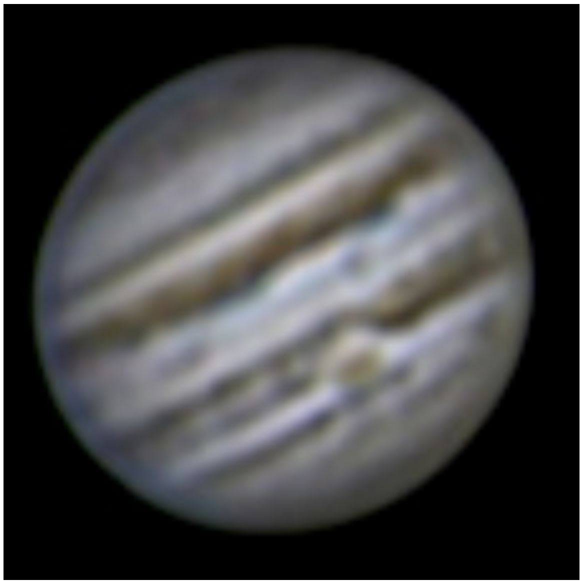
# SkyWAAtch



By Olivier Prache

By Carl Lydon

By John Paladini

## King of the Solar System

With more than twice the mass of the other planets combined, Jupiter is the solar system's most dominant object besides the Sun. The planet has played a significant role in scientific history as telescopic observation of Jupiter's moons helped confirm Copernicus' heliocentric theory of planetary motion.

Olivier Prache produced his image with a 12.5" Hyperion astrograph and a ToUcam webcam (processed with Registax). Carl Lydon used a Canon Rebel T3 DSLR in video mode (30fps) stacked 2x and 3x barlow (best 700 frames out of 2400; stacked with Lykeos and edited with Keith's Image stacker and photoshop). John Paladini captured his image through a C5.

# Events for February 2013

## WAA Lectures

**"Latest Results from Mars Curiosity"**
**Friday February 1st, 7:30pm**
**Lienhard Hall, Pace University**
**Pleasantville, NY**

Br. Robert Novak will describe the scientific instruments on the Mars Curiosity rover and actual measurements made with these instruments. The Curiosity results will be compared to previously known values from earth and space-based measurements, such as his group's results for Martian water vapor. He will discuss how these measurements will be used to plan future research on Mars. Br. Robert is a Professor of Physics and Chair of the Physics and Astronomy Department at Iona College; he has been a full time faculty member there since 1980. He holds degrees in Physics from Iona College (B.S., 1972), Stevens Institute of Technology (M.S., 1977), and Columbia University (M.Phil, Ph.D., 1980). Since 1996, he has worked with the Astrobiology Group at NASA's Goddard Space Flight Center in Greenbelt Maryland. Free and open to the public. **Please Note**: This meeting will be held in Lienhard Hall, which is behind Miller Hall. Directions and Map.

## Upcoming Lectures

**Miller Lecture Hall, Pace University**
**Pleasantville, NY**

On March 1st, our speaker will be Scott Nammacher who will discuss his astrophotography as well as the design and construction of his remotely operated 2-story observatory. On April 5th, Dr. Caleb Scharf will present on his book *Gravity's Engines*. Lectures are free and open to the public.

## Starway to Heaven

There will be no public *Starway to Heaven* in February. *Starway to Heaven* events will resume in March.

## Renewing Members. . .

Harry S. Butcher, Jr. - Mahopac
Robert Rehrey - Yonkers
George N. Thomas - Irvington
Alex Meleney - Greenwich
David Butler - Mohegan Lake
Paul Andrews - Patterson
Bob Quigley - Eastchester

### MEMBERS CLASSIFIED

As a service to members, the WAA newsletter will publish advertisements for equipment sales and other astronomy-related purposes. Ads will only be accepted from WAA members and must relate to amateur astronomy. Please keep to 100 words, include contact info and provide by the 20th of the month for inclusion in the next issue. The newsletter is subject to space limits; so ads may be held to subsequent issues.

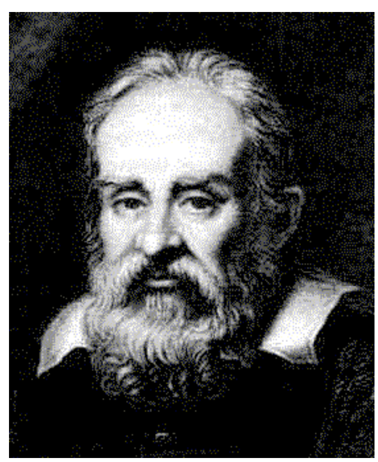
The WAA may refuse an ad at its sole discretion. In particular, price information will not be accepted. Members and parties use this classified service at their own risk. The Westchester Amateur Astronomers (WAA) and its officers accept no responsibility for the contents of any ad or for any related transaction.

Send classified ad requests to:
waa-newsletter@westchesterastronomers.org.

### WAA APPAREL

Charlie Gibson will be bringing WAA apparel for sale to WAA meetings. Items include:
- **Caps, $10** (navy and khaki)
- **Short Sleeve Polos, $12** (navy).

**Call: 1-877-456-5778 (toll free)** for announcements, weather cancellations, or questions. Also, don't forget to periodically visit the WAA website.



Galileo

# Articles and Photos

## The Ages of Discovery
### by Larry Faltz

Historians speak of "Great Ages of Discovery," eras in which Western Civilization sought out unexplored territories and new knowledge through expeditions in the physical world. The first Great Age began in the 15th century with Henry the Navigator, under whose influence the Portuguese mapped the African coast and rounded the Cape of Good Hope, voyaging all the way to India. The Spanish, engaged with their Iberian neighbors in a geopolitical struggle for ocean trading routes and new colonies to exploit, "discovered" the New World through the efforts of the hired Italian captain Cristoforo Columbo. They also sponsored the quest of the Portuguese mariner Ferdinand Magellan to find a westward route to the Spice Islands (Indonesia), and his expedition (1519-1522) was the first to circumnavigate the globe, although he died en route. By the middle of the 16th century, the major oceans were generally mapped, the Americas colonized, and the first Great Age came to a close.

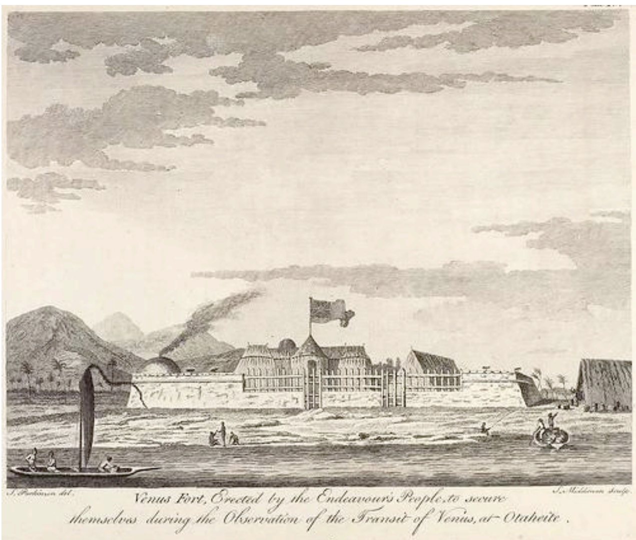
The first Great Age was about commerce, geopolitics and conquest. Its highway was the ocean, its craft the sailing ship, and its motto can perhaps be summarized by Spanish soldier Vargas Machuca's comment in 1599 "*a la espada y el compas, mas y mas y mas y mas*" (by the sword and compass, more and more and more and more).

Science as we know it today was born during the first Great Age. While intellectual and philosophical progress had been made in the late medieval period by such thinkers as Albertus Magnus and Roger Bacon, the dawn of the scientific age is generally dated as 1543, the year of the publication of Nikolaus Copernicus' *De revolutionibus orbium coelestium* (On the Revolutions of the Heavenly Spheres) and Andreas Vesalius' anatomy textbook *De humani corporis fabrica* (On the Workings of the Human Body). In the 17th century, Kepler, Galileo and Newton paved the way for a truer understanding of the universe. This was a period of fertile intellectual discovery and mild technological advancement, but it was not until the mid 18th century that the next Great Age commenced.

The second Great Age differed from the first in that it was born from science, and its goal was to "fill in the blanks" of the world and discover new knowledge for its own sake. On a background of another geopolitical struggle, the imperialist and cultural competition between France and England, two great endeavors initiated the Second Age: the paired 1735 expeditions, one to Lapland and one to Ecuador, of the Paris Academy of Sciences to measure an arc of the meridian, and the group of expeditions in 1761 and again in 1769 to observe the Transit of Venus in order to determine the astronomical unit. For the next 150 years, expeditions on land and sea sought the interior of Africa, the American West, the Arctic, the Andes, the Himalayas and eventually the South Pole. The second Great Age can be said to have ended with Ernest Shackleton's epic and heroic 1914-16 *Endurance* expedition, although an exclamation point could be considered the conquest of Mount Everest by Sir Edmund Hillary and Tenzing Norgay in 1953.

Sir Joseph Banks (painting by Joshua Reynolds, in the National Portrait Gallery, London)

The British expedition to Tahiti in 1769, under Captain James Cook, included a remarkable passenger, Joseph Banks (1743-1820). The son of a well-to-do landowner, Banks went to Oxford, but his interest turned to botany and he moved to London to study plants, spending time at the British Museum and in the Chelsea Physic Garden (where you can stroll at your leisure today). He signed on as the botanist on Cook's voyage, covering all his own expenses. His experiences in Tahiti were quite noteworthy. Banks was the only crew member who tried to truly understand the Tahitians, essentially "going native" and adopting the islander's dress (or lack of it), customs and language. He lived with a native woman and sometimes acted as mediator between the disdainful British and the wily but naïve Tahitians during their frequent scrapes. During the 3 year voyage, which included visits to South America and Australia, Banks collected an enormous number of plant specimens. He was eventually made an advisor on plants for King George III, and under his direction Kew Gardens, the great British botanical park in southwest London, grew to become the largest collection of plants in the world, which it remains today. Banks was also instrumental in encouraging the settlement of Australia.



Fort Venus, on Tahiti, in 1769

Banks became the President of the Royal Society, Britain's leading scientific institution, in 1778 and held the title until 1819, acting as a catalyst for a vast range of scientific endeavors, primarily through his personal interactions with investigators and enthusiasts from every field. The Royal Society itself was founded on November 18, 1660, following a lecture at London's Gresham College by Christopher Wren, then Professor of Astronomy and later the architect of London's magnificent St. Paul's Cathedral. The group included Robert Boyle (of Boyle's Law, $pV=k$, relating the pressure and volume of a gas at constant temperature), polymath clergyman John Wilkins, influential statesman and diplomat Sir Robert Moray, and mathematician William, Viscount Brouncker. The organization was called "a Colledge for the Promoting of Physico-Mathematicall Experimentall Learning." Two years later, King Charles II granted a royal charter and it's been known ever since as the Royal Society. The Society's motto is *Nullis in verba*, which basically means "Don't take anyone's word for it." In other words, make the observations yourself, surely the fundamental requirement of experimental science. Election to Fellowship in the Royal Society is Britain's greatest scientific honor. At present there are 1400 fellows.

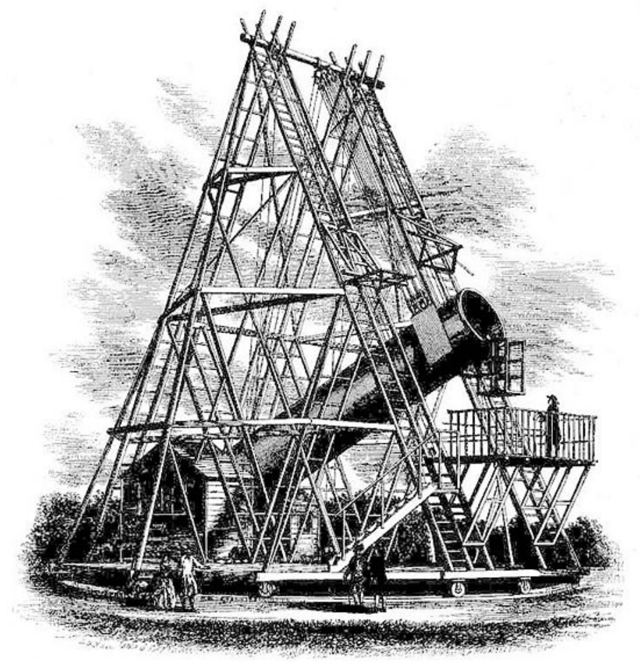
The first scientific society, by the way, was the *Academia Secretorum Naturae*, founded in Naples in 1560 but shut down by the Pope in 1578 on suspicion of sorcery. In 1603, the *Accademia dei Lincei* was founded in Rome; Galileo was later a member. This organization sadly faded into oblivion in 1651.

To honor the Royal Society's 350th anniversary in 2010, Bill Bryson edited an enjoyable and stimulating collection of essays, *Seeing Further: The Story of Science, Discovery, and the Genius of the Royal Society* (William Morrow, 2010). The 22 essays cover a wide range of scientific and philosophical topics reflecting the society's protean influence and connections over three and a half centuries. I particularly enjoyed a piece by the prolific Canadian writer and poet Margaret Atwood describing how the satiric 3rd book of Jonathan's Swift's *Gulliver's Travels*, in which the protagonist voyages to the island of Laputa and observes all sorts of bizarre and laughable experiments and philosophies, is directly modeled after the many seemingly wacko researches by Royal Society members resulting from its encouragement of experimentation. Since it's *Nullis in verba*, you've got to observe it yourself, so why not investigate respiration by, for actual example, putting a duck in a vessel, exhausting the air, and seeing what happens? Then repeat with a viper, hedgehog and a toad. It was only a short trip to Swift's Grand Academy of Laputa, where a "projector", the Laputan equivalent of "scientist", inflates a dog through its nether orifice in an attempt to cure colic. [*Gulliver's Travels* is one of the most observant books of our culture, and if you haven't read it since high school, take another shot at it.] There is a delightful essay by Oliver Morton (I reviewed his excellent book *Mapping Mars* in the September 2010 newsletter) on the cultural impact of viewing the Earth from space, and another by British biographer Richard Holmes on ballooning, which took Europe by storm in 1783 (fostered in England under Banks' influence). Henry Petroski, a professor of Civil Engineering and History at Duke, reviews historical and engineering perspectives of bridge design (his 2004 book *Pushing the Limits*, about gigantic architectural projects, is well worth reading). Richard Dawkins writes about the events surrounding the publication of Darwin's *Origin of Species*. And so on, in an eclectic volume of definite interest to anyone with a reasonably good scientific background and an interest in its history.

In Canterbury, England last October, I came upon the aptly-named Chaucer Bookstore, on the delightfully named Beer Cart Lane. I acquired a copy of Richard Holmes' fine book *The Age of Wonder* (Harper Press, 2008), which explores the influence that Joseph Banks had on English science. Of interest to astronomers, the Herschels figure prominently in three of the chapters. The transformation of William Herschel from émigré musician to telescope maker to skilled and obsessive observer, and then to one of the most respected contributors to the deliberations of the Royal Society, is exquisitely developed. Carolyn Herschel clearly gains the author's sympathy and respect for her quiet perseverance and dedication, and her own rather remarkable observing skills. Her relationship with William and its impact on their work is scrutinized in detail. William's deep caring for and protection of the young Carolyn, 12 years his junior, sadly faded a bit once he reached middle age and married. Nevertheless, we get to understand how committed to the task the two of them were, glued to the telescope night after night with Carolyn sitting the dark patiently transcribing William's shouted observations, making discovery after discovery. Herschel presented many of these to the Royal Society along with a variety of papers on cosmology and astrophysics, some of which were prescient (greater astronomical distances mean going back in time, the Milky Way evolves) and some fantastic (there are living creatures on the moon and planets). Holmes also shows how the discoveries of these "romantic" scientists echoed in the popular imagination. An example is John Keats' famous 1816 poem *On First Looking into Chapman's Homer*, which clearly refers to Herschel's discovery of Uranus:

> Much have I travell'd in the realms of gold,
> And many goodly states and kingdoms seen;
> Round many western islands have I been
> Which bards in fealty to Apollo hold.
> Oft of one wide expanse had I been told
> That deep-brow'd Homer ruled as his demesne:
> Yet did I never breathe its pure serene
> Till I heard Chapman speak out loud and bold:
> Then felt I like some watcher of the skies
> When a new planet swims into his ken;
> Or like stout Cortez, when with eagle eyes
> He stared at the Pacific—and all his men
> Look'd at each other with a wild surmise—
> Silent, upon a peak in Darien.

There was, after all, only one new planet, Uranus, which swam into Herschel's ken in 1781. The only thing Keats got wrong was that it was Balboa, not Cortez, who sighted the Pacific during that first Great Age of Discovery. But don't hold it against him: the point of course is about the wonder of discovery.

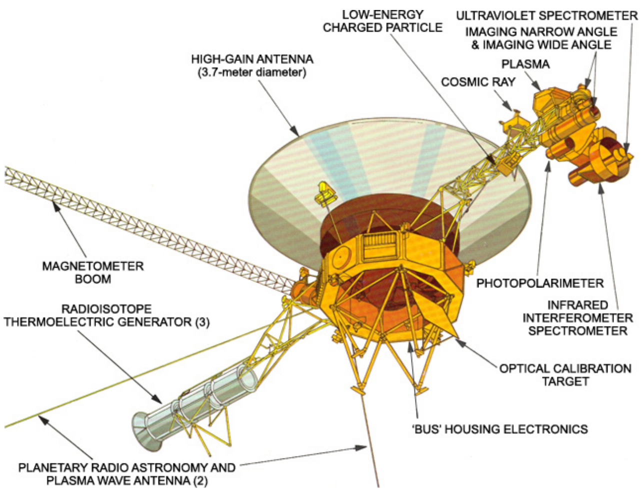


William Herschel's 40-foot reflector at Slough (constructed 1785-1789)

We now find ourselves in the third Great Age of Discovery, which started on October 4, 1957 with the launch of Sputnik. Like the first two ages, the Third Age was energized by geopolitics: the United States versus the Soviet Union (or perhaps capitalism versus communism). Science had become a legitimate pursuit, with 400 years of history and development to provide rules and goals, and the only grand target left for voyages of discovery was space. Although most people consider the Apollo 11 landing the pinnacle of space exploration to date, the expedition that embodies the spirit of discovery is rightly the pair of unmanned planetary probes called Voyager.

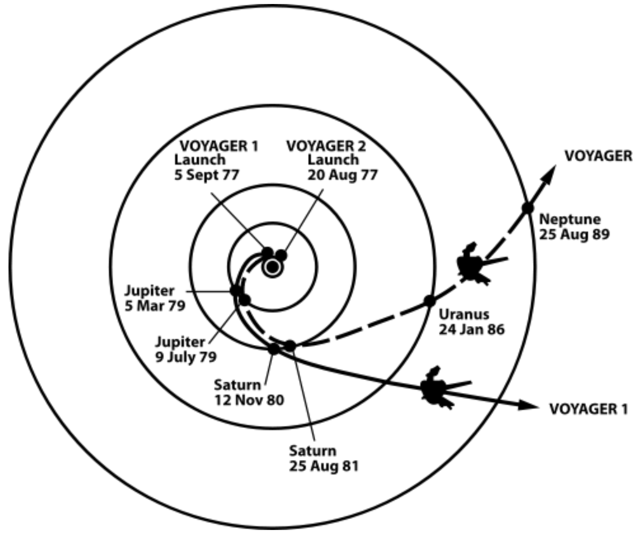
What sets Voyager apart from Apollo, besides its robotic nature (although much of Apollo's success was robotic, depending on computer control over power and navigation), is that what was found on the moon was really expected, but what the Voyagers found was truly unexpected. We pretty much knew what we were going to find on the moon, and when we got there, we found it. There were certainly small surprises and interesting confirmations, but nothing like the volcanoes of Io, the ice sheets of Europa or the shepherd moons of Saturn.

The story of Voyager is worth learning in detail, and it's the subject of a very fine book, *Voyager: Seeking Newer Worlds in the Third Great Age of Discovery* by Stephen Pyne (Viking, 2010). Pyne, Regents Professor in the School of Life Sciences at Arizona State University, intersperses well-constructed narratives about the genesis, construction, launch and discoveries of the probes with commentary on how Voyager has parallels in technology, effort and significance with expeditions from previous Ages of Discovery. Pyne is a really skilled writer (his 1986 book *The Ice*, still available in paperback, is one of the best books I've read on the Antarctic) and his insights are illuminating. I highly recommend this book. More straightforward reportage (effective, but a little boring) can be found in Henry Dethloff and Ronald Schorn's *Voyager's Grand Tour* (Smithsonian Institution Press, 2003).




Voyager spacecraft (NASA)

Of course the actual story of Voyager is dramatic enough in itself. It was the space probe that almost wasn't. Proposed, killed for budgetary reasons, proposed again and eventually cobbled together on the frame of the Mars Viking landers, the Voyagers' ability to reach their targets depended on gravity assist. This technique was first proposed in 1963 by a mathematics graduate student, Michael Minovich, who had been hired for the summer in 1961 by JPL to calculate trajectories for probes to Venus. Taking up this work, Gary Flandro at JPL proposed the "gravitational perturbation technique," which was soon refined by other scientists. In 1965, it was realized that the once-in-176-years alignment of the outer planets would allow a spacecraft to utilize the gravitational field of each planet to propel it to the next, making the "Grand Tour" possible without requiring a rocket so ridiculously large that it was unaffordable.



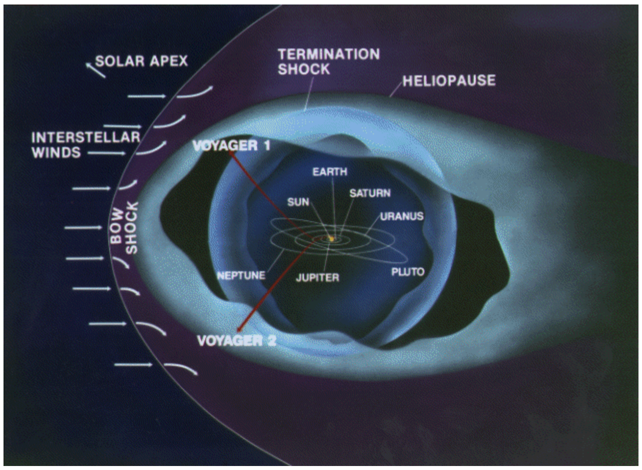

Voyager Trajectories (NASA)

Voyager 2 launched first, on August 22, 1977, and took a slightly more circuitous route than Voyager 1, which lifted off 14 days later. Voyager 1 made closest approach to Jupiter on March 5, 1979, followed 4 months later by Voyager 2. The spectacular and surprising images of the planet and its moons, coupled with a vast amount of electromagnetic and spectroscopic data, energized the science team and the public, and the passes at Saturn (Voyager 1 on November 12, 1980, Voyager 2 on August 25, 1981) were watched live by millions on television. The acquisition of each image was greeted with gasps of amazement from the assembled scientists and from us at home.

These successes occurred in spite of many mechanical problems during the voyage, as might be expected in any complex device that can't be preventively maintained. Unlike ships at sea during the first two Ages, there's no ship's carpenter, no stockpile of spares (although there was plenty of redundancy in the Voyagers' design and construction) and the craft can't put into port for repairs. The spacecraft still depended on men, but they could only labor on its behalf indirectly. Voyager 2 seemed to have a greater share of problems. Shortly after launch, its instrument boom failed to fully deploy, but it was functional enough and workarounds were put in place. In April 1978, the officer of the watch forgot to send a mandatory weekly message, and Voyager 2 went into safe mode. Ultimately the primary receiver failed, and the backup receiver was never quite right afterwards. But again, engineers found ways to overcome the limitations. Voyager 2's moveable scan platform seized after its Saturn encounter, which threatened data acquisition at

Uranus and Neptune. Engineers were able to send commands that made the device functional. Voyager 1's solar wind detector failed completely in 1990, but other instruments are used to detect particle flows.

Voyager 1 went out of the plane of the solar system after its encounter with Saturn, but Voyager 2 was directed to Uranus (closest approach January 24 1986) and Neptune (August 25, 1989) before its planetary mission was over.



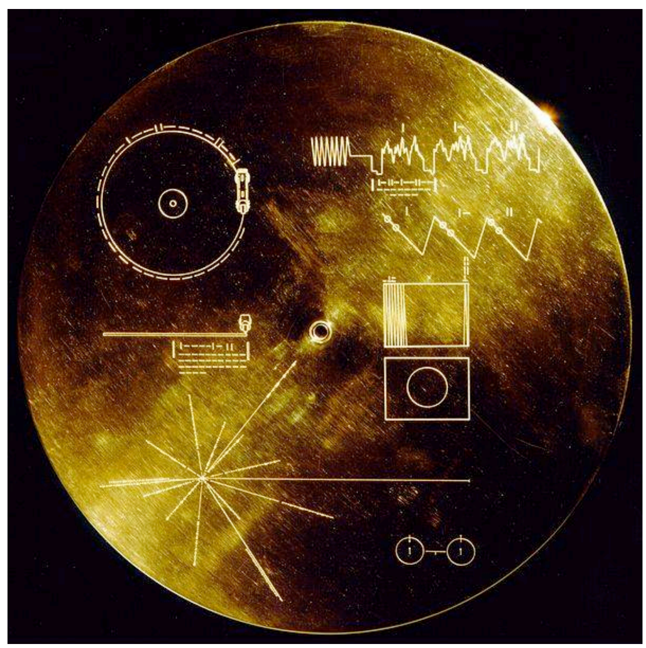

The edge of the solar system (NASA)

The Voyagers are no longer planetary explorers. They are now referred to as the Voyager Interstellar Mission. The probes are still alive and relatively healthy for old geezers, and are transmitting data from the zone where the solar system transitions to interstellar space. They've joined Pioneer 10 and 11 both of which stopped transmitting in the 1990's, in that expanse. In 2004, Voyager 1 encountered the "termination shock," where the solar wind, the stream of charged particles emanating from the sun, abruptly slows down from supersonic speed and becomes turbulent. On July 28, 2012, the probe found that the particle flows dropped close to zero and the magnetic field increased. On October 9, 2012, mission scientists announced that they believe the craft has encountered the heliopause, where interstellar space truly begins. It's currently (on January 19$^{th}$) 123.09 AU from the Sun, moving at 17.26 km/s. Voyager 2 is 100.67 AU out. Pioneer 10 is calculated to be at 107 AU and Pioneer 11 is 86 AU away.

The two Voyagers are expected to operate until at least 2025. What's amazing is that their transmitters operate at only 22 watts, and their signals, more than 17 hours after transmission, are received at an astoundingly small $10^{-26}$ watts! The global Deep Space Network is able to capture data, currently coming in at about 1.4 kilobits/second.

Each Voyager carries the famous "Golden Record," an etched copper disk with sounds and images chosen by a committee led by Carl Sagan, which might inform extraterrestrials who find the spacecraft about who we are. Along with voices speaking many Earth languages, there's music of various ethnic groups, some classical music and even Chuck Berry singing "Johnny Be Good."

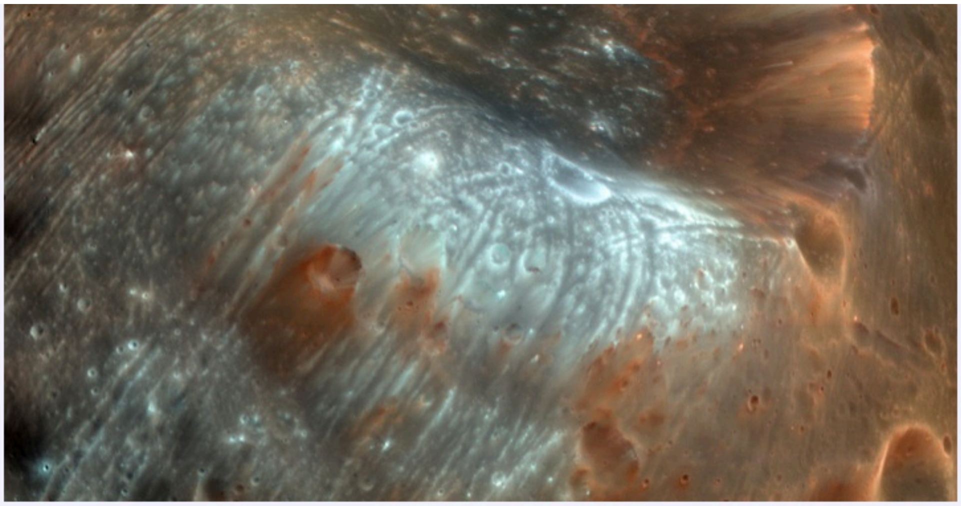
As it happened, in 1974 the Areceibo Radio Telescope was upgraded, and at a ceremony marking its reopening, a 1-megawatt transmitter beamed a binary coded message, written by Frank Drake and Carl Sagan, to the M13 star cluster. It's presumed that in 25,000 years some M13ian might detect it. Lewis Thomas, MD, the prolific medical writer (*Lives of a Cell*) and former dean at Yale and NYU medical schools, was asked what he thought about the transmission. "We should send Bach," he suggested, "but that would be boasting." Indeed there's some Bach on the Golden Record, but as we know from a famous Saturday Night Live skit, the aliens' first transmission back to us will likely be, "Send more Chuck Berry."



The cover of Voyager's Golden Record (NASA)

When the aliens play the Golden Record, decipher its contents and contact us, another Great Age of Discovery will begin.

## Internet Corner: Astronomy Picture of the Day
### by Tom Boustead


**Stickney Crater**
**Image Credit:** HiRISE, MRO, LPL (U. Arizona), NASA

**lanation:** Stickney Crater, the largest crater on the martian moon Phobos, is named for Chloe Angeline Stickney Hall, mathematician and wife of astronomer Asaph Hall. Asaph Hall overed both the Red Planet's moons in 1877. Over 9 kilometers across, Stickney is nearly half the diameter of Phobos itself, so large that the impact that blasted out the crater likely came close iattering the tiny moon. This stunning, enhanced-color image of Stickney and surroundings was recorded by the HiRISE camera onboard the Mars Reconnaissance Orbiter as it passed within e six thousand kilometers of Phobos in March of 2008. Even though the surface gravity of asteroid-like Phobos is less than 1/1000th Earth's gravity, streaks suggest loose material slid down le the crater walls over time. Light bluish regions near the crater's rim could indicate a relatively freshly exposed surface. The origin of the curious grooves along the surface is mysterious but be related to the crater-forming impact.

**Tomorrow's picture:** light-weekend

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Every day NASA opens a window on the artistry of the universe through its Astronomy Picture of the Day (http://apod.nasa.gov/). APOD offers daily astrophotos, artist recreations or short videos which can stretch the mind or offer a source for contemplation.

As the above screenshot depicts, along with the astrophoto each day's entry includes an informative description with hyperlinks to more information. The site includes an archive of all past entries as well as an index. This can be valuable if, for example, you're putting together an educational presentation. (Note: some of this material is subject to copyright and so usage requires permission. For details, consult APOD's section on Image Permission).

The site also includes a handy calendar. This allows you to quickly hunt up the APOD astrophoto for a particular date. Lastly, the Education tab includes links to informative websites and a Discuss tab offers a venue for those who wish to join in a conversation about APOD's photos.

For IPAD users, there are several relevant Apps at the App Store, which exploit APOD content. For $2.99 Spacebook is an easy App to navigate, with thumbnails appearing on the start screen (All Images). Click on an image and you bring up a full screen version with the APOD, which can be shared via twitter or instagram. There is also a search feature. For free, you can download the Astronomy Picture of the Day App. This brings up the day's photo and description. There is a wheel for navigating to past entries. Stars Today is also free and allows navigation to the day's APOD photo. There is also a link to a daily audio podcast although I could not make this feature work. Moreover, the advertisements at the bottom of the screen were annoying.

Overall, tablets users may just as well wish to rely on APOD's own features. Include a link in your browser or add the page to your Homescreen.

## Will the Bright Spring Comet Be a Lemmon?
### by Bob Kelly

The latest observations as of press time for our newsletter are leading astronomers to think that Comet PanSTARRS will not be a spectacular show low in the western sky in March. The equations based on the brightness so far predict a peak brightness of magnitude +3, instead of -1. A mag +3 PanSTARRS may be hard to pick out of the horizon hazes and lingering twilight 10 degrees above the horizon 30 minutes after sunset.

Comet Lemmon, on the other hand, has been running ahead of the brightness equation that would predict a mag +3 comet in April or May. But it is far in the southern sky and will not be visible to us until it is on its way out of the inner solar system and its brightness is fading.

But, stay tuned for news on Lemmon. Comet ISON, the next contestant in the Great Comet Search, is on its expected brightness curve for a negative magnitude peak later this year. But there is plenty of time to get ready for ISON, or for it to depart from the path to brilliance.

So PanSTARRS may not be the 'great comet' we want, but it will be well located for observing in March, if you can get a clear view low in the western sky. A fuzzy coma around a bright nucleus with a spiky tail would be pretty in binoculars. Also, PanSTARRS will be well placed for observing around our monthly Starway to Heaven the second or third Saturday in March, when we'd be happy to point it out to you!

For charts plotting the observed brightness of comets compared to the brightness calculated from the equation used to predict the peak brightness, see:

http://www.aerith.net/comet/weekly/current.html.

## The Art of Space Imagery
### by Diane K. Fisher

When you see spectacular space images taken in infrared light by the Spitzer Space Telescope and other non-visible-light telescopes, you may wonder where those beautiful colors came from? After all, if the telescopes were recording infrared or ultraviolet light, we wouldn't see anything at all. So are the images "colorized" or "false colored"?

No, not really. The colors are translated. Just as a foreign language can be translated into our native language, an image made with light that falls outside the range of our seeing can be "translated" into colors we can see. Scientists process these images so they can not only see them, but they can also tease out all sorts of information the light can reveal. For example, wisely done color translation can reveal relative temperatures of stars, dust, and gas in the images, and show fine structural details of galaxies and nebulae.

Spitzer's Infrared Array Camera (IRAC), for example, is a four-channel camera, meaning that it has four different detector arrays, each measuring light at one particular wavelength. Each image from each detector array resembles a grayscale image, because the entire detector array is responding to only one wavelength of light. However, the relative brightness will vary across the array.

So, starting with one detector array, the first step is to determine what is the brightest thing and the darkest thing in the image. Software is used to pick out this dynamic range and to re-compute the value of each pixel. This process produces a grey-scale image. At the end of this process, for Spitzer, we will have four grayscale images, one for each for the four IRAC detectors.

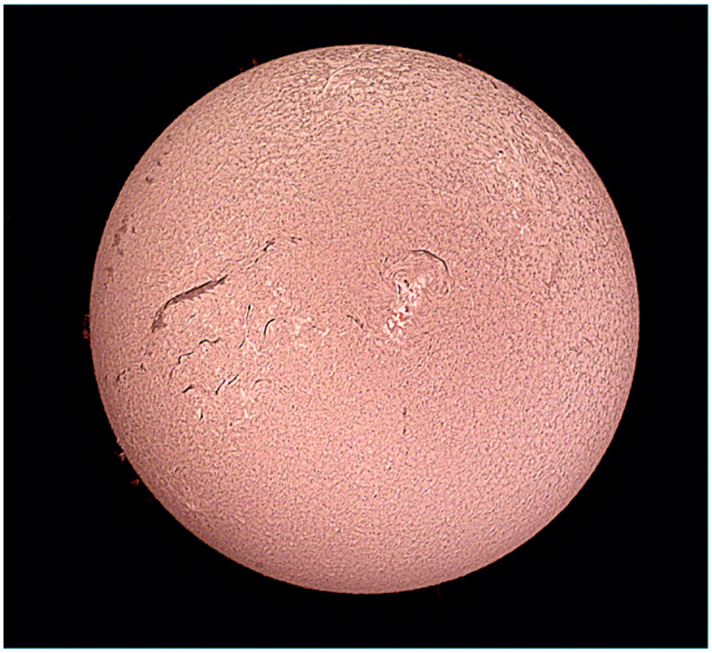
Matter of different temperatures emit different wavelengths of light. A cool object emits longer wavelengths (lower energies) of light than a warmer object. So, for each scene, we will see four grayscale images, each of them different.

Normally, the three primary colors are assigned to these gray-scale images based on the order they appear in the spectrum, with blue assigned to the shortest wavelength, and red to the longest. In the case of Spitzer, with four wavelengths to represent, a secondary color is chosen, such as yellow. So images that combine all four of the IRAC's infrared detectors are remapped into red, yellow, green, and blue wavelengths in the visible part of the spectrum.

Download a new Spitzer poster of the center of the Milky Way. On the back is a more complete and colorfully-illustrated explanation of the "art of space imagery." Go to:
spaceplace.nasa.gov/posters/#milky-way.

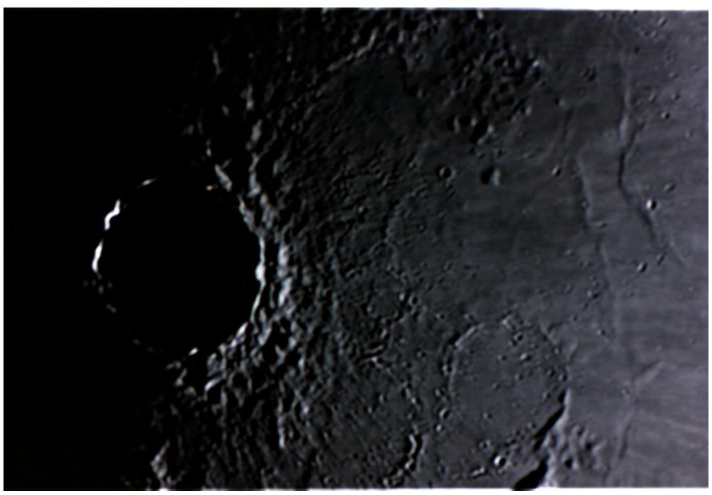
*This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.*


*This image of M101 combines images from four different telescopes, each detecting a different part of the spectrum. Red indicates infrared information from Spitzer's 24-micron detector, and shows the cool dust in the galaxy. Yellow shows the visible starlight from the Hubble telescope. Cyan is ultraviolet light from the Galaxy Evolution Explorer space telescope, which shows the hottest and youngest stars. And magenta is X-ray energy detected by the Chandra X-ray Observatory, indicating incredibly hot activity, like accretion around black holes.*



### ◀ Solar Image

Courtesy of Larry Faltz is this image of the sun on November 22, 2012. Larry used a Lunt 60mm hydrogen-alpha telescope double-stacked for ~0.5 A bandpass. Celestron Neximage 5 color imager (Bayer filter) @ 2048x1536 pixels, captured at 6 fps. A Mallincam MFR-3 focal reducer (0.7x) was used to fit the full solar disk on the 5.7mm x 4.28mm chip. Best 100 frames of 360 stacked and wavelet processed with Registax 6.1, final processing in Photoshop.



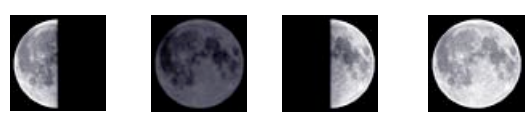
### ◀ Copernicus Sunrise

Courtesy of John Paladini is this image of the lunar crater Copernicus as the sunrises. John took this image through his C5.

This image helps highlight the important role of sun angle in lunar observing.

# Almanac

## For February 2013 by Bob Kelly



Feb 3 Feb 10 Feb 17 Feb 25

February may be the shortest month, but we have a lot to look at this month and an exciting month of March to prepare for.

Comets are on everyone's mind. PanSTARRS, the featured comet for March, is too far south to see from our latitude in February. A web site, http://www.aerith.net/comet/weekly/current.html, provides updated forecasts of comet brightness and visibility, using observers' reports and formulas for predicting the potential brightness of comets. So, we wait and listen for reports from the other hemisphere.

For another month, Jupiter is the star of the show, and seemingly has the stage all to himself. Now it's the brightest star-like object in the sky, high in the evening sky all month. Spend some time watching Jupiter's moons go in and out of the planet's shadow; it really gives the Jovian system that 3D effect (without the 3D glasses!). While you're in the neighborhood, there is much to see, with the Pleiades (looking like a small dipper) and Hyades (like a large 'V') star clusters. Just over to the lower right are the wonders of Orion. Going deeper into Jupiter's neighborhood, take a look for Vesta and Ceres. At magnitudes 7.8 and 8.1, respectively, and getting fainter, this is a great time to get a good map of their locations and see these star-like points of light that are being investigated by the Dawn spacecraft.

Nearby, you can go really deep and find the Crab Nebula by following the left side of the Hyades cluster's V, past very bright Aldebaran out to the next bright star – the end of the horn of Taurus the Bull. The Crab is a tiny, faint, cloud, M1 on Messier's list of comet-like objects. It's not much to look at, but it's home to an even fainter super-rapidly pulsating star (too faint for me at mag 16--my eight-inch scope only goes to 14). All this was formed in a supernova explosion in 1054, visible in daytime. But it's worth a look, since you were in the neighborhood anyway. If you want to fish for more than crab, get your own copy of *Turn Left at Orion* by Gary Consolmagno and Dan M. Davis (Cambridge University Press, now in its 4th edition)!

Venus is very bright at mag -3.9, but racing ahead of us in its inner orbit, it dives deep into the Sun's glare, surfacing in the evening sky in May. Mars seems to still stubbornly refuse to enter the glare, but is very low in the western evening sky. Mercury passes by on the 8th, its glow of mag -1.0 helping us find Mars, one-seventh as bright at mag +1.2. In a telescope, you can compare tiny Mars' 4 arc seconds vs. Mercury's 50% larger 6 arc seconds. How much magnification do you need to see the differences in their colors and phases? Then Mercury moves a bit further out from the Sun, with one of the best appearances in the evening sky for the year through the third week in February. The thin Moon joins the scene, just above them, on the 11th.

Another preparation activity is to prepare now for the partial solar eclipse that will block out half the sun at sunrise on November 3rd. Around February 8th the sun will rise at about the same place on the horizon as on November 3rd. So the 8th is the best time to see where the Sun will be on the horizon when the eclipse will occur, so you can test out framing the sunrise with interesting foreground objects in advance of the eclipse.

Our Moon makes a close pass by Spica in Virgo on the morning of the 28th. Spica disappears behind in Moon as seen from south of the USA border. The Moon is equidistant from Jupiter on the 17th and 18th. Compare this to the nearer passes in January and another near pass upcoming in March. (Get a photo of the couple with any camera or even a camera-phone.) Saturn gets to pair up with the Moon on the 3rd and on March 1st and 2nd. (Better start planning for those early March events, since February will be over before you know it!)

Solar cycle number 24 has been quieter than cycle 23, but we get to see some large sunspots from time to time, with properly filtered telescopes. Check spaceweather.com or photos from one of the solar satellites, like SOHO, to see when it's worth doing some astronomy with our daytime star. Look while you can, since three distinct methods of predicting future solar cycles all say that the next 11-year cycle, number 25, will be very weak.

The International Space Station makes passes during evening twilight most evenings from the 6th through the 28th. Can you track it with binoculars, or even more challenging, with a wide-field telescope, and see the shapes of its solar wings?

One more thing – an asteroid slips through the Earth-Moon system on the 15th. This 150-foot wide object will pass 18,000 miles from the Earth's surface during nighttime in Europe, Asia and Australia, close enough to perceptively move while watching it, even in a small telescope. They will see a mag 8 speck in their scopes, but 2012DA14 will be 11th magnitude by the time it gets dark in the eastern USA- getting dimmer and moving more slowly.

Bob's Heads UP blog is at bkellysky.wordpress.com.