SkyWAAtch

Image Copyright: Mauri Rosenthal

The Whirlpool

Courtesy of Mauri Rosenthal is this image of M51, the Whirlpool Galaxy in Canes Venatici. Notes Mauri: The beautiful spiral arms of the bluish galaxy are both enhanced and disrupted by the yellowish companion dwarf galaxy, NGC 5195, as it passes behind the disk. Both galaxies are about 25 million light years away. Mauri captured this image over two nights, April 18th and 21st, from his yard in Beech Hill, Yonkers using a 3.5" Questar telescope. The imaging camera is a Starlight Xpress Trius SX-9C behind a Questar 0.5x focal reducer, at approximately f/8. The Questar mount is autoguided by an SBIG-STi guider using PHD2. This image used a stack of 30 x 5 min exposures (stacked and processed with Nebulosity 3.2, PixInsight, and GIMP).

In This Issue . . .

Events for June 2015

WAA April Lecture

"Meteorites and the Amateur Astronomer"
Friday June 5st, 7:30pm
Lienhard Lecture Hall,
Pace University, Pleasantville, NY

Alan Witzgall will discuss the intricacies of meteorites: what they are and what they tell us about space and the origins of the universe. Mr. Witzgall will touch upon how to identify meteorites. He will bring his meteorite collection to show after the talk.

Alan Witzgall holds a Bachelor's degree in Earth Sciences from Kean University. He is an active long-term member of the Amateur Astronomers, Inc. of Cranford, NJ, and is a past president of that organization. He is also active at the New Jersey Astronomical Association in High Bridge, NJ, serving there as its Vice-president. He is currently a senior optician for ESCO Optics of Oak Ridge, NJ. His career in optics started with building telescopes in his basement during his high school years. In 1977, one of them, a 10-inch reflector, took First Award at Stellafane. Directions and Map.

Upcoming Lectures

Lienhard Lecture Hall,
Pace University, Pleasantville, NY

As usual, there will be no WAA lectures for the months of July and August. Our Lecture series will resume in September.

Starway to Heaven

Saturday June 13th, Dusk.
Ward Pound Ridge Reservation,
Cross River, NY

This is our scheduled Starway to Heaven observing date for June, weather permitting. Free and open to the public. The rain/cloud date is June 20th. **Note**: By attending our star parties you are subject to our rules and expectations as described here. Directions.

New Members. . .

Jonathan Williams - New Rochelle
Sethu Palaniappan - Scarsdale

Renewing Members. . .

Jose E. Castillo - Pelham Manor
Dante Torrese - Ardsley
Donna Cincotta - Yonkers
Scott Rubin - Yorktown Heights
Erik & Eva Andersen - Croton-on-Hudson
Lydia Maria Petrosino - Bronxville
Tom Crayns - Brooklyn
Tim Holden - White Plains
James Steck - Mahopac
Red Scully - Cortlandt Manor
Arumugam Manoharan - Yonkers

Astrophotography Exhibition Through July 3rd 2015

Pound Ridge Library is exhibiting the astrophotography of Scott Nammacher, a Westchester based amateur astrophotographer. The exhibit is entitled "Treasures of the Northern and Southern Night Skies." Mr. Nammacher will show his photographs, taken from two remotely operated observatories (one in Australia and the other in New Mexico) and from his up-state observatory, Starmere Observatory. He has been photographing nebulas, galaxies, along with cloud and gas regions, and more local solar system targets since the early 2000s.

Pound Ridge Library Address: 271 Westchester Ave., Pound Ridge, NY 10576.

Website: www.poundridgelibrary.org

Artist Website: starmere.smugmug.com

Artist Email: snammacher@msn.com

WAA Apparel

Charlie Gibson will be bringing WAA apparel for sale to WAA meetings. Items include:

- Caps and Tee Shirts ($10)
- Short Sleeve Polos ($12)
- Hoodies ($20)
- Outerwear ($30)

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

Almanac
For June 2015 by Bob Kelly


Jun 2 Jun 9 Jun 16 Jun 24

What lights up our brains: The sounds of the opening chords of an epic rock anthem; the distinctive smell and taste of a great meal; the feeling of a place called "home." The brain also gets excited when it sees two bright objects close together in a dark sky. This month, Jupiter and Venus light up our brains, passing so close together we can see them in the center of our retinas, where objects come into sharp focus.

For almost a week around June 30th, you can capture Venus and Jupiter in the same eyepiece field of your telescope – compare their sizes, shapes and brightness and think about how Jupiter is 420 million miles behind Venus. *Sky & Telescope* notes this is the second close pass of Venus and Jupiter in a set of three close passes that might have been the inspiration for the Star of Bethlehem 2,018 years ago. Their third conjunction will be in late October in the morning sky.

The best photo-op of the month is when our Moon joins the scene on the 20th and 21st. Early in the month, you can watch Venus line up with Castor and Pollux as the Gemini dance into the twilight. For the rest of 2015, Venus is the closest planet to Earth, closest at inferior conjunction in August.

As Jupiter races Venus for the western exit, so goes our last chances to see the giant planet's moons and belts well. One of the last double shadow transits occurs on the night of the 4th/5th, but it starts around Jupiter-set at our longitude. Look earlier for the transit of Io's tiny shadows, the first of the two.

Saturn is another gem in the evening sky, low in Libra, just ahead of the Scorpion's claws. Don't be discouraged if it takes time to get sharp vistas of its rings and the planet's faint bands of clouds. Hazy summer nights may cast a veil over deep sky objects. But without the turbulent jet stream overhead, you'll see steadier views of the planets. It's a good time to see how much magnification your telescope can use. The nearly full Moon points out Saturn on the 1st and the 28th.

Mercury and Mars will be difficult. Mars is in conjunction behind the Sun on the 14th. Mercury sneaks into the morning sky, but is hard to see from New York, only two-thirds as high above the horizon as May's excellent evening excursion. It's a better view from the Southern Hemisphere. Uranus and Neptune are up in the morning sky, but not far up.

On the 28th, around 11pm, the Moon covers up a magnitude 4.1 star in Libra. Get out early to find and track the star before it disappears at the dark edge of the 90% sunlit Moon.

On Saturday the 13th, the equation of time is zero, meaning sundials read local time correctly. For standard time, adjust by 4 minutes per degree of longitude from the standard time meridian. For daylight time, add another hour. Perhaps that's one reason sundials don't come in wristwatch form, despite being solar-powered with no batteries or winding needed.

With the Summer Solstice on the 21st, our long summer twilights mean it's satellite-sighting season! At our latitude, at any time of night, satellites can be seen obeying Newton's Laws while gliding overhead in sunlight. From May 30th though June 4th, the International Space Station, with its international crew of six working together, can be seen every ninety minutes or so each night. How many over-flights can you catch in one night? If you see some slow moving meteors later this month, they may be part of the weak June Bootids shower.

Overhead, give some love for a magnitude +3½ star in Draco, between the bowl of the Little Dipper and the handle of the Big Dipper. That's Thuban, and it was our pole star around 3000 BC.

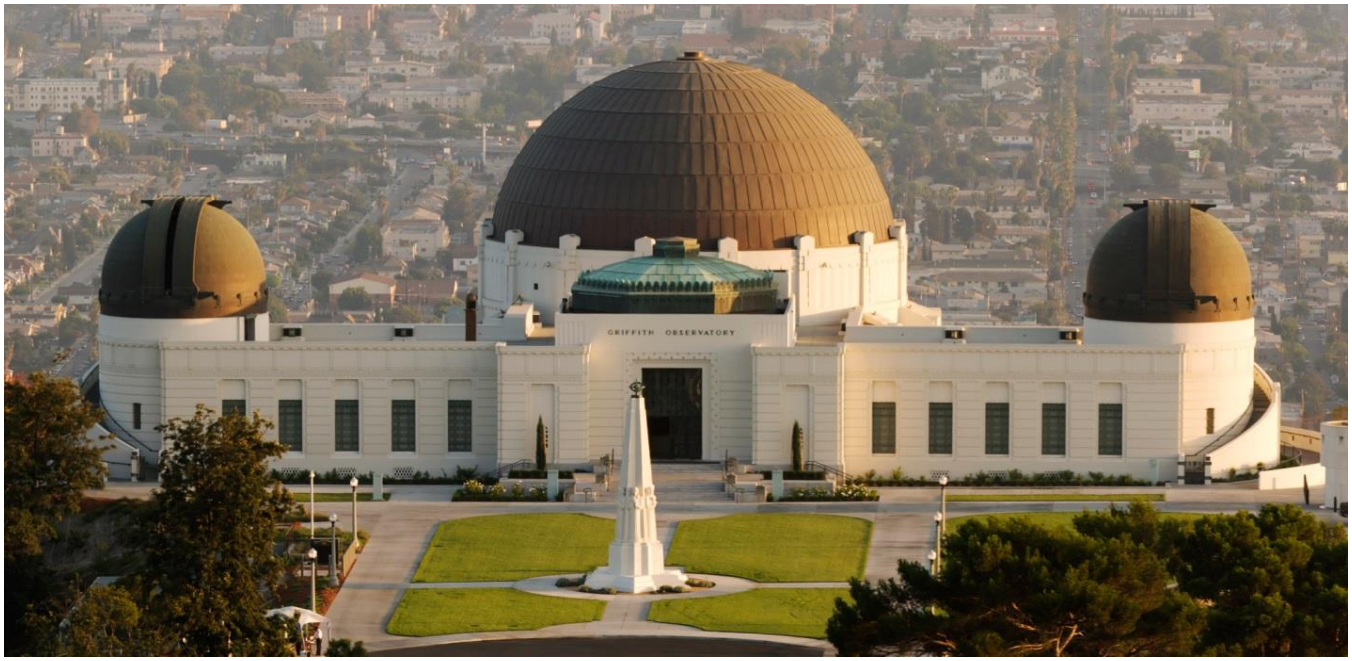
Mark your calendar for these events in July:

9th… Combination of distance from Earth (approaching us) and phase (decreasing) shows us Venus at its most illuminated. Venus is brightest on the 11th.

18th… Venus, the Moon and Jupiter are close together in twilight.

California Dreamin'

Larry Faltz



Elyse and I spent a week in California in March visiting family, and as usual we sought out some astronomical diversions, this time in the form of visits to two famous Southern California institutions, the Griffith Observatory in Los Angeles and the Huntington Library in Pasadena. No traveler to this part of the world with an interest in astronomy and the history of science and culture should miss either of these two astonishing places.

The Griffith is an iconic structure that you've seen in many movies, of which the most famous is probably *Rebel Without A Cause*, the 1955 film that sealed James Dean's fame (he achieved immortality by dying at age 24 shortly before the movie was released). It's also been featured on innumerable television shows including, inevitably, one of the *Star Treks*, the *Voyager* 2-part episode "Future's End." Perched on a hilltop in rambling Griffith Park overlooking Hollywood and downtown Los Angeles, the building projects a distinct art deco majesty. Although we'd been to the Griffith on past trips, we decided to revisit it when we glimpsed it from Barnsdall Art Park, a hilltop refuge on Hollywood Boulevard one and a quarter miles south of the Griffith, where we went to see Hollyhock House, a newly-restored Frank Lloyd Wright residence built for a wealthy patron of the arts around 1920, some 15 years before the Griffith Observatory opened.

Hollyhock House

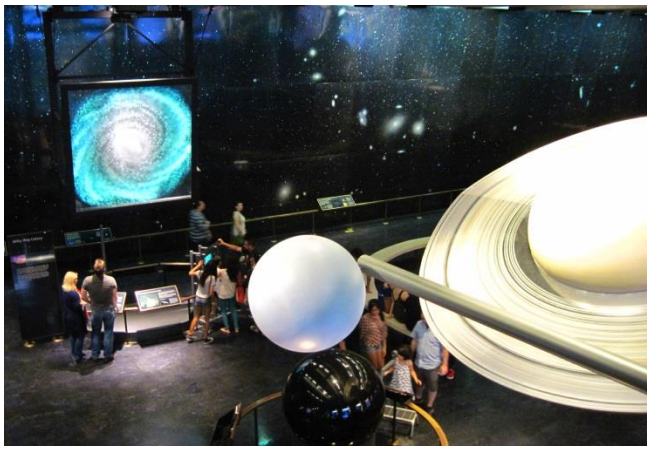
The 3,000 acres of Griffith Park were donated to the city of Los Angeles in 1896 by Welsh-born Griffith J. Griffith (1850-1919, and I didn't make a mistake in his name). He started out as a journalist but made his money in mining. Griffith's will left funds specifically for an observatory whose goal would be public enlightenment and that would not charge admission. Russell Porter of Stellafane fame, designer of the 200" Palomar telescope, made preliminary sketches for the project. Construction was an undertaking of the New Deal-era Works Progress Administration, and took two years. The observatory opened to the public on May 14, 1935. To this day, admission to the Griffith is free (there is a charge for the planetarium shows). The facility is open every day until 10 pm. On every clear night, of which there are many in LA, there is viewing through the observatory's very fine 12" Zeiss refrac-

tor, housed in the small dome on the eastern side of the building. The western dome houses a triple-beam coelostat that projects both white-light and hydrogen-alpha images into an exhibit in the building every clear day of the year.

View north from Hollyhock House. The Griffith Planetarium is on the right, and the Hollywood sign on the left.

We were there on a beautiful March Sunday afternoon, the kind that makes you wonder why you don't live in LA: a cloudless sky, temperature in the mid-70's and no humidity to speak of, nor did we encounter much traffic on the freeways, it being a weekend. The road up from Hollywood Boulevard gains over 700 feet of altitude as it winds past the famous Greek Theater (also a gift from Griffith) and through the hills to the observatory, which is 1,134 feet above sea level. Since the main parking lot was full, we had to park a bit down the hill on the road that leads to the famous Hollywood sign, which stands a mile and a half to the northwest. Along the way, hundreds of people were snapping selfies with the observatory (or in the other direction the Hollywood sign) in the background. Inside the entrance rotunda, it was very crowded with people waiting for the sky show, which is given many times a day on a first-come first-served basis, except for members, who can reserve tickets. Overhead, the elegant 1930's-era ceiling by the noted muralist Hugo Ballin (1879-1956) surrounds the observatory's original Foucault pendulum.

The two wings of the ground level contain exhibits about astronomy and astronomy technology. There were excellent displays about telescopes, a discussion of optics, a live feed from the Palomar 200" telescope, white light and hydrogen alpha images from the coelostat and a fine presentation about spectroscopy among many other displays that encompassed the full range of astronomical subject matter. In the early 2000's, the city of Los Angeles realized that the Griffith was too small to meet modern concepts of planetarium design, especially in view of the dramatic rebuilding of New York's Hayden Planetarium into the Rose Center for Earth and Space. A bond issue was floated to the tune of almost $100 million, and the building was renovated and expanded, reopening in 2006 after nearly 4 years of construction.



Part of the Gunther Depths of Space Hall, with the "Big Picture" on the rear wall.

A large chamber, the Gunther Depths of Space Hall, was hollowed out under the south side of the building. It contains scale models of the planets similar to those in the Rose Center, with the sun represented by the spherical shell of the Leonard Nimoy Event Horizon Theater, situated to one side of the large space. The back wall displays the "Big Picture," a photograph of the Virgo galaxy cluster measuring 150 feet long by 20 feet high. It's reputed to be the largest astronomical image in the world. It's a mosaic of images taken by the 48" Samuel Oschin telescope at Palomar, an instrument most recently employed to find and track Kuiper belt objects.

Screen shot of the feed from the 200" Palomar telescope

On a balcony above the Depths of Space Hall dedicated to modern astronomical technology, a cloud chamber and spark chamber periodically detected muons generated by cosmic rays.

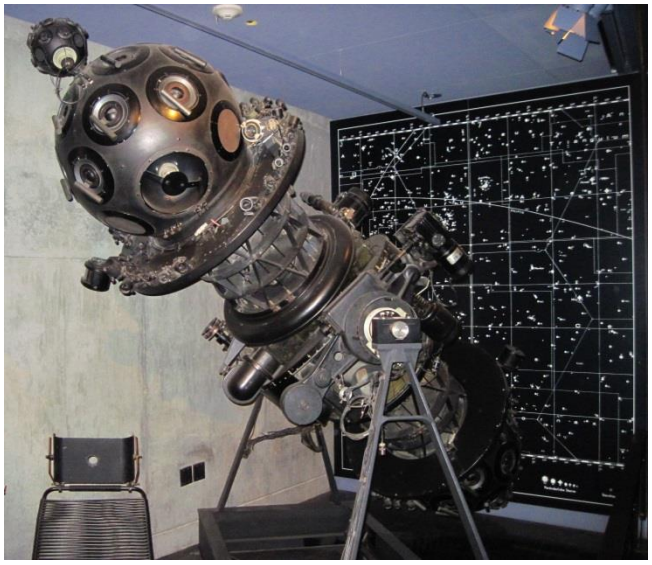
Educational show in the Nimoy Theater

We took in a free show in the 190-seat Nimoy Theater. Two young, well-informed and rather droll presenters gave an entertaining, scientifically accurate yet technically uncomplicated talk about life in space and the formation of comets. The climax of the show came when they dramatically manufactured one from a mixture of graphite, dry ice, ammonia and water, with the help of a vacuum chamber and a large Ziploc bag. It was a very educational, dynamic and altogether enjoyable performance that really engaged the large, enthusiastic audience. I'm not sure there's anything quite like it at the Hayden.

The solar telescope on the west side of the Griffith

The ceiling of the W.M. Keck Foundation Central Rotunda

Like the new Hayden, the renovated Griffith uses an advanced digital system, but unlike the Hayden the elegant old Zeiss Mark IV projector is displayed in a place of honor. The Hayden's Mark IV, in use from 1960 to 1997, when the original planetarium was demolished, seems to have disappeared.



The Zeiss Mark IV (in use from 1964-2002)

There's a palpable sense that the Griffith is "for the people." It was endowed to foster education, it was born during the New Deal and it's owned by the City of Los Angeles. To some extent it is a twin of New

York's original Hayden, which also was opened in 1935 with the same goal and art deco sensibility, but the Griffith's extended 10 am-10 pm hours, lack of an admission charge and public ownership seem somehow to endow it with a more enlightened, proletarian aura, and I found a significant contrast between the Griffith's busy displays in distinct physical areas and the current Hayden's rather spare educational exhibitions, presented essentially in a single large chamber.

12" Zeiss refractor, in public use every clear night

On another very beautiful southern California day, we drove out to the Huntington Library in Pasadena. The Huntington is one of the world's great cultural institutions. It sits in a 120 acre park-like setting, not far from the Cal Tech campus in one of Pasadena's beautifully manicured residential neighborhoods (it's formally just over the border in the adjacent town of San Marino). The library houses over 7 million objects, including 400,000 rare books and over a million photographs and other objects. There is an extensive art collection (of which the most famous piece is Gainsborough's *Blue Boy*) housed in several other buildings and visitors can stroll in a variety of landscaped areas, including an enormous rose garden, an elegant Japanese garden and a huge Chinese pavilion. There's an admission charge, well worth it because you can spend the entire day there, both indoors and out.

The Chinese Pavilion at the Huntington

In the library building itself, a large room houses the "Remarkable Works, Remarkable Times" exhibition of 150 of the most important documents in the collection, along with explanatory material and related artifacts. Among the treasures is a copy of the Gutenberg Bible on vellum, one of only 11 known to exist. There's the gorgeous Ellesmere manuscript of Chaucer's *Canterbury Tales*, an exquisitely handwritten, illuminated manuscript from about 1405 and the version upon which all subsequent editions of Chaucer have been based, a Shakespeare First Folio, and letters and manuscripts by Washington, Lincoln, Thoreau and many other notables. Several docents roamed the room engaging visitors and helping explain the history and importance of the documents. A gentleman eager to show us the Chaucer, thinking we might be unfamiliar with the work, did a double-take when I recited the opening lines in Old English, a trick I learned in college (thankfully I was not required to read the entire work in that essentially incoherent language).

Gutenberg Bible on Vellum

The other major public exhibition in the library building is "Beautiful Science: Ideas that Changed the World," dedicated to original works in astronomy, medicine, natural history and light. The original edition of Darwin's *Origin of Species* is there, along with hundreds of later editions in a wide range of languages, honoring the critical importance of this work to human thought and scientific progress. The Medicine display includes the first edition of Vesalius' seminal anatomy atlas, *De humani corporis fabrica* (published in 1543, the same year as Copernicus' *De revolutionibus*), the first edition of Gray's Anatomy (I used the 28th edition in medical school) and notes on anthrax by Louis Pasteur.

A room lined with cases of antique light bulbs, almost 400 in all, was dedicated to the understanding of light.

A 1572 translation of Ibn Al-Haytham's 11th century *Kitab al-manazir* (Book of optics) was on display. This was the first work to suggest that vision results from light entering the eye, not from something emanating from it as was previously thought (a 1557 translation of Euclid's *Optics* was also on display). There was a first edition of Johannes Kepler's *Astronomiae Pars Optica* (The Optical Part of Astronomy, 1604), his treatment of the nature of light and optics. This work contains the first description of the inverse-square law governing the intensity of light. Kepler also showed that the lens of the eye projects an inverted image onto the retina. There was a 2nd edition of Isaac Newton's *Opticks* (1717), which describes his experiments with prisms and the sun's spectrum. A copy of the *Philosophical Transactions of the Royal Society* for 1865 was opened to Maxwell's paper on the "dynamical theory of the electromagnetic field," the first presentation of what later became "Maxwell's equations" of electromagnetism. George Ellery Hale's personal copy of Fraunhofer's *Bestimmung des Brechungs- und des Farben-Zerstreuungs - Vermögens verschiedener Glasarten, in Bezug auf die Vervollkommnung achromatischer Fernröhre* (Determination of the refractive and color-dispersing power of different types of glass, in relation to the improvement of achromatic telescopes, 1816) was exhibited as well. This work describes Fraunhofer's experiments with different types of glass and reports his invention of the spectroscope. The first English translation of Kirchoff's *Researches on the Solar Spectrum* from 1862 was opened to a diagram of solar absorption lines. A copy of the 1905 volume of the *Annalen der Physik* was open to "Zur Elektrodynamik bewegter Körper" ("On the Electrodynamics of Moving Bodies") by Albert Einstein, his paper presenting the Special Theory of Relativity.

A small section of the light bulb collection

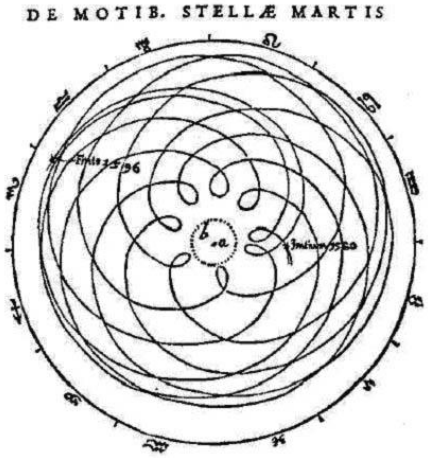
A large, darkened room dedicated to major historical works about astronomy was the highlight of the library for me. The ceiling was festooned with images from historical star maps. Manuscripts and early editions were displayed in glass cases, each opened to some interesting text or illustration. I was impressed enough to write down the entire contents of this exhibit.

One side of the Astronomy display at the Huntington. Elyse is looking through a replica of Galileo's 1609 telescope.

In chronological order, the works on display were:

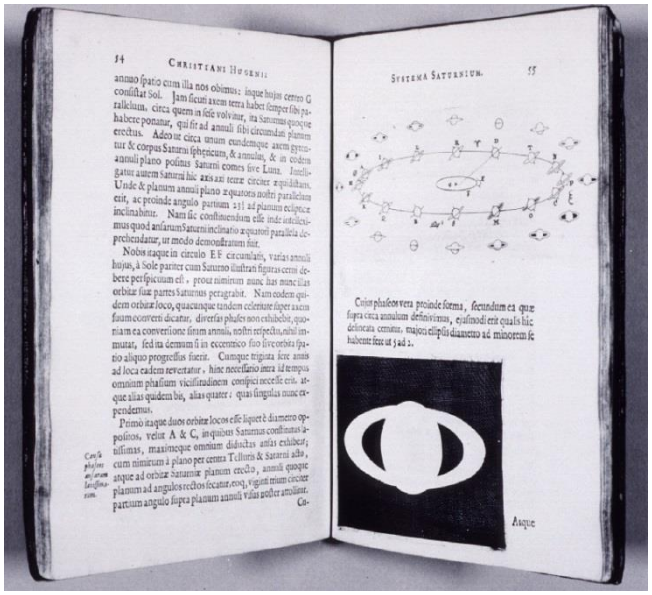
- A handwritten, illuminated copy of Ptolemy's *Almagest* in Latin on parchment, dating from 1279.
- A work by the noted 13th century astronomer and polymath Nasir al-Din al-Tusi, hand-written in Persian in the 14th century.
- Peter Apian's *Astronomicum Caesareum* (1540), opened to a beautifully colored volvelle (a circular calculating engine made of rotating paper discs).
- A Latin translation of Aristotle's *De Caelo et mundo*, published in Venice in 1495
- A Latin translation of Ptolemy's *Almagest* published in Venice in 1528.
- The second edition of Nicholas Copernicus' *De revolutionibus orbium coelestium*, printed in Basel in 1566.
- Kepler's *Astronomia Nova*, 1609, in which he described how his study of the orbit of Mars finally revealed that the planet moved in an ellipse. Kepler's laws of planetary motion are presented in this work.
- An original *Sidereus Nuncius* (Starry Messenger) by Galileo from 1610, describing the first telescope observations of the heavens.

- A 1610 edition of Tycho Brahe's *Astronomiae Instaurate mechanica*, a compendium of his instruments and observations.



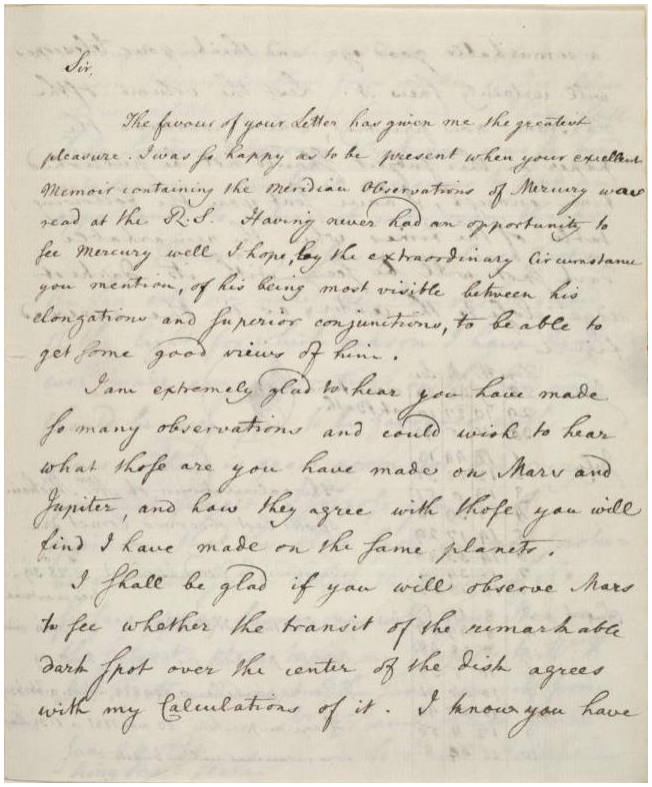
The positions of Mars, from Kepler's *Astronomia Nova*

- First edition (1632) of Galileo's *Dialogo sopra i due massimi sistemi del mondo* (Dialogue Concerning the Two Chief World Systems), published in Italian. This was the work that got Galileo in trouble with the Inquisition the following year. He was accused of heresy and had to repent (did he really mutter "*eppur muove*"?). It was placed on the Index of Forbidden Books for 200 years.
- Francesco Fontana's *Novae coelestium terrestriumq[ue] rerum observationes, et fortasse hactenus non vulgatae*, a lunar and planetary atlas from 1646.
- Johannes Hevelius' *Selenographia* from 1647 (see last month's newsletter).



Huygen's *Systema Saturnia*

- Christian Huygens' *Systema Saturnia* (1660), which includes his drawings of Saturn's rings and the Orion nebula.
- A volume of Joan Blaeu's *Atlas Maior*, published in 1664 and said to be the most expensive book published in the 17th century. The Latin edition is in 11 large volumes and has 594 maps and 3,000 pages of text, covering terrestrial, nautical and astronomical regions.
- The *Philosophical Transactions of the Royal Society* for 1672 opened to Isaac Newton's design for his newly-invented reflector telescope
- Newton's *Principia Mathematica*, a first edition from 1687. This is possibly the most important book in the history of science.
- Thomas Wright's *An Original Theory or New Hypothesis of the Universe*, 1750. In this work Wright described the shape of the Milky Way and suggested that nebulae were distant galaxies.


Sir,

The favour of your Letter has given me the greatest pleasure. I was so happy as to be present when your excellent Memoir containing the Meridian Observations of Mercury was read at the R.S. Having never had an opportunity to see Mercury well I hope, by the extraordinary circumstance you mention, of his being most visible between his elongations and superior conjunctions, to be able to get some good views of him.

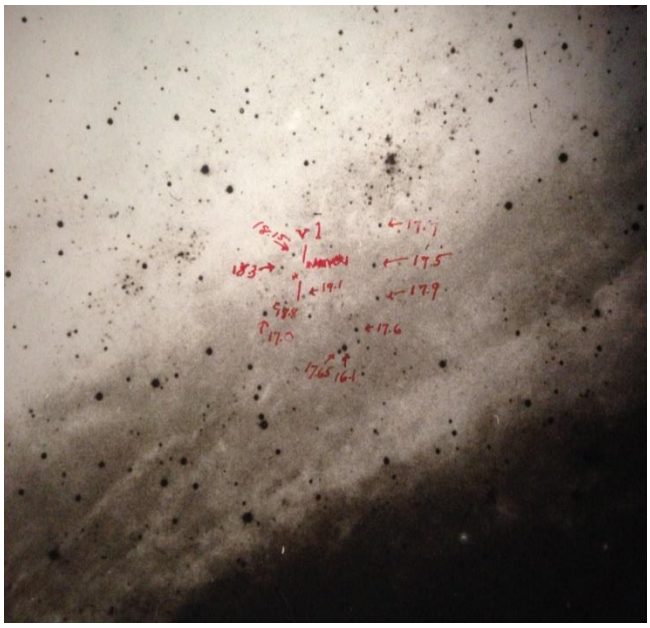
I am extremely glad to hear you have made so many observations and could wish to hear what those are you have made on Mars and Jupiter, and how they agree with those you will find I have made on the same planets.

I shall be glad if you will observe Mars to see whether the transit of the remarkable dark spot over the center of the disk agrees with my calculations of it. I know you have

Herschel's letter about features on Mars

- A letter from William Hershel to Edward Pigott dated 6/24/1781 describing surface features of Mars. Herschel thought that he saw vegetation on the planet.
- A letter from William Herschel dated 9/18/1784 describing Algol as a variable star.

- A letter from Annie Jump Cannon, who was instrumental in developing the classification of stars, to colleague Frederick Seares about stellar wavelengths, dated 8/10/1912.
- A letter from Albert Einstein to George Ellery Hale dated 10/14/1913 asking whether it would be possible to measure star positions around the sun. Hale responds, telling Einstein to wait for a solar eclipse. Einstein, who hadn't yet published the General Theory of Relativity (it came in late 1915), obviously had already figured out that light would be bent in a gravitational field.
- Edwin Hubble's logbook for the 100-inch Hooker telescope at Mt. Wilson, 1919-1923.
- A glass plate photograph of Messier 31 by Edwin Hubble taken with the 100" Hooker instrument. Specific Cepheid variables are marked in his hand. These stars were used to help establish the distance to the galaxy.



Edwin Hubble's image of part of M31, with stellar magnitudes indicated (the image is a negative).

Of all the sciences, astronomy is most connected to its past. The human race's search to understand the world, to shed arbitrary fantasies and to seek proof began with a curiosity about the rhythms of the heavens. We carry today the imprint of the first sky observers who kept records, the Babylonians, in the form of our 360-degree circle, 60-minute hours and 60-second minutes. Lacking precision instruments and anyway more inclined to pure thought than measurement (although there were notable exceptions), the ancient Greeks could only make what they thought were logical guesses, as we can read in Aristotle's *De caelo* and Plato's *Timaeus*. It is true that a few Greeks were rigorous enough to make fairly accurate readings (Eratosthenes' calculation of the Earth's circumference and Hipparchus' calculations of distances to the Sun and Moon come to mind). The message of the Pythagoreans, who antedated Plato and Aristotle, that there must be mathematical rules that govern reality, had its major flowering in Ptolemy's *Almagest*, which held sway for centuries. But even his understanding of the world was merely inferred, not truly deduced, biased as it was by prior assumptions that the Earth was the center of the universe and that all heavenly movements must be circular. It took almost 1400 years for that truly valuable quality of the human psyche, skepticism, to drive Copernicus, then Kepler, then Galileo and then Newton, to discard previous biases and make the intellectual leaps necessary to elucidate the true nature of the universe.

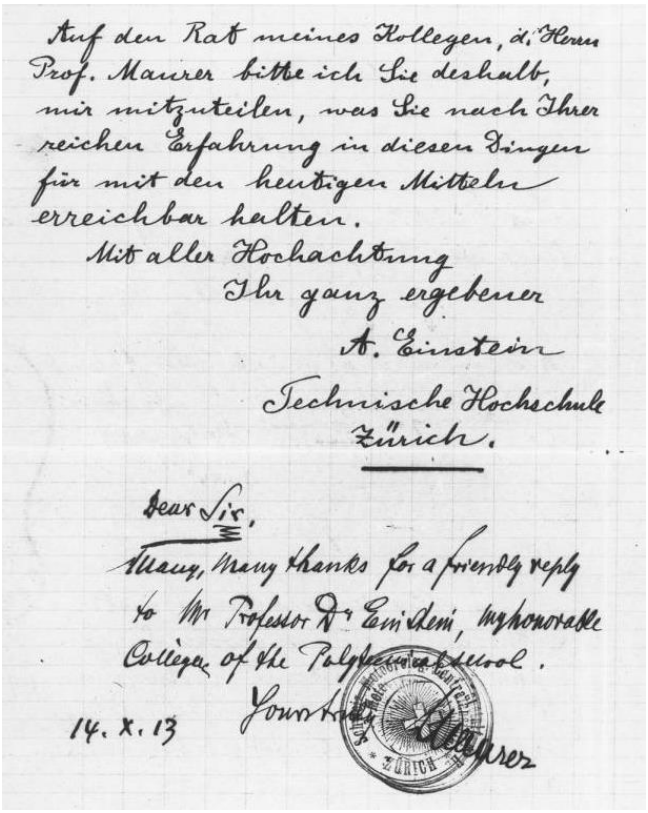
The Ellesmere Chaucer

There's something rather thrilling about seeing the actual volumes of the great works of intellectual discovery and creation. Yes, we can get translations in

paperback, or even on line, and many of the originals have been digitized and offered free on the Internet. This offers a certain kind of protection and even a form of immortality (would that we were able to digitize the contents of the Library at Alexandria before it was burned!). But the authentic physical volumes have a special impact. They are somehow tangible proof that the intellectual leaps and discoveries are still current. They are, in a word, *tangible*.

Title page of Galileo's Dialogo

One can only image what it took to produce a tome such as Kepler's *Astronomia Nova*, or Copernicus's *De revolutionibus*. Taken from a handwritten original, the pages had to be set manually, each page made up of lines of individual letters cast in lead (the letters of course were in reverse, and I can tell you that, having taken printing in junior high school, it's not so easy to get things right). The process of making type and then setting it, line by line, into special jigs is incredibly laborious and few, if any, were sad to see it go once computers took over the job of publishing. Illustrations were either woodcuts or etchings, requiring a sure hand, extraordinary draftsmanship, meticulous attention to detail and of course the ability to draw in reverse. Once printed, the books were expensive, and they are not easy to read even if you are fluent in Latin, in which most of them were written, Galileo's *Dialogo* being the main exception until the 18th century. When we speak of astronomy's connection to its past, it's a connection of ideas but those ideas had to have a physical embodiment and that's what we encounter in these works.


Auf den Rat meines Kollegen, d. Herrn Prof. Maurer bitte ich Sie deshalb, mir mitzuteilen, was Sie nach Ihrer reichen Erfahrung in diesen Dingen für mit den heutigen Mitteln erreichbar halten.

Mit aller Hochachtung

Ihr ganz ergebener

A. Einstein

Technische Hochschule Zürich.

Dear Sir,

Many, many thanks for a friendly reply to Mr Professor Dr Einstein, my honorable College of the Polytechnic school.

14. X. 13

Yours truly

Last page of Einstein's letter to Hale

The development of science, driven by astronomy, did not occur in intellectual isolation, and that's what makes the Huntington such an inspiring place to visit. The other major themes of our civilization, among them literacy, education, exploration, the rule of law, democracy, ethics, equality and tolerance, evolved in parallel (a fine book about the development of western thought from the Renaissance to the present is Jacques Barzun's *From Dawn to Decadence*, HarperCollins, 2000), and the Huntington displays many of the signposts of our culture's journey. Seeing those objects made me think back to the Griffith Observatory, which perhaps symbolizes many of those themes. Like the Huntington, it has the quality of being a temple to enlightenment, a telling exception to the many places around the world in which the dominating structure stands for greed or fundamentalism.

Is the Most Massive Star Still Alive?

Ethan Siegel

The brilliant specks of light twinkling in the night sky, with more and more visible under darker skies and with larger telescope apertures, each have their own story to tell. In general, a star's color correlates very well with its mass and its total lifetime, with the bluest stars representing the hottest, most massive and *shortest-lived* stars in the universe. Even though they contain the most fuel overall, their cores achieve incredibly high temperatures, meaning they burn through their fuel the fastest, in only a few million years instead of roughly ten billion like our sun.

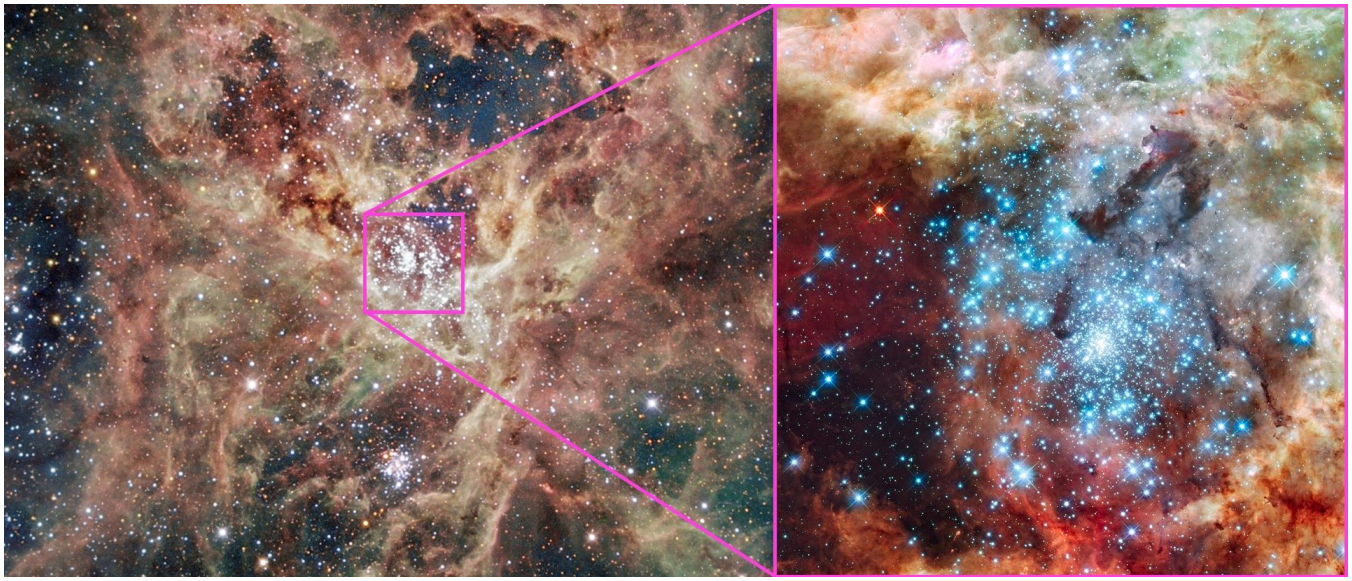
Because of this, it's only the youngest of all star clusters that contain the hottest, bluest stars, and so if we want to find the most massive stars in the universe, we have to look to the largest regions of space that are actively forming them right now.

In our local group of galaxies, that region doesn't belong to the giants, the Milky Way or Andromeda, but to the Large Magellanic Cloud (LMC), a small, satellite galaxy (and fourth-largest in the local group) located 170,000 light years distant.

Despite containing only one percent of the mass of our galaxy, the LMC contains the Tarantula Nebula (30 Doradus), a star-forming nebula approximately 1,000 light years in size, or roughly seven percent of the galaxy itself. You'll have to be south of the Tropic of Cancer to observe it, but if you can locate it, its center contains the super star cluster NGC 2070, holding more than 500,000 unique stars, including many hundreds of spectacular, bright blue ones. With a maximum age of two million years, the stars in this cluster are some of the youngest and most massive ever found.

At the center of NGC 2070 is a very compact concentration of stars known as R136, which is responsible for most of the light illuminating the entire Tarantula Nebula. Consisting of no less than 72 O-class and Wolf-Rayet stars within just 20 arc seconds of one another, the most massive is R136a1, with 260 times the sun's mass and a luminosity that outshines us by a factor of *seven million*.

Since the light has to travel 170,000 light years to reach us, it's quite possible that this star has already died in a spectacular supernova, and might not even exist any longer! The next time you get a good glimpse of the southern skies, look for the most massive star in the universe, and ponder that it might not even still be alive.



Images credit: ESO/IDA/Danish 1.5 m/R. Gendler, C. C. Thöne, C. Féron, and J.-E. Ovaldsen (L), of the giant star-forming Tarantula Nebula in the Large Magellanic Cloud; NASA, ESA, and E. Sabbi (ESA/STScI), with acknowledgment to R. O'Connell (University of Virginia) and the Wide Field Camera 3 Science Oversight Committee (R), of the central merging star cluster NGC 2070, containing the enormous R136a1 at the center.

Venus in the Ultraviolet
Image by John Paladini

John Paladini on Earth, distance 90 million miles

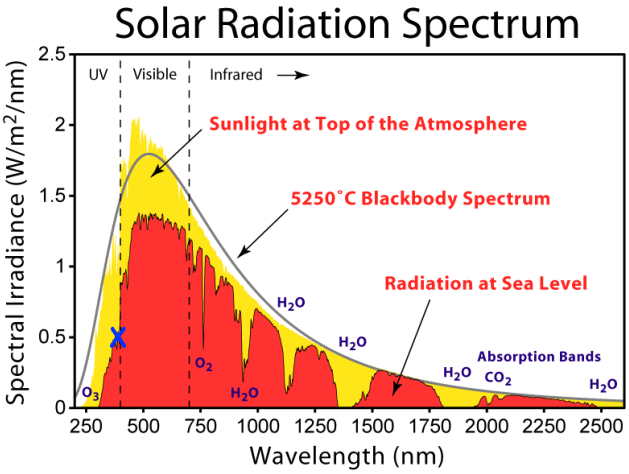
NASA's Galileo in space, distance 1.7 million miles

The thick cloudy atmosphere of Venus has features that are only visible at ultraviolet wavelengths. Because the human eye is not sensitive in the UV, visual observation of Venusian features with an eyepiece and UV filter is essentially impossible. In addition, the Earth's atmosphere absorbs a good deal of the ultraviolet portion of the spectrum, decreasing the number of available photons. Astrophotography with a sensitive detector is the only way to record any planetary detail.

In early May, WAA's John Paladini challenged himself to image the planet Venus in ultraviolet light. John used a Celestron 9.25" SCT on a CGEM mount, an Omega ultraviolet filter with 10 nm bandpass centered on a wavelength of 390 nm, a Televue 2.5x Barlow and a ZWO ASI120MM monochrome planetary camera (640x480 pixels). John captured 1414 frames and stacked the best 1061 in Registax 6. After applying wavelets in Registax, he completed the processing in Photoshop CS3.

John's image clearly shows variances in the albedo of the Venusian cloud layer. The lowest reflectivity is seen in both sub-polar zones. For comparison, John sent an ultraviolet image taken in 1990 by the Galileo space probe, a mission to Jupiter that used a gravitational assist from Venus on its way to the giant planet. The distribution of albedo features on the planet's disk is similar to John's image. John says, "They've got a space view. I've got to do this from my driveway in Mahopac."

Ultraviolet wavelengths are attenuated in the Earth's atmosphere by scattering and absorption. Lord Rayleigh showed in the late 19th century that scattering of light by molecules in the atmosphere is inversely proportional to the 4th power of wavelength. Shorter wavelength blue light is much more scattered than other visible wavelengths, which is why the daytime sky is blue, but the formula also means that ultraviolet light will be scattered even more and thus highly attenuated. Electrons in atmospheric water vapor and ozone absorb UV light by being kicked into orbitals with higher energy levels. Water molecules absorb infrared light by increasing rotational and vibrational energy in the hydrogen-oxygen bonds. Ultraviolet and infrared astronomy research instruments are located in dry mountaintop observatories or, even better, on space telescopes.



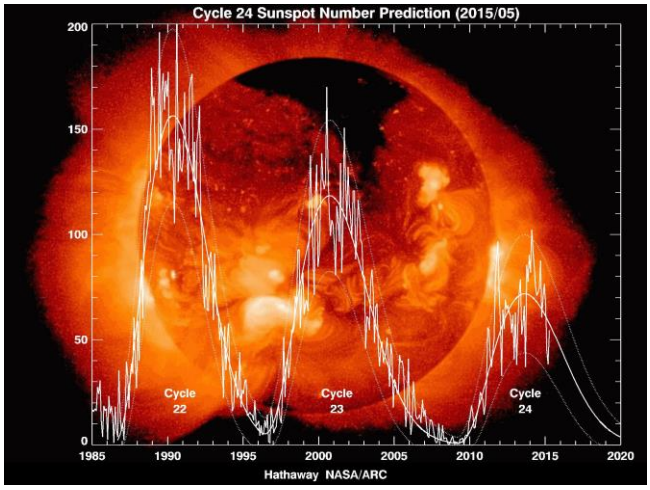
Intensity of solar radiation both within and outside of the Earth's atmosphere. The blue X indicates the irradiance at 390 nm. Venus's clouds simply reflect sunlight.

Astrophotos

The Earth is a Planet Too

Lightning requires a sufficiently high electric potential between two areas in space and a resistant medium in between—for example, an atmosphere. Not surprisingly lightning strikes have been observed on atmosphere rich planets like Jupiter, Saturn and Venus; they are suspected elsewhere in the solar system.

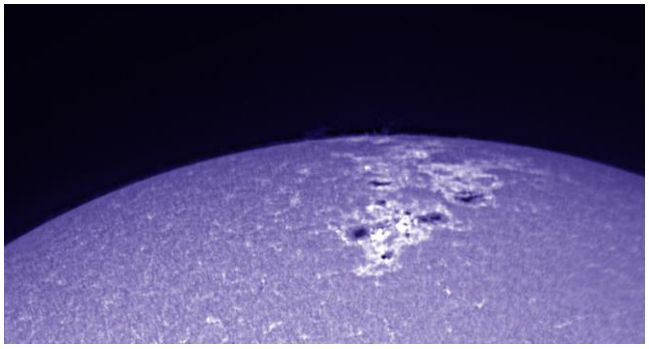
John Paladini took this picture of a lightning strike far closer to home.



Solar Activity

Notes Bob Kelly: Is the Sun quieting down after its weak maximum? We had a great sunspot group last month, but the numbers are waning, overall. But large, electromagnetically disruptive coronal discharges are still possible.

Image Credit: NASA



Solar Close-up

John Paladini recorded this image of two small solar flares and some solar prominences using a CaK filter and 66 mm refractor.