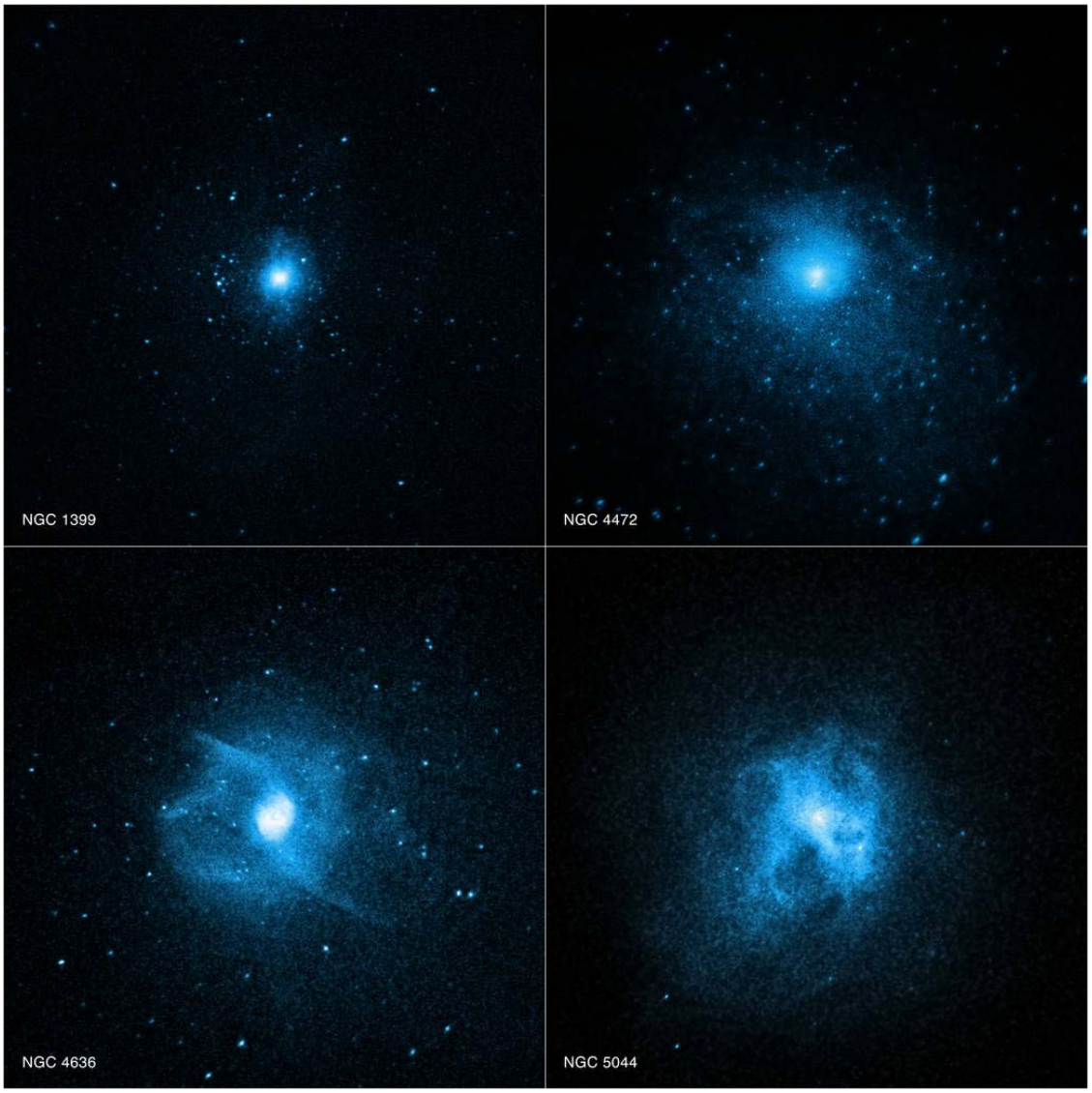
Front Page Image

Giant elliptical galaxies have long been considered self-perpetuating, recycling the dust and cooled gas from burned-out stars in stellar nurseries. But astronomers have recently discovered a class of "red and dead" galaxies, whose remnant gases have not cooled sufficiently to form new stars, or have an abundance of cooled gas that somehow fails to aggregate into new stars.

Astronomers have probed eight giant galaxies through the ESA Herschel space observatory and Chandra X-ray observatory. The front-page image, seen through a foreground of stars from the Milky Way, shows the galaxy NGC 5044, which despite having large amounts of cold gas, remains devoid of new stars.

The image below shows four of the eight galaxies studied. The two above, NGC 1399 and 1472 are largely devoid of cold gas, while the others, NGC 4536 and 5044 have sufficient cold gas, but are unable to create new stars.

Theories to explain these anomalies focus on the active black holes at the center of the galaxies. Evidence is growing that in some cases the black holes appear to be warming the existing cold gases beyond the temperature necessary for star formation, or that the cooling gases are flowing to the center of the galaxies and being exhaled as jets of highly energetic particles. Although plausible, these theories could add new complexity to our concept of the singularity. For more information, go to *http://sci.esa.int/herschel/53732-bullying-black-holes-force-galaxies-to-stay-red-and-dead/; or http://www.nasa.gov/mission_pages/chandra/news/red-and-dead-galaxies.html*



Credits: X-ray: NASA/CXC/Stanford Univ/N.Werner et al; Optical: DSS
Chandra X-ray Observatory images of four elliptical galaxies.

Image Credits

Front page design and graphic calendars: Allan Ostergren

Second Saturday Stars poster: Marc Polansky

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

Page 3 Photos

The only flight-qualified external space shuttle tank arrived in Marina del Rey (California) on May 18th after traveling 5,000 miles (8,000 km) by bar ge from NASA's Michoud Assembly Facility in New Orleans. The External Tank (ET-94) is 28 feet in diameter, 154 feet long and weighs approximately 65,000 pounds.

The tank has since been moved to its final destination (the California Science Center) where it will be displayed with the space shuttle Endeavour. The tank had been built in 2000 for the Columbia shuttle but never flew (it was replaced by a lighter version before it was assigned to a flight).

Construction of the new pavilion showcasing the Endeavour in a launch configuration (vertical), along with the external tank and solid rocket boosters is expected to begin this year and be open to visitors in 2019.

Photos Provided by: Ms. Kyle Cloutier

Second Saturday Stars

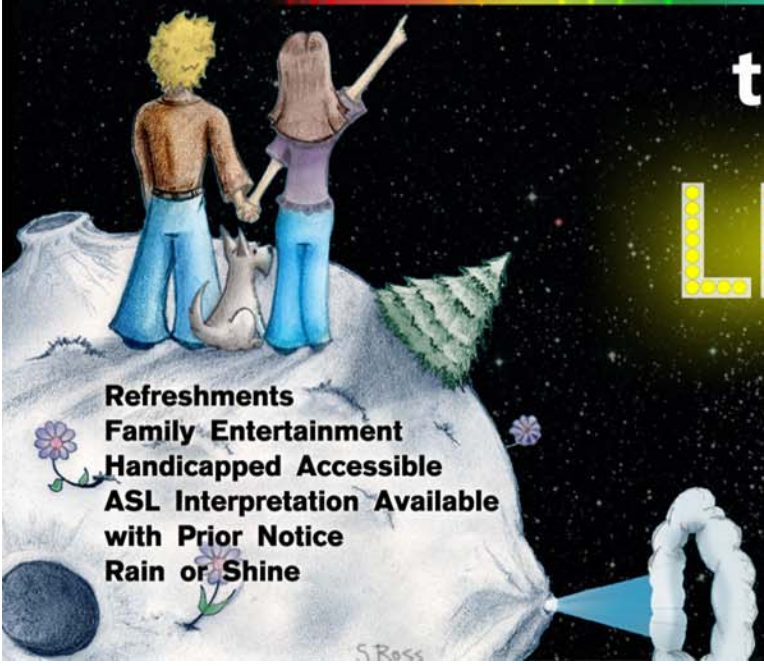
FREE EVENT

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

June 11th
8:00 - 10:00 pm

Spectroscopy:

Exploring the Universe through LIGHT

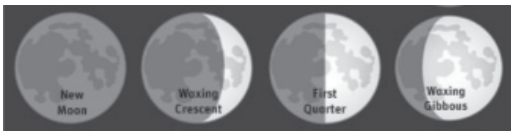
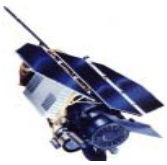
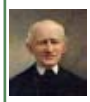
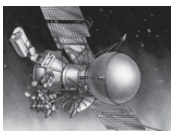
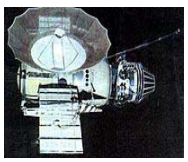


Refreshments
Family Entertainment
Handicapped Accessible
ASL Interpretation Available with Prior Notice
Rain or Shine

Map

June 2016

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Phases of the Moon  June 4 — June 12  June 20 — June 27			1  Launch of ROSAT (Röntgen) X-ray observatory (1990)	2 Full strawberry Moon  Launch of Soviet Venus Orbiter, Venera 15 to map surface of Venus, in tandem with Venera 16 (1983)   Launch of Mars Express spacecraft and ill-fated Beagle 2 lander. (2003)	3  Moon at Perigee (closest to earth) 200-inch Hale Telescope dedication (1948)   Gemini 9 launch, Thomas Stafford, Eugene Cernan. (1966) Launch of Gemini 4; Ed White 1st American to walk in space (1965) 	4  Maiden flight of Space X Falcon 9 rocket (2010)
5  Mercury-Redstone 3, or Freedom 7, first US human spaceflight, on May 5, 1961, piloted by astronaut Alan Shepard (1961)	6  Venera 16 - last of Soviet Venus orbiter/ lander missions to map Venusian landscape (1983)	7  "Three flames ate the sun, and big stars were seen." - etching on Chinese oracle bones indicating ancient solar eclipse, with three coronal streamers and stars visible in the darkened sky. (1302 BC)	8  Giovanni Cassini born, observer of Mars, Jupiter and Saturn (1625)  Launch of Venera 9, - 1st black/white images of surface of Venus (1975)	9 Dedicationof the Kathleen Fischer Sundial at the McCarthy Observatory (2012)  Johann Gottfried Galle, German astronomer, born - first to view planet Neptune, using calculations of Urbain Le Verrier 1846. (1812) 	10  Launch of Explorer 49 - moon orbiter and radio astronomy explorer (1973) Launch of Mars Exploration Rover A Spirit (2003) 	11  Flyby of Venus by Soviet spacecraft Vega 1 on its way to Comet Halley - dropped off lander and a balloon to study middle cloud layers (1985)  2nd Saturday Stars Open House McCarthy Observatory
12  Launch of Venera 4, Soviet Venus lander, first to enter orbit of another planet (1967)	13  Return of sample capsule from the Hayabusa (MUSES-C) spacecraft, taken from near-Earth asteroid Itokawa (2010)	14  Launch of Mariner 5, Venus flyby mission (1967) Launch of Venera 10, Soviet Venus orbiter/ lander (1975)	15  flyby of Venus by Soviet spacecraft Vega 2 on its way to Comet Halley; dropped off lander and a balloon to study middle cloud layers (1985)	16 Moon at Apogee (farthest from earth)   Liu Yang becomes the first Chinese woman in space (2012) Valentina Tereshkova, 1st woman in space (1963) 	17  Discovery of the Dhofar 378 Mars meteorite (2000)	18  Sally Ride, 1st U.S. woman in space (1983) Launch of Lunar Reconnais-sance Orbiter and LCROSS satellite to Moon (2009) 
19  Flyby of Earth by the ill-fated Nozomi spacecraft on its way to Mars (2003)	20  Discovery of Nova 1670 in Vulpeculae by Pere Dom Voiture Anthelme, a Carthusian monk in Dijon, France (1670)	21 Summer Solstice 05:04 UT (1:04 AM EDT)   Yáng Liwei, a Chinese major general, military pilot and a CNSA astronaut; was first man sent into space by the Chinese space program and his mission, Shenzhou 5, made China the third country to independently send people into space (1965)	22  Royal Greenwich Observatory founded (1675) Discovery of Pluto's largest moon Charon by Jim Christy (1978)   Launch of Soviet space station Salyut 5 (1976)	23  Martin John Rees born, British cosmologist and astrophysicist, has contributed to knowlege of the cosmic background radiation, galaxy clustering and formation, and on the final disproof of Steady State theory. (1942)	24 Fred Hoyle born, British astronomer and proponent of nucleosynthesis (1915) Sir William Huggins makes 1st photographic spectrum of a comet (1881)	25 Rupert Wildt born, German astronomer (1905) Hermann Oberth born, father of modern rocketry and space travel (1894)
26 Charles Messier born, famed comet hunter (1730) German astronomer Walter Baade discovers near-earth asteroid 1566 Icarus inside orbit of Mercury, which became the subject of asteroid-busting "project Icarus." (1949) 	27 Alexis Bouvard born,postulated existence of 8th planet, later identified as Neptune (1767) launch of SEASAT 1, first Earth-orbiting satellite designed for remote sensing of oceans (1978) Flyby of the asteroid Mathilde by the NEAR spacecraft (1997) 	28 Nakhla meteor fall in Egypt - A piece of Mars object fabled to have hit dog (1911)	29 George Ellery Hale born, founding father of Mt. Wilson Observatory (1868) Shuttle Atlantis docks with Russian space station Mir to form the largest man-made satellite ever to orbit the Earth - the second time ships from two countries had linked up in space (1995). 	30 Death of 3 cosmonauts in Soyuz 11 when capsule depressurizes in reentry (1971) Tunguska explosion event (1908) Leap second added to world clocks	