Galactic Observer

John J. McCarthy Observatory

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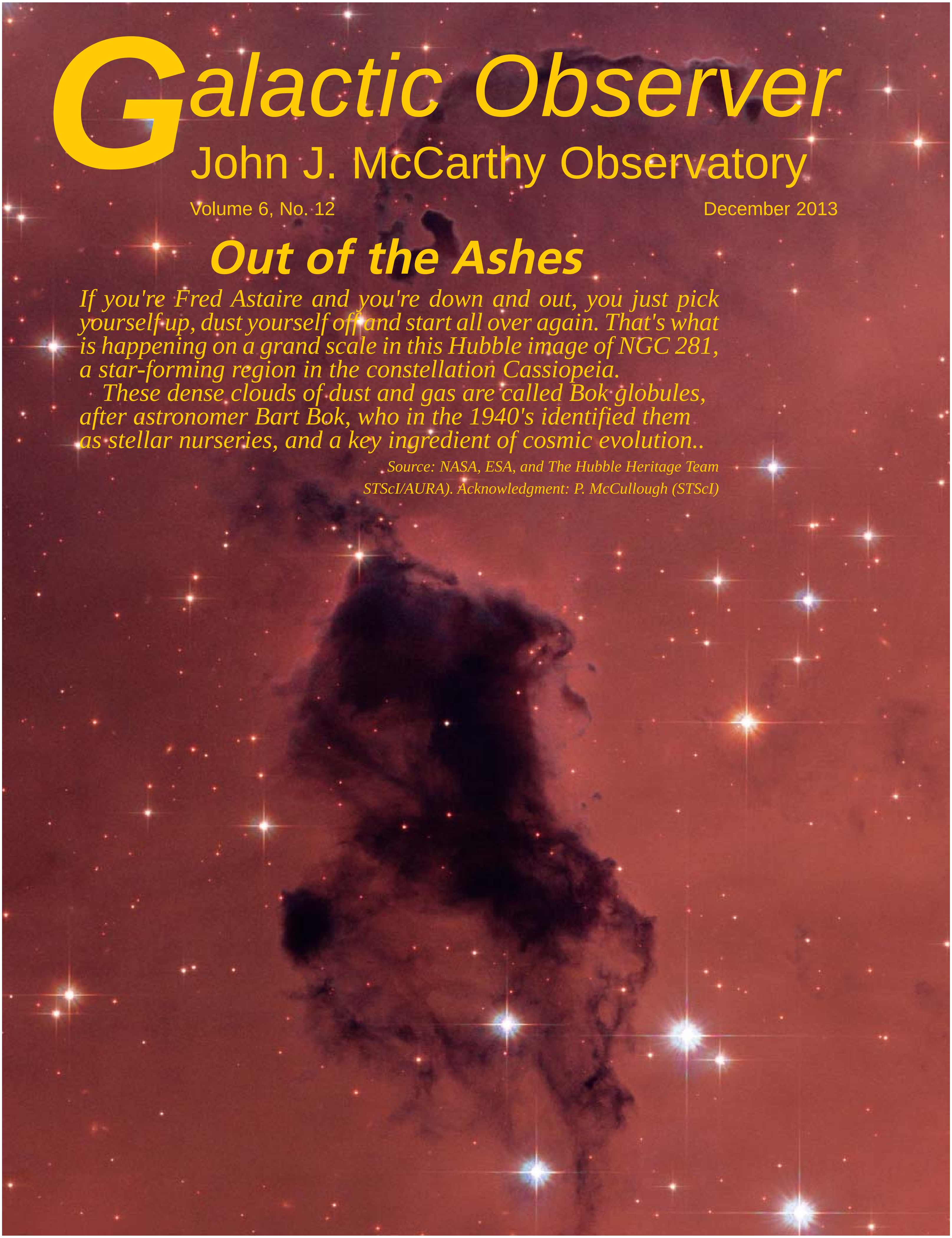
Out of the Ashes

If you're Fred Astaire and you're down and out, you just pick yourself up, dust yourself off and start all over again. That's what is happening on a grand scale in this Hubble image of NGC 281, a star-forming region in the constellation Cassiopeia.

These dense clouds of dust and gas are called Bok globules, after astronomer Bart Bok, who in the 1940's identified them as stellar nurseries, and a key ingredient of cosmic evolution..

Source: NASA, ESA, and The Hubble Heritage Team STScI/AURA). Acknowledgment: P. McCullough (STScI)



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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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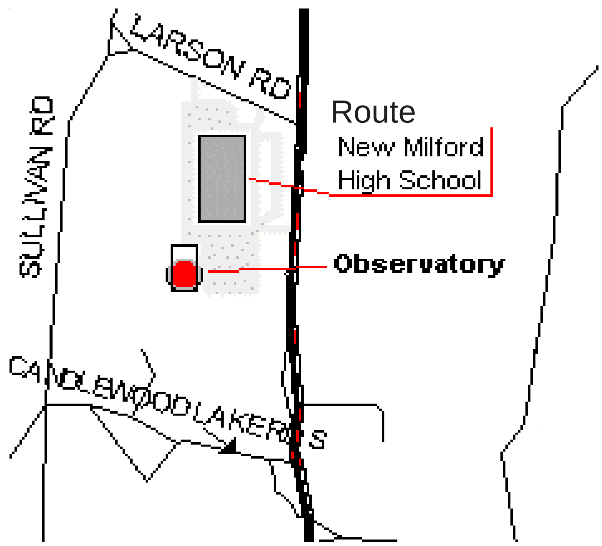

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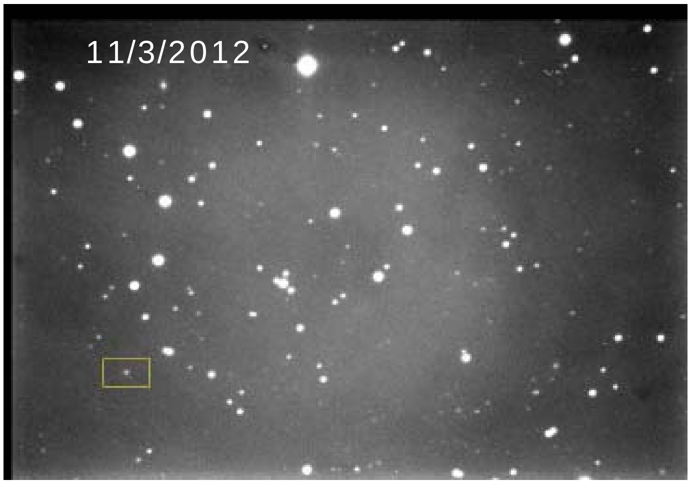
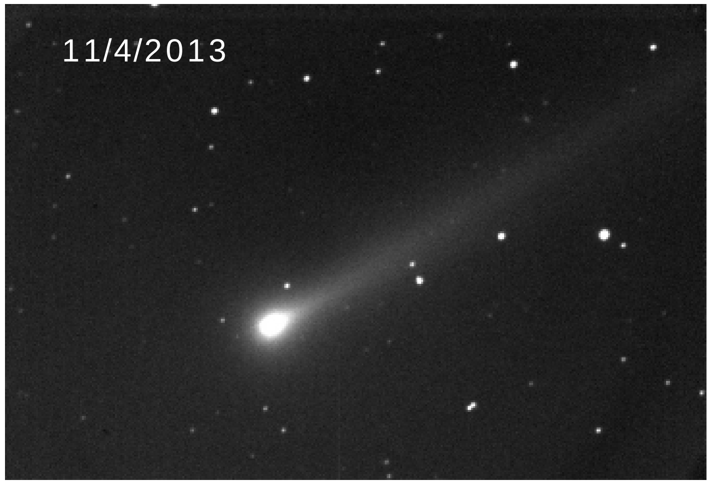




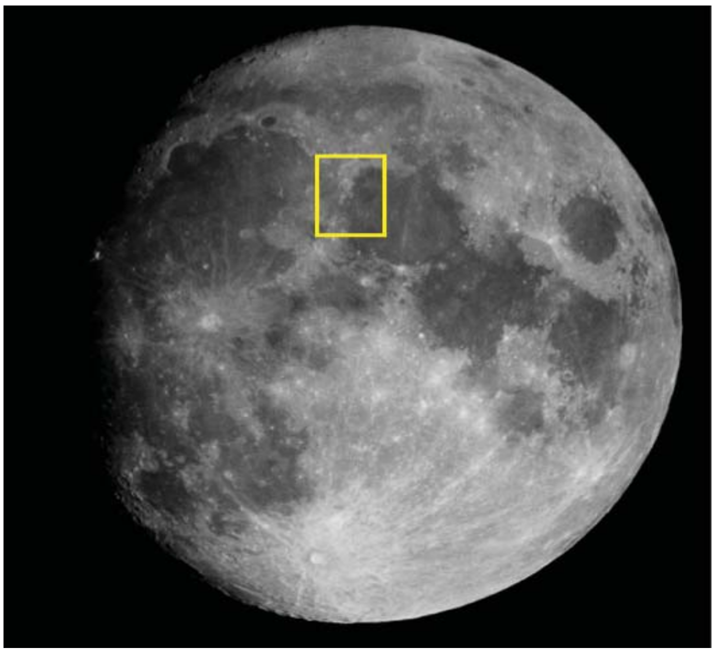
ISON Rolling Along

A series of photos of comet ISON from the McCarthy Observatory as the comet rushes towards its close encounter with the Sun on November 28th. The composite photo at bottom was taken and assembled by Carly KleinStern and Marc Polansky on November 19, 2013. The color image was generated from 12 ten second exposures with red, green, and blue filters, and 24 ten second luminance exposures. At the time the images were taken, the comet was already inside the orbit of Venus. Five days later, the comet crossed the orbit of Mercury.

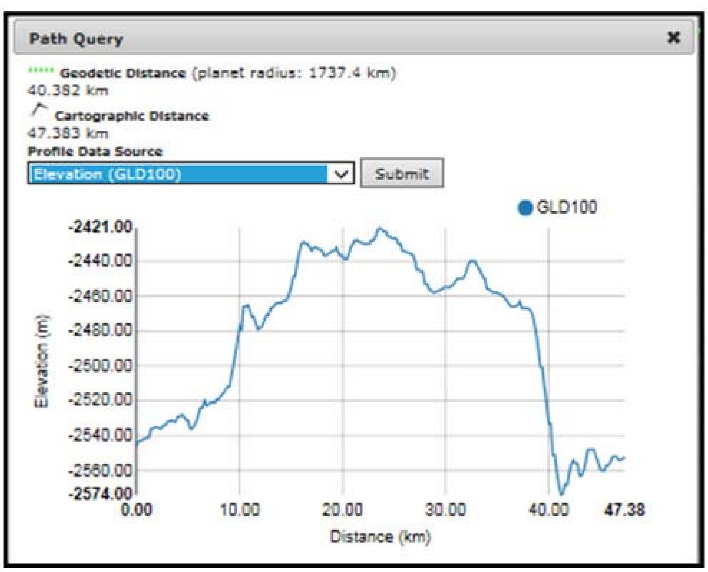
Before it was lost in the glare of the Sun, the comet had brightened sufficiently to be seen with binoculars or a small telescope. Once ISON has rounded the Sun, and if it survives the encounter, the comet should once again be visible in the morning sky. Look for the comet starting around December 1st as it begins to race away from the Sun.

“Out the Window on Your Left”

IT’S BEEN MORE THAN 40 years since we left the last footprint on the dusty lunar surface. Sadly, as a nation founded on exploration and the conquest of new frontiers, we appear to have lost our will to lead as a space-faring nation. But, what if the average citizen had the means to visit our only natural satellite; what would they see out the window of their spacecraft as they entered orbit around the Moon? This column may provide some thoughts to ponder when planning your visit (if only in your imagination).



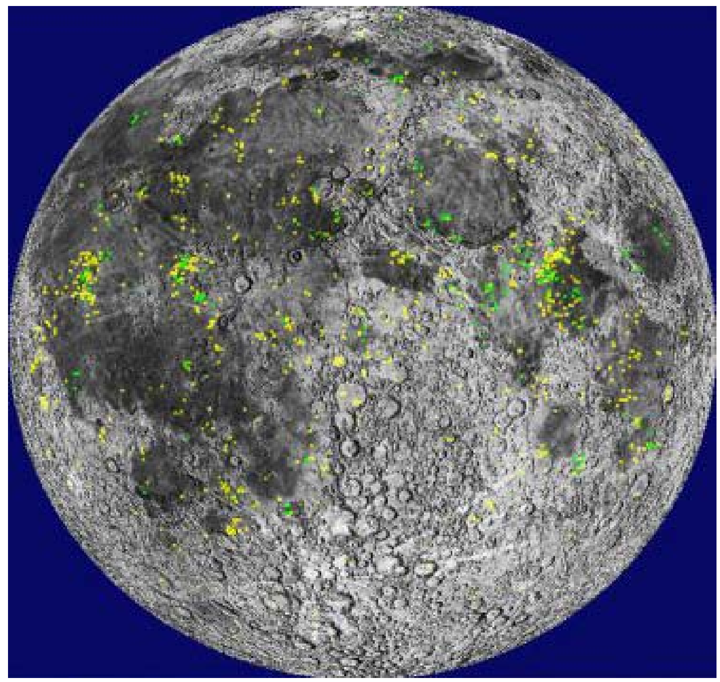
Lunar "seas" and "bays" are actually expansive low-lying plains formed by ancient lava flows



East-West Cross Section of Valentine Dome
LRO/LROC ACT-REACT-QuickMap

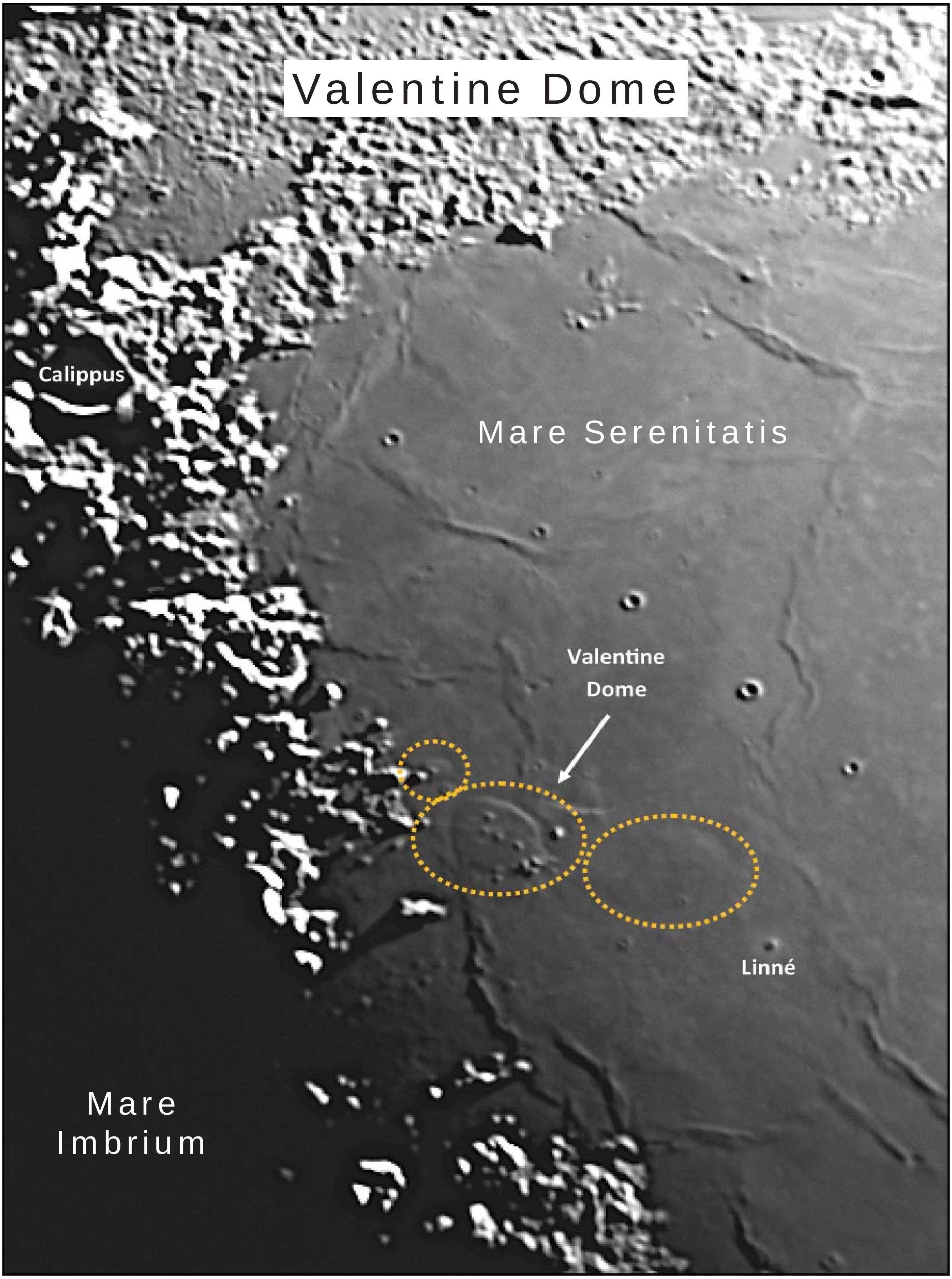
The Valentine Dome is visible in this month’s image. Located on the western shore of Mare Serenitatis (Sea of Serenity), the dome is approximately 19 miles (30 km) in diameter. It rises 425 feet in height (130 m) with a relatively flat top. The east-west cross section of the dome (below right) is based on data from the Lunar Reconnaissance Orbiter. The dome has been classified as an intrusive dome, and was likely formed by magma welling up from below. The mare ridges that appear to intersect at the dome may have also played a role in the dome’s formation.

Two other possible domes are indicated in the image. The smaller dome, visible to the north west, is similar in appearance to the domes found near the Cauchy region in eastern Mare Tranquillitatis. The other possible, and much larger, dome is broader and less distinct, appearing as an uplifted area with gentle, sloping sides.



Lunar domes are small pancake-shaped volcanic-shield volcanoes that form from fast-cooling magma. Source: Lunar Geological Research Group (GLR).

Southeast of the dome region is the crater Linné. Characteristic of a relatively fresh impact, Linné has a bright halo of ejecta that makes this small crater (less than 1½ miles in diameter) easy to spot. The crater is notable in that the 19th century German astronomer Julius Schmidt claimed in 1866 that the crater had disappeared or been obscured, leaving behind only a bright mound. The announcement was “confirmed” by other observers and used to support the argument of an active and still evolving Moon. The crater was subsequently recovered and has been visible ever since.


Valentine Dome
Calippus
Mare Serenitatis
Valentine Dome
Linné
Mare Imbrium

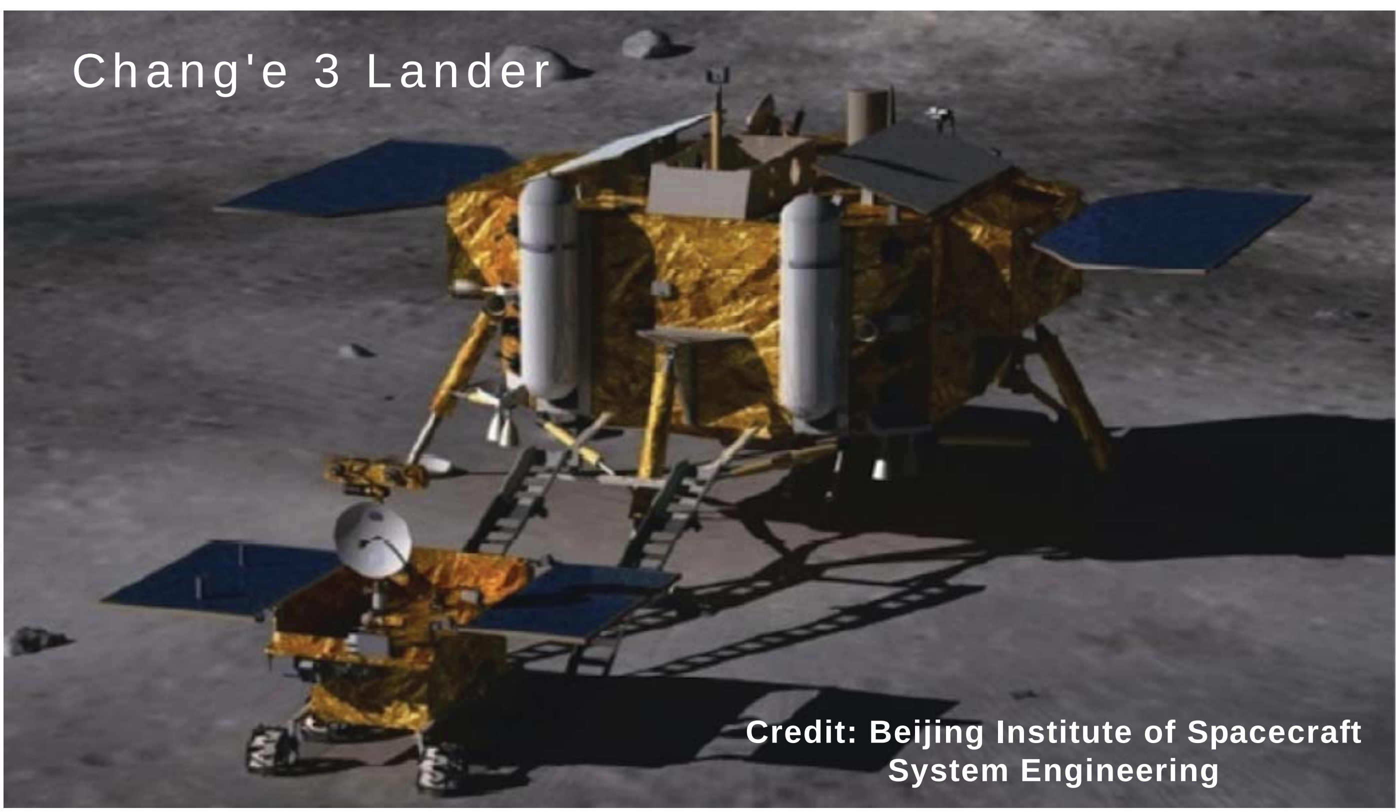
China's Moon Program

A Chinese rover may be driving across the Moon's surface by the end of this year. China's space exploration agency is currently preparing its Chang'e 3 space-

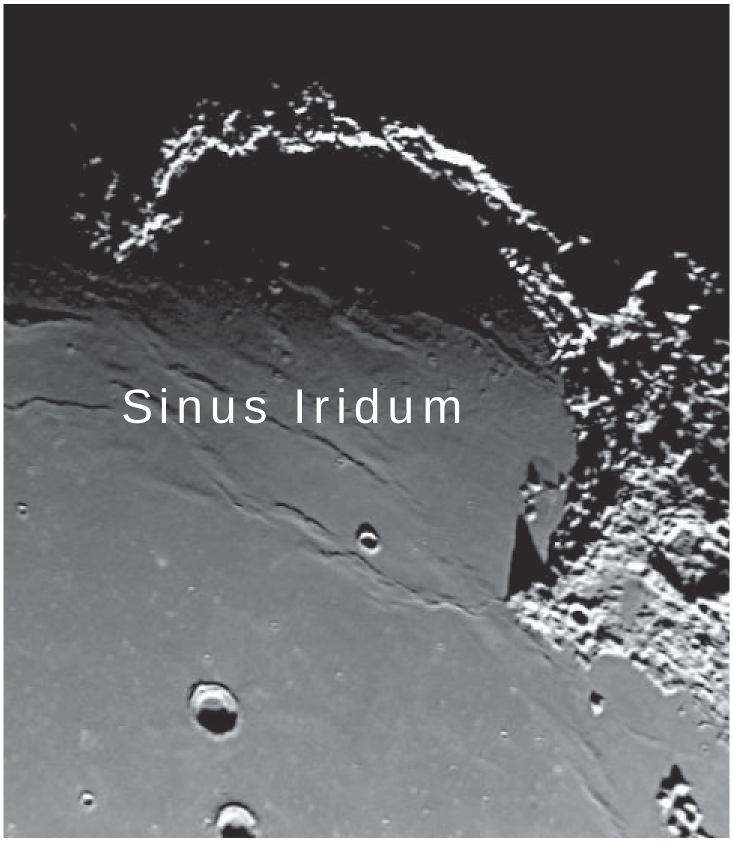
craft for launch from the Xichang Satellite Launch Center in southwest China. Based upon the presumed landing site, and the stated preference to land shortly after sunrise, a launch date in the first week in December is likely.

Chang'e 3 is China's third lunar mission. Chang'e 1 was launched in October 2007. The spacecraft operated for 16 months in lunar orbit, generating a highly-detailed map of the entire surface. Chang'e 2 was launched in October 2010 and was similar in design to Chang'e 1, but with a higher resolution camera. Its mission included low altitude surveys of possible landing sites (for Chang'e 3). After completing its lunar mission, the spacecraft traveled to the Earth-Sun L2 Lagrangian point to test deep space communications. (Lagrangian points are positions in space around two large bodies in orbit around each other where the gravitational fields are in balance, allowing a third, smaller body to remain in position with minimal expenditure of energy. L2 lies beyond Earth's orbit, opposite the Sun and at such a distance that a spacecraft would achieve stasis and follow Earth in its orbit.) In 2012, Chang'e 2 left L2 to rendezvous/flyby the asteroid 4179 Toutatis.

Chang'e 3 will be China's first attempt for a soft landing on the Moon. The spacecraft will be comprised of a service module that will remain in orbit and a landing module. The nuclear powered lander will be equipped with imaging cameras, ground penetrating radar, a near-ultraviolet astronomical telescope, and a small, six-wheeled rover. The 2,600 pound (1,200 kg) lander is expected to operate for 12 lunar months. The solar powered rover has a 90 day design life. The lander and the rover are designed to survive/ operate during the extremely cold lunar nights.



Credit: Beijing Institute of Spacecraft System Engineering



The tentative landing site for Chang'e-3 is Sinus Iridum (Bay of Rainbows), a large, flooded impact crater located on the northwest rim of Mare Imbrium. In addition of collecting and analyzing samples, the rover may be able to determine the depth of the regolith and underlying basaltic lava flows.

The Chinese are also working on a Chang'e 4 spacecraft as a backup to Chang'e 3, and also as a demonstration of autonomous surface navigation techniques. After Chang'e 4, a sample return mission is planned (Chang'e 5), tentatively in 2017. Chang'e 5 would be capable of drilling into the lunar regolith and extracting samples from a depth of 6½ feet (2 meters).

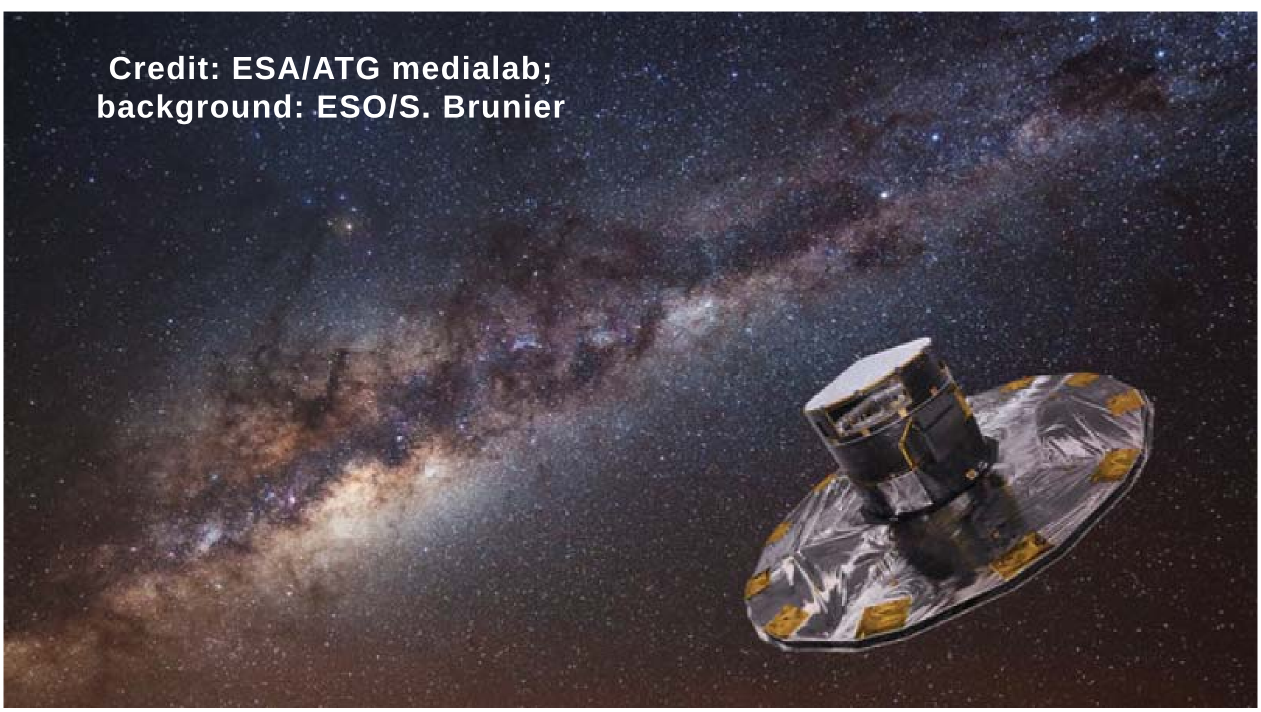
China's robotic lunar exploration program is just part of a more ambitious program of solar system exploration. China expects to have a permanent space station in orbit by 2020, and has long-range plans for manned expeditions to the Moon and Mars.

Gaia

Between 1989 and 1993, the European Space Agency's (ESA) Hipparcos spacecraft catalogued more than 100,000 stars to a high precision, and many more to a lesser precision over its five year mission. In late December, the ESA will launch Gaia, a successor to Hipparcos that will catalogue a thousand million stars with a precision 200 times more accurate than its predecessor. The data collected by Gaia will be used to create a comprehensive, three-dimensional map of our galaxy.

The spacecraft is comprised of two optical telescopes and several science instruments to analyze the light collected. A thirty-three foot (10 meter) sunshade will keep the telescopes in the shade and the instruments cold. The backside (sun side) of the shade is partially covered with solar panels that will generate power for the spacecraft.

Gaia will be launched from the European Spaceport in Kourou, French Guiana. The spacecraft will be positioned at the L2 Lagrangian point.



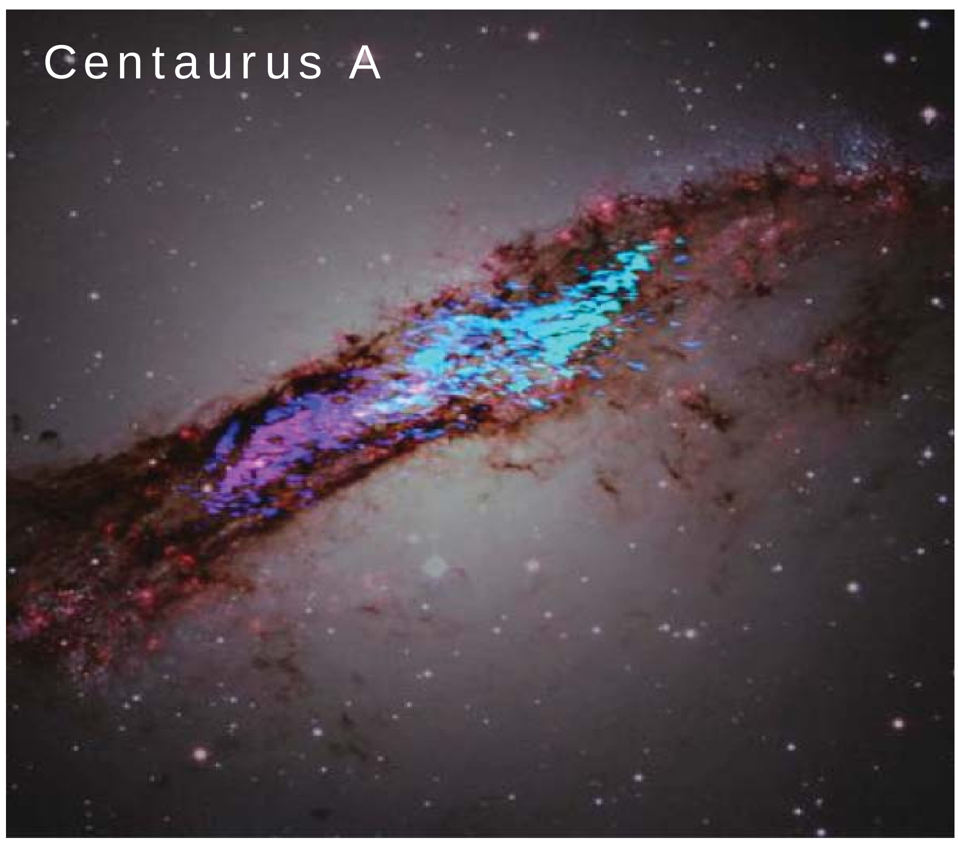
Atacama Large Array

On a desert plateau, 16,400 feet (5,000 meters) above sea level, a state-of-the-art telescope has been constructed that will allow scientists to peer inside clouds of gas and dust just a few degrees above absolute zero and watch the early beginnings of stellar formation.

Credit: ALMA (ESO/NAOJ/NRAO)

The telescope, the Atacama Large Millimeter/submillimeter Array (ALMA), was funded and constructed by an international consortium on Chile's Chajnantor Plateau. The thin, dry atmosphere on the plateau is almost devoid of water vapor, making it an ideal location to observe in the millimeter/submillimeter wavelengths.

The telescope is comprised of 66 dishes: fifty-four 39 foot (12 meter) diameter antennas and twelve 23 foot (7 meter) diameter antennas. The dishes can be rearranged: spread further apart to detect small scale structures such as protostars, embedded with dense gas clouds, orgrouped together to image the large scale structures of galaxies. Data gathered by the 66 dishes is processed and refined by a supercomputer capable of performing 17 quadrillion operations per second.



Centaurus A

Credit: ALMA (ESO/NAOJ/NRAO), T.A. Rector (University of Alaska Anchorage). Visible-light image: ESO

NASA's Deep Space Network Turns 50

The Deep Space Network consists of three deep-space communications facilities. The facilities are currently located in California's Mojave Desert, near Madrid, Spain and near Canberra, Australia. The locations, approximately 120 degrees apart, allow continuous communications with distant spacecraft as the Earth rotates.

The network's first facility, Goldstone in the Mojave Desert, became operational in 1958 and was first used to communicate with the unsuccessful Pioneer 3 spacecraft that failed to achieve escape velocity. It was subsequently used to communicate with Pioneer 4, the first spacecraft to escape Earth's gravity on its way to the Moon (the Pioneer spacecrafts were design to collect trans-lunar radiation data).

On December 24, 1963, Dr. William Pickering, then JPL Director, announced the establishment of the Deep Space Network, coordinating operations at Goldstone with facilities in Woomera, Austrailia and Johannesburg, South Africa. While two out of the three facilities have been relocated, Goldstone remains. The 230 foot (70 meter) diameter antenna at Goldstone is the largest and most sensitive receiver in the network. It is capable of receiving the faint signals from the Voyager 1 spacecraft now almost 12 billion miles (19 billion km) from Earth and at the edge of the solar system.

Ms. Kyle Cloutier stands in front of the newly refurbished 70 meter antenna at Goldstone

Purchasing a Telescope

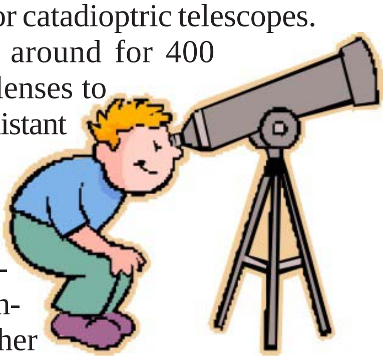
During the holidays it's not uncommon to see parents and grandparents carrying around a telescope that they just picked up at the mall or warehouse store for their budding astronomer. Unfortunately, too many of these thoughtful gifts end up in a basement or attic after one or two uses. All too often, telescope manufacturers prey on consumer's expectations, which are often out of line with the capabilities of the product, resulting in frustration and disillusionment. However, even a crudely constructed telescope can be coaxed to produce acceptable images, if the observer understands the limitations of his or her instrument.

There is no perfect telescope for everyone. An inexpensive, mass-produced telescope that gets carted out of the house and set up every clear night, stimulates the users' imagination and encourages them to push the instrument's capabilities to its limits is far more valuable than the most highly crafted optical masterpiece that spends its nights in a closet.

There are several types of telescopes available to the general consumer. Each has advantages and disadvantages, and with a little education, a consumer can find a telescope that fits his or her needs and lifestyle. Again, if you don't use it, a telescope is about as useful as a garden gnome and not as cute.

Types of Telescopes

There are three basic types of telescopes: refractors, reflectors and compound or catadioptric telescopes.



Refractors have been around for 400 years and use a series of lenses to bring the light rays from distant objects to focus. They are highly regarded for their unobstructed and high-contrast images. The optical tubes are sealed and generally more rugged that other designs. As such, the optics rarely need to be adjusted (realigned) which makes the refractor a good choice as a travel telescope. Refractors are an excellent choice for planetary and lunar viewing and for double stars, but generally do not have the large light gathering capacity needed for faint objects such as nebula and galaxies. The disadvantages of refractors include: the potential for different wavelengths of light to diverge from a common focus as they pass through the glass (producing color "fringing" around bright objects), the position of the eyepiece at the rear of the optical tube (requiring the telescope to be mounted fairly high off the ground for comfortable viewing), the closed tube that can take some time to cool down, and the price (highest cost per inch of aperture of the basic telescopes designs).

Reflectors have been around for almost as long as refractors, but use mirrors instead of lenses to bring light to the observer's eye. A large mirror located at the closed end of the optical tube reflects light back up the tube to a smaller mirror mounted near the open end and out to an eyepiece. Mirrors are much easier and less expensive to manufacture than lenses with only an optical curve required on the front of the mirror. With mirrors, the light never passes through the glass, so there is no divergence of the light rays. However, since the optical tube is open to the atmosphere, mirrors will require periodic cleaning, adjustment and, eventually, recoating. Reflectors offer the best value, particularly for larger apertures.

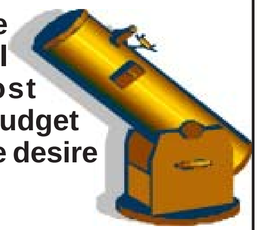
The most popular compound or catadioptric telescopes combine a large, rear spherical mirror with a front corrector lens to create a very compact optical tube. Companies such as Meade and Celestron built their businesses on the Schmidt-Cassegrain design. While generally more expensive than reflectors, the compound telescope offers a very portable alterative for large aperture telescopes. Disadvantages include cool down time (since the optical tubes are sealed), and a relatively large secondary mirror that degrades the image of high contrast objects (planets or the Moon). The front corrector plate is also susceptible to dew formation although this can be managed with a dew shield or corrector plate heater.

There are several terms that are used in the sales promotion of telescopes. Some of the common ones are discussed below:

Aperture

Aperture refers to the size of the largest lens or mirror in the telescope, for example, the primary mirror in an 8-inch reflector is 8-inches in diameter. As a general rule, bigger is better, as light gathering and resolution increase with the size of the optics. However, as with everything else, there are other considerations that limit the practical size of a particular instrument. Alvan Clark & Sons figured the 40-inch lens for the Yerkes Observatory's refractor, delivering the lens in 1897. More than 100 years later, it is still the world's largest working refractor. Why? The weight of the glass and the complexities in supporting a large lens by its edge and the absorption of light passing through the glass were factors; however, the refractor was ultimately done in by Sir Isaac Newton when he built the first reflecting telescope in 1668.

Dobsonian-type telescopes are reflectors on a simple, swivel mount. They offer a low-cost solution for those on a limited budget with aperture fever (an insatiable desire for a larger telescope).



Mirrors, unlike lenses, can be completely supported from the back. Since light does not pass through the glass, reflected images do not suffer from "chromatic aberration." Today single mirrors are routinely produced with diameters exceeding 28 feet and telescopes are constructed combining multiple mirrors to achieve even larger light gathering capabilities. So what size is good for you? Before you answer, you may want to consider:

• Are you planning on setting up your telescope in a permanent installation, e.g., backyard observatory, or will you be moving it in and out of your home every time you plan on observing. If the latter, then weight, portability and ease of set up are important considerations. Due to its size and weight, my telescope saw very little use until I invested in a wheeled platform that allows me to easily roll the fully assembled telescope in and out of my garage in minutes.

• Are you planning on taking your telescope on the road, with you on vacation or planning to travel some distance to find truly dark skies or observe a "once in a lifetime event?" Whether by train, plane or automobile, care must be taken to protect your telescope and ensure that it arrives at its destination in working order (mechanically and optically). If this is important to you, a smaller and simpler design such as a refractor may be a good choice.

• What are you interested in looking at? Spectacular views of the Sun, Moon and planets can be acquired with a relatively modest instrument. However, if your passion is hunting down the more elusive and distant residents of our the Milky Way Galaxy or exploring other galaxies far, far, away, it will require a much larger aperture to capture those meager photons.

Magnification

Magnification is likely the most overrated measure of a telescope's capabilities. Magnification is a function of the eyepiece placed in the path of the incoming light and in front of the observer's eye; the observer can change the magnification by simply selecting a different eyepiece. As such, it shouldn't be a criterion in selecting a telescope.

The limiting useful magnification is approximately 50 times the diameter of the objective lens or primary mirror. For example, a small refracting telescope with a 4-inch objective lens can be pushed to a magnification of 200 times, however, only under the best observing conditions and, in general, only on bright objects such as the Moon and planets. Most astronomers prefer the views that lower magnification provides with a wider field and brighter image. So, the next time you are captured by the stunning views of the universe on the packaging of a modest instrument, remember that the potential of most telescopes is rarely realized, particularly if you reside in the light polluted skies of the northeast. A higher power eyepiece magnifies not only the telescope's intended target but also the side-effects of living under 20 miles of Earth's atmosphere.

Mounts

While generally not at the top of the list as far as features, the telescope's mounting system and construction is key to its ease of use and the stability of the image. A poorly designed mount or one with flimsy construction can be just as frustrating to deal with as poor optics. An altitude-azimuth or alt-az mount is the simplest type of telescope mount and generally the easiest to set up. In thisarrangement, the mount allows the telescope to move left and right while pivoting up and down. It is commonly found on Dobsonian-type telescopes, is user friendly and can be mechanized to track celestial objects across the sky.

Another common mount design is the equatorial mount. In this design, one axis is aligned with the celestial pole, requiring only the movement around this axis to follow objects across the sky. It is the easiest configuration for tracking and is generally preferred for astrophotography. Some alt-az mounts can be converted to an equatorial configuration with the addition of an "equatorial wedge." Equatorial mounts, however, can be heavier than their alt-az counterparts.

Go-To

Essentially, a computer controlled pointing system, "go-to" systems, allows the user to select an object from a data base and command the drive motors on the mount to move the telescope to the object's location in the sky. This presupposes that the telescope user has properly set up the telescope and successfully navigated through the alignment process (a process by which the telescope's computer determines where it's pointed, the local time, and its position on the Earth). Most "go-to" telescopes come with a large database, some of which can be modified (supplemented) by the user. While "go-to" capability is extremely convenient and can take you to thousands of objects in its database in a blink of an eye, it doesn't necessarily mean that you will be able to see the object. Depending upon the size of your telescope (see Aperture), many objects in these databases are just too dim to see with the equipment provided. CCD cameras are much more sensitive than your eye and can accumulate light for long durations. So, if you are planning on using your telescope primarily as a camera lens, then some of the disadvantage of a small aperture can be overcome. However, if you plan on doing most of your observing at the eyepiece, you may want to consider spending the money on a larger aperture rather than on "go-to" electronics.

What to Do

If you are seriously considering acquiring a telescope, a little bit of research can go a long way in enjoying your final purchase. If possible, try to observe through the telescope(s) that you are considering. The McCarthy Observatory has a monthly open house. When the skies are clear, up to a dozen telescopes can be found on the premises (including refractors, reflectors, a Dobsonian, and several Schmidt-Cassegrains). Compare the same celestial objects through different scopes, talk to the owners about portability, ease of setup and operation. Check out product reviews in trade magazines such as *Sky and Telescope* and *Astronomy* and on their websites. Contact reputable dealers and visit trade shows such as the Northeast Astronomical Forum where you can pick the brains of industry experts.

Life Cycle of Stars

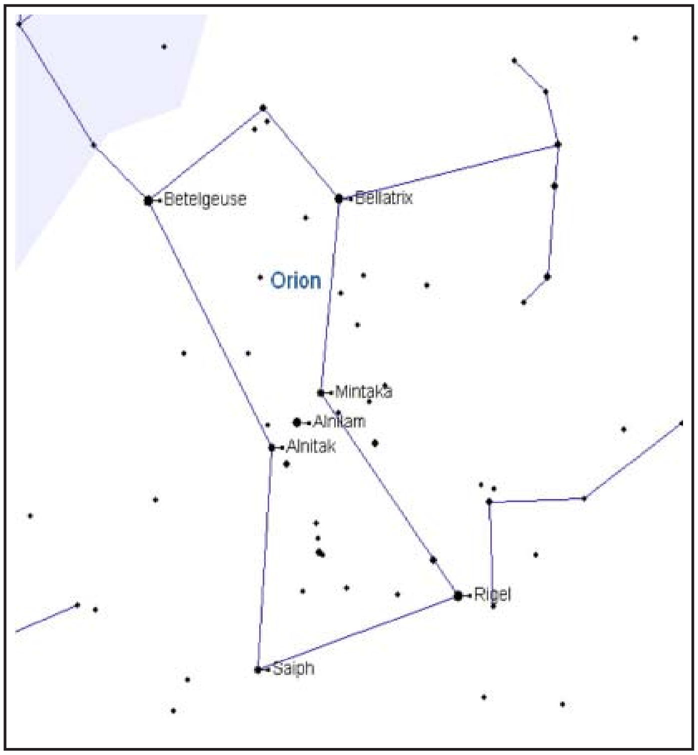
"You know Orion always comes up sideways.
Throwing a leg up over our fence of mountains,
And rising on his hands, he looks in on me
Busy outdoors by lantern-light with something
I should have done by daylight…"

The excerpt is from the poem "Star Splitter" by the American poet and insightful observer of the night sky, Robert Frost. As Frost so eloquently describes, the rotation of the Earth gives the appearance of Orion climbing over its edge (the horizon) to take its place in the night sky.

One of the largest and most prominent constellations in the winter sky, the stars and other celestial objects located within Orion's boundary provide a visual history of the life cycle of a star, from birth to death. The asterism comprising the body of the mythological hunter forms an hourglass pattern. Betelgeuse and Bellatrix mark the location of the shoulders. The three bright stars Alnitak, Alnilam and Mintaka (from east to west) form the belt or waist of the giant. Saiph and Rigel identify the knees or legs. Hanging from the belt stars is Orion's sword, marked by three faint "stars."

The middle "star" in the sword is actually the Great Orion Nebula (M42). This expansive cloud of gas, comprised primarily of hydrogen and helium, is an active star-forming region approximately 1,350 light years distant. So large is the cloud that light (moving at 186,000 miles each second) takes over 25 years to travel from one side of the cloud to the opposite side. The cloud glows from the energy emitted by the newly formed stars created within the cloud. The four brightest stars embedded within the cloud are known as the Trapezium and can be easily seen through a small telescope. The stars are estimated to be less than 1 million years old, extremely young as compared to the 5 billion years our Sun has been shining.

The eastern shoulder of Orion is marked by the red giant Betelgeuse (Alpha Orionis). Betelgeuse is the 10th brightest star in the sky and 640 light years distant. It is the largest star located within



Starry Night Deluxe

1,000 light years of our Sun and has a diameter 600 times our Sun. Its tenuous atmosphere would extend out to the orbit of the planet Jupiter if Betelgeuse was placed in the center of our solar system.

Betelgeuse exemplifies the beginning of the end of a star's life. The hydrogen in the core has been expended (converted into helium) and nuclear fusion has essentially stopped. Gravity is forcing the helium core to contract and the temperature within the core to rise. The higher temperature is causing hydrogen outside the core to fuse faster and the outer layers of the star to expand. As the surface (photosphere) distends, the temperature drops. Betelgeuse's ruddy orange appearance is due to its relatively low surface temperature of 3,650 K, as compared to our Sun's temperature of 5,800 K.

Opposite Betelgeuse and marking the western knee of the hunter is the star Rigel (Beta Orionis). This blue-white giant is the 6th brightest star in the sky, even at a distance of 770 light years. One of the most luminous stars in the night sky, Rigel is 85,000 times brighter than our Sun. Only its vast distance prevents it from outshining any other star in the sky. Its massive size (17 times more massive and 78 times the size of our Sun), consumes hydrogen at a rapid pace. As such, Rigel's demise will come quickly and violently.

The Orion constellation contains a myriad of deep sky objects, including nebulas and multiple star systems. Several multiple star systems are located south of the Orion Nebula, including Iota Orion, Struve 747 and Struve 745. There are also many areas of nebulosity. M43 is a detached portion of the Great Orion Nebula (M42), and is located just north of the main cloud. M78 is a bright diffuse nebula located 2½° northeast of Alnitak. The star Alnitak illuminates the nebula IC 434 and within it, the most famous dark cloud, the Horsehead Nebula (photo above right).

Orion is also a great celestial signpost. Many of the brightest stars of the winter sky can be located by using the sight lines formed by Orion's brightest stars. Approximately 30° east from Bellatrix and Betelgeuse lays Procyon the brightest star in Canis Minor, Orion's smaller hunting dog. Sirius, the brightest star in the sky, can be found by extending a line from the belt stars 20° to the southeast. Only 8 light years away, Sirius is also the brightest star in Canis Major, Orion's larger hunting dog. Approximately 20° to the northwest of the belt stars is the star Aldebaran, a red giant star and one of the "eyes" of the bull, Taurus. Beyond Aldebaran is the open star cluster, the Pleiades. Extending a line approximately 45° from the middle belt star Alnilam north between the stars Bellatrix and Betelgeuse is the star Capella, the brightest star in the constella-

tion Auriga. The western most belt star Mintaka and the star marking the eastern shoulder, Betelgeuse, point north-east to the Gemini twins Castor and Pollux, approximately 40° distant.

December History

1968 was a year of turmoil. The United States was entangled in a war that even the Secretary of Defense concluded could not be won and he resigned from office. The My Lai massacre was one of many atrocities of the Vietnam War perpetrated by both sides during this year. Major U.S. cities were the target of race riots and anti-war protests. Chicago police violently clashed with protesters at the Democratic National Convention and civil rights leader Martin Luther King and presidential candidate Robert Kennedy were assassinated in 1968. To many Americans, the only heartening event in this otherwise horrific year was the reading from the Book of Genesis by the crew of Apollo 8 as they orbited the Moon on Christmas Eve.

The race to beat the Soviets to the Moon took a dramatic turn in 1968 and saw the United States take its first lead by year's end. Apollo 7 was launched in October 1968 into Earth orbit. A week or so later, the Soviets launched two Soyuz space craft into Earth orbit (one manned and one unmanned for a planned rendezvous). In November, another unmanned Zond flew around the Moon and photographed the previously unseen far side. The United States expected that the Soviets would attempt another moon shot in early December when the launch window for the Baikonur space center in Kazakhstan reopened (a Zond stood poised on the launching pad). Curiously, the opportunity passed without any activity. Cosmonaut Alexei Leonov would later attribute the Soviet's loss of initiative and resolve to the premature death of Sergei Korolev, the "Chief Designer" of the Soviet space program as well as the design complexities of their Moon rocket (the N1).

While Apollo 7 had been a successful maiden voyage of the completely redesigned command module (after the Apollo 1 fire), the United States had yet to leave Earth orbit. NASA's original plan was to launch a series of increasingly complex missions to near-Earth orbit before attempting a lunar excursion. Development of the lunar lander was behind schedule and violent vibrations in the Saturn rocket's main stage needed to be corrected before NASA felt confident of sending men to the Moon. However, the apparent progress by the Soviets threatened to upstage the United States once again. It was a proposal by a quiet engineering genius, George Low, (Manager of the Apollo Spacecraft Program Office) to send the Apollo 8 command module alone into lunar orbit that would ultimately place the United States in a position to achieve President Kennedy's goal to land a man on the Moon and safely return him to Earth by the end of the decade.

Apollo 8 was launched on December 21st under the command of Frank Borman with astronauts William Anders and Jim Lovell (Lovell replaced Michael Collins on the original team; Collins, who required back surgery, would go on to be the Command Module Pilot for Apollo 11). The launch was scheduled so that the crew would arrive at the Moon as the Sun was rising on the Sea of Tranquility. With the Sun low in the sky, the astronauts could photograph potential landing sites and resolve surface detail that would otherwise be washed out in the glare from a higher Sun.

The crew of Apollo 8 was the first to ride the three stage Saturn V rocket, with the explosive energy of an atomic bomb (the Saturn V had only been launched twice before – both unmanned). The night before the launch, the astronauts were visited by Charles Lindbergh. During the visit, it was discussed that the engines on the Saturn V would burn 10 times the amount of fuel every second that Lindbergh had used to fly nonstop from New York to Paris.

The Apollo 8 astronauts were also the first humans to leave Earth orbit and pass through the Van Allen radiation belts that extend up to 15,000 miles from Earth. To accomplish the mission, Apollo 8 had to cross the 240,000 mile void between the Earth and the Moon with sufficient precision so as to intercept the Moon (traveling at 2,300 miles an hour through space) just 69 miles above the lunar surface. By successfully doing so, the astronauts were the first humans to witness the rising of the Earth above the Moon's horizon (Earthrise). They would also be the first to return to Earth and reenter the atmosphere at a speed of 25,000 miles an hour.

The highlight of the mission, to many, was the broadcast from the Apollo 8 command module during the ninth orbit of the Moon. After a brief introduction of the crew and their general impressions of the lunar landscape, William Anders said that the crew had a message for all those on Earth. The astronauts took turns reading from the book of Genesis, the story of creation. Frank Borman closed the broadcast with: "And from the crew of Apollo 8, we close with: Good night, Good luck, a Merry Christmas, and God bless all of you, all you on the good Earth." It is estimated that a quarter of Earth's population saw the Christmas Eve transmission.

In order to safely return to Earth, the main engine had to be restarted on the far side of the Moon (out of contact with the Earth). If successful, Apollo 8 would reappear from behind the Moon at a predetermined time. As predicted, the spacecraft re-emerged on time and when voice contact was regained, astronaut Jim Lovell would announce “Please be informed, there is a Santa Claus.” It was Christmas Day. Apollo 8 would return safely to the Earth two days later, splashing down in the Pacific Ocean shortly before sunrise. The astronauts and the capsule were recovered by the aircraft carrier USS Yorktown.

Jupiter and its Moons

Jupiter reaches Opposition on December 2nd and is well placed in the evening sky throughout the month. As one of the brightest star-like objects in the night sky, Jupiter can be found in the constellation Taurus.

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 left shows the shadow of Ganymede on the Jovian disk. On nights of good visibility the following events should be visible through a moderately-sized telescope (between approximately 7 pm and midnight).

Date	Transit Time	Date	Transit Time
2nd	8:30 pm	9th	9:15 pm
4th	10:07 pm	10th	5:06 pm
5th	5:59 pm	11th	10:53 pm
6th	11:45 pm	12th	6:44 pm
7th	7:37 pm	14th	8:22 pm
16th	10:00 pm	23rd	10:45 pm
17th	5:51 pm	26th	8:15 pm
18th	11:38 pm	28th	9:53 pm
19th	7:29 pm	30th	11:31 pm
21st	9:07 pm		

Transit of Jupiter's Red Spot

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

Date	Transit Time	Date	Transit Time
1st	10:46 pm	18th	9:45 pm
4th	8:15 pm	21st	7:14 pm
6th	9:53 pm	23rd	8:52 pm
9th	7:22 pm	25rd	10:30 pm
11th	9:00 pm	28th	7:59 pm
13th	10:38 pm	30th	9:37 pm
16th	8:07 pm		

December Nights

Nights in December are not to be missed. While the often frigid and turbulent atmosphere can be frustrating for astronomers, the reflection of shimmering starlight (or moonlight) off a snow covered landscape can be truly magical. The bright stars of the winter sky glow with color from orange to yellow to brilliant blue-white. A star-filled sky in December is unsurpassed in grandeur.

Sunrise and Sunset

Sun	Sunrise	Sunset
December 1st (EST)	07:01	16:24
December 15th	07:13	16:24
December 31st	07:20	16:33

Astronomical and Historical Events

1st Flyby of Saturn's largest moon *Titan* by the Cassini spacecraft
1st History: launch of Soviet satellite Sputnik 6 and two dogs: Pchelka and Mushka (1960)
2nd New Moon
2nd History: dedication of the John J. McCarthy Observatory in New Milford, CT (2000)
2nd History: launch of SOHO solar observatory (1995)
2nd History: touchdown of Soviet Mars lander: communications were lost with Mars 3, the first spacecraft to touch down on the Red Planet, after 20 seconds, possibly due to raging dust storm (1971)
2nd History: launch of space shuttle Endeavour (STS-61), first servicing of the Hubble Space Telescope, including the installation of corrective optics and new solar panels (1993)
2nd History: Pioneer 11 spacecraft makes its closest approach to Jupiter; encounter redirects the spacecraft to Saturn and an escape trajectory out of the solar system (1974)
3rd History: Pioneer 10 spacecraft makes its closest approach to Jupiter; first space probe to fly through the asteroid belt and to an outer planet (1973)
3rd History: discovery of Jupiter's moon *Himalia* by Charles Perrine (1904)
4th Moon at perigee (closest distance from Earth)
4th History: launch of space shuttle Endeavour (STS-88), first International Space Station construction flight, including the mating of the Unity and Zarya modules (1998)
4th History: launch of the Pathfinder spacecraft to Mars (1996)
4th History: Pioneer Venus 1 enters orbit, first of two orbiters (and probes) to conduct a comprehensive investigation of the atmosphere of Venus (1978)
4th History: launch of Gemini 7 with astronauts Frank Borman and Jim Lovell (1965)
4th History: launch of the Little Joe 2 rocket, test flight for the Mercury capsule and first U.S. animal flight with Sam, a Rhesus monkey (1959)
5th Kuiper Belt Object 84922 (2003 VS2) at Opposition (35.572 AU)
7th History: arrival of the Galileo space probe at Jupiter (1995)
7th History: launch of Apollo 17 with astronauts Ronald Evans, Harrison Schmitt (first scientist – geologist) and Eugene Cernan (last man on the Moon – so far) (1972)
8th Kuiper Belt Object 2004 XR190 at Opposition (56.666 AU)
8th History: a Dragon spacecraft, launched by SpaceX into low-Earth orbit, is recovered in the Pacific Ocean: first time a spacecraft recovered by a commercial company (2010)
8th History: discovery of asteroid *5 Astraea* by Karl Hencke (1845)
9th First Quarter Moon
9th Kuiper Belt Object 19521 Chaos at Opposition (40.542 AU)
9th History: Pioneer Venus 2 enters orbit, second of two orbiters (and probes) to conduct a comprehensive investigation of the atmosphere of Venus (1978)
9th History: Ausson meteorite fall, hits building in France (1858)
10th History: launch of the X-ray Multi-Mirror Mission (XMM-Newton), the largest scientific satellite built in Europe and one of the most powerful (1999)
10th History: Mihonoseki meteorite fall; through roof of a house in Japan (1992)
10th History: Claxton meteorite fall; hits mailbox (1984)
10th History: St. Louis meteorite fall, hits an automobile (1950)
12th History: launch of Oscar, first amateur satellite (1961)
13th Geminids Meteor Shower peak
13th History: Mt. Wilson's 100-inch telescope used to measure the first stellar diameter (Betelgeuse); measured by Francis Pease and Albert Michelson (1920)
13th History: First light of Mt. Wilson's 60-inch telescope (1908)
14th Second Saturday Stars - Open House at the McCarthy Observatory (7:00 pm)

Astronomical and Historical Events (continued)

14th Scheduled launch of the Cygnus cargo spacecraft on an Orbital Sciences' Antares rocket to the International Space Station from Wallops Island, Virginia
14th History: flyby of Venus by Mariner 2; first spacecraft to execute a successful encounter with another planet, finding cool cloud layers and an extremely hot surface (1962)
14th History: flyby of Mars by Japan's Nozomi spacecraft after an attempt to achieve orbit fails (2003)
14th History: Weston meteorite fall: first documented fall in the United States (1807)
14th History: birth of Tycho Brahe, Danish astronomer noted for his observational skills, the precision of his observations, and the instruments he developed; builder of Uraniburg, the finest observatory in Europe (1546)
15th History: launch of Soviet spacecraft, Vega 1 to Venus and then to Comet Halley (1984)
15th History: landing of Soviet spacecraft Venera 7 on the surface of Venus (1970)
15th History: discovery of Saturn's moon *Janus* by Audouin Dollfus (1966)
15th History: launch of Gemini 6 with astronauts Walter Schirra and Thomas Stafford (1965)
16th History: launch of Pioneer 6, the first of four identical solar orbiting, spin-stabilized spacecraft (1965)
17th Full Moon (Full Cold Moon)
17th History: Project Mercury publicly announced (1958)
17th History: Wright Brothers' first airplane flight, Kitty Hawk, N.C. (1903)
19th Moon at apogee (furthest distance from Earth)
19th History: launch of space shuttle Discovery (STS-103), third servicing of the Hubble space telescope including the installation of new gyroscopes and computer (1999)
19th History: launch of Mercury-Redstone 1A; first successful flight and qualification of the spacecraft and booster (1960)
19th History: Benares meteorite fall hits house in India (1798)
20th Scheduled launch of the Gaia spacecraft from French Guiana to survey more than one billion stars in an effort to chart the chart the evolution of the Milky Way galaxy
21st Winter Solstice at 17:11 UT (12:11 pm EST)
21st History: launch of the Soviet spacecraft Vega 2 to Venus, continued on to Comet Halley (1984)
21st History: landing of Soviet spacecraft Venera 12 on the surface of Venus, found evidence of thunder and lightning in the atmosphere (1978)
21st History: launch of Apollo 8 with astronauts Frank Borman, Jim Lovell and William Anders, first to circumnavigate the Moon (1968)
21st History: launch of Luna 13, Soviet moon lander (1966)
22nd Ursids Meteor Shower peak
22nd Comet C/2013 R1 (Lovejoy) at Perihelion – closest approach to the Sun (0.812 AU)
22nd Discovery of the Mars meteorite LEW 88516 (1988)
23rd History: discovery of Saturn's moon *Rhea* by Giovanni Cassini (1672)
24th History: meteorite fall in the village of Barwell (Leicestershire, England) showers village and hits automobile (1965)
24th History: Deep Space Network created (1963)
24th History: Jean-Louis Pons born into a poor family with only basic education, took post at observatory at Marseilles as concierge, went on to become most successful discover of comets (discovered or co-discovered 37 comets, 26 bear his name) (1761)
24th History: inaugural launch of the Arianne rocket, Europe's attempt to develop a cost-effective launcher to serve the commercial market (1979)
25th Last Quarter Moon
25th History: Mars Express spacecraft enters orbit around Mars (2003)
25th History: landing of Soviet spacecraft Venera 11 on Venus, second of two identical spacecraft (1978)
25th History: launch of Soviet Salyut 4 space station (1974)
27th Comet C/2012 S1 (ISON) closest approach to Earth (0.429 AU)

Astronomical and Historical Events (continued)

27th History: discovery of the ALH84001 Martian meteorite in the Allan Hills, Far Western Icefield, Antarctica, made famous by the announcement of the discovery of evidence for primitive Martian bacterial life (1984)
27th History: Johannes Kepler born, German mathematician and astronomer who postulated that the Earth and planets travel about the sun in elliptical orbits, developed three fundamental laws of planetary motion (1571)
30th History: flyby of Jupiter by Cassini spacecraft on mission to Saturn (2000)
30th History: discovery of Uranus' moon *Puck* by Stephen Synnott (1985)
31st History: GRAIL-A, lunar gravity mapping spacecraft enters orbit (2011)

References on Distances

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

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

International Space Station/Space Shuttle/Iridium Satellites

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

Solar Activity

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

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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

December 14th

7:00 - 9:00 pm

NASA Spin Offs

ENRICHED BABY FOOD

ANTI-CORROSION COATINGS

LEDs

GPS

MULTIVITAMINS

SATELLITE MAPS

FREEZE DRYING

COCHLEAR IMPLANTS

UAVs

INVISIBLE BRACES

INFRARED THERMOMETERS

SATELLITE TV

CORDLESS TOOLS

CELL PHONE CAMERAS

SCRATCH RESISTANT LENSES

VIDEO GAME JOYSTICKS

UV SUNGLASSES

WATER PURIFICATION

DRY ELECTRODES

MODERN INSULATION

CAT SCANNERS

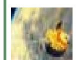
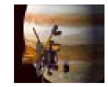
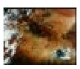
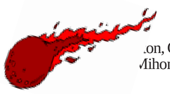
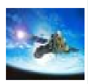
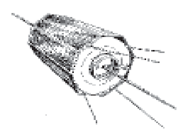
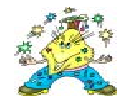
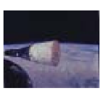
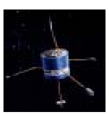
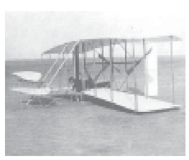
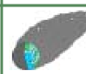
POWDERED LUBRICANTS

Refreshments
Family Entertainment
Activity Center
Stars & Planets
Rain or shine

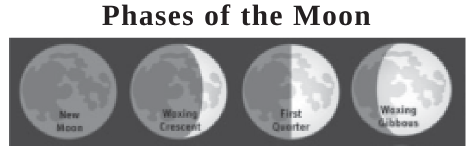
Map

December 2013

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1  Launch of Soviet satellite Sputnik 6 with two dogs, Pchelak and Mushka (1960)	2 Jupiter at Opposition (rising at sunset and visible all night)   Launch of SOHO solar observatory (1995) Space Shuttle Endeavour first Hubble servicing mission (1993) Dedication of John J. McCarthy Observatory in New Milford, CT - 2000 	3 Flyby of Jupiter by Pioneer spaccraft 1973   Discovery of Jupiter moon Himalia by Charles Perrine 1904	4 Moon at perigee (closest distance to Earth)   Gemini 7 launch - Borman/Lovell (1965) Launch of Pathfinder spacecraft to Mars - 1996   Pioneer orbits Venus to study atmosphere (1978) Launch of Little Joe 2 rocket, test flight for the Mercury capsule with Sam, a Rhesus monkey (1959) 	5  Discovery of Kepler-22b, by NASA's Kepler Space Telescope in the constellation of Cygnus - the first known transiting planet to orbit within the habitable zone of a Sun-like star (2011)	6  America's first attempt at putting a satellite into orbit failed as Vanguard TV3 rose only about four feet off a Cape Canaveral launch pad before crashing back down and exploding (1957)	7  Gerard Kuiper born - proposed belt of minor planetary objects beyond Neptune (1905) Arrival of Galileo space probe at Jupiter 1995   Apollo 17 (Evans, Schmitt, Cernan) 1972
8 Discovery of asteroid 5 Astraea by Karl Hencke (1845)   Galileo spacecraft 1st Earth flyby (1990) SpaceX Dragon, launched into low-Earth orbit, is recovered in the Pacific Ocean: first by a commercial company (2010) 	9  Pioneer Venus 2 in orbit, 2nd to study planet's atmosphere (1978) Ausson meteorite fall, hits building in France (1858)   Asteroid 2011 WU4 Near-Earth Flyby (0.084 AU)	10 St Louis meteorite, hits automobile (1950) on, GA, hits mailbox (1984) Mihonoseki, Japan, hits house (1992) Launch of XMM-Newton European X- Ray satellite (1999) 	11  Challenger, the Lunar Lander for Apollo 17, touched down on the Moon's surface with astronauts Harrison Schmitt and Eugene Cernan - last two men to walk on moon (1972)	12 Launch of Oscar, first amateur satellite (1961) 	13  Asteroid 4179 Toutatis near-Earth flyby (0.046 AU)  Geminids meteor shower peak	14 Weston, CT Meteorite, first documented U.S. strike (1807)   Tycho Brahe born, 1546 - Danish astronomer  2nd Saturday Stars New Milford High School
15  Discovery of Saturn moon Janus by Audouin Dollfus (1966) Soviet Venus missions: landing of Venera 7 on the surface of Venus (1970); Vega 1 to Venus and Comet Halley (1984);  Gemini 6 launch (Schirra, Stafford) 1965 	16 Launch of Pioneer 6, first of four solar orbiting spacecraft  Mars origin meteorite QUE 94201 discovered in Queen Alexandra range, Antarctica 1994 	17  Wright Brothers first flight, Kitty Hawk, NC 1903	18  NASA showed the first images from the $670 million Spitzer Space Telescope, launched 4 months earlier (2003)	19  Moon at apogee (farthest from Earth) Mercury 1, unmanned spacecraft 1960 Launch of Discovery STS-103, 3rd Hubble servicing mission (1999) Benares meteorite, hits house in India (1798)	20 Soviet cosmonaut Georgy Grechko makes the first spacewalk during the Salyut 6 EO-1 mission (1977) Comet 21P Giacobini–Zinner discovered in the constellation Cygnus by Michel Giacobini from (Nice, France) (1900)	21 Winter Solstice 17:11 UT (12:11 pm EST) Apollo 8 (Borman, Lovell, Anders), first to circumnavigate the Moon - 1968 Launch of Soviet spacecraft Vega 2 to Venus and on to Comet Halley - 1984
22 Discovery of LEW 88516 meteorite -Martian origin (1988) Ursids meteor shower peak	23 Discovery of Saturn's moon Rhea by Giovanni Cassini 1672	24 inaugural launch of the Ariane rocket (1979) Jean-Louis Pons born - discoveror of comets (1761) Barwell meteorite falls on English village (1965)	25 Mars Express spacecraft orbits Red planet (2003) Launch of Soviet Salyut 4 space station (1974) Venera 11 on Venus, 4 days after sister lander Venera 12 (1978)	26 Charles Babbage born - British mathematician, co-founder of Royal Astronomical Society and inventor of first mechanical computer (1791)	27 Johannes Kepler born 1571 - established laws of planetary motion ALH 84001 meteorite in Antarctica - cross section shows signs of possible Martian bacterial life (1984)	28 Galileo spacecraft explores auroras during eclipse of Jovian moon Ganymede (2000)
29 Nancy Jane Sherlock Currie born - an engineer, US Army officer and a NASA astronaut, designed hardware for space station and served on four shuttle missions (1956)	30 Discovery of Uranus' moon Puck by Stephen Synnott (1985) Cassini meets Galileo at Jupiter and gets Jovian gravity boost, while en route to Saturn (2000)	31 GRAIL-A spacecraft (Gravity Recovery And Interior Laboratory) enters lunar orbit, to be followed by GRAIL-B the following day. Duo will map the moon's gravity field (2011)				

Phases of the Moon



Dec 2 Dec 9

Dec 17 Dec 25