SkyWAAtch

Witch's Broom

The Veil Nebula is a large red, white, and blue target for astro-photographers high in Cygnus during the summer months. Mauri Rosenthal imaged this section – the Western Veil or "Witch's Broom" Nebula (NGC 6960) from his yard in Scarsdale over nine nights in June and July. Each third of the image – left, middle, and right – required one night's worth of images through each of 3 filters – a "broadband" light pollution filter, and narrowband OIII and H-alpha filters. The image was captured with a Starlight Xpress cooled astro-cam through an auto-guided Questar 3.5" telescope, and processed with Nebulosity and PixInsight.

The Witch's Broom is the remnant of a supernova, which exploded about 10,000 years ago. It lies at a distance of approximately 1400 light years.

In This Issue . . .

Events for August

Upcoming Lectures

Pace University, Pleasantville, NY

There will be no lecture for the month of August. Lectures resume on September 16th with Member Presentations Night.

Starway to Heaven

Saturday August 27th, Dusk.
Ward Pound Ridge Reservation,
Cross River, NY

This is our scheduled Starway to Heaven observing date for August, weather permitting. Free and open to the public. The rain/cloud date is September 3rd. **Important Note**: By attending our star parties you are subject to our rules and expectations as described here. Directions and Map.

New Members. . .

Santian Vataj -Somers

Renewing Members. . .

Satya Nitta - Cross River
Gene Lewis - Katonah
Cathleen Walker - Greenwich
Lydia Maria Petrosino - Bronxville
Jon Gumowitz -White Plains
Owen Dugan - Sleepy Hollow
Robbin Conner - Millwood
Jan Wauters - Larchmont
Ihor Szkolar - White Plains
Michael & Ann Cefola - Scarsdale
Chris and Regina Di Menna - Brewster
Eric and Katherine Baumgartner - Redding
Al Ferrari - Yonkers

Outreach Event at Kent, New York Saturday, August 13th

Member telescopes are needed for an Outreach event at the Public Library in Kent, NY. The Conservation Committee of Kent will host the event. Sunset will be at 7:56pm. Primary viewing objects will be Mars and Saturn along with a 77% illuminated moon. The location is 17 Sybils Crossing, Carmel, NY in front of the Kent, NY library on Rt. 52, just off of Rt. 84 exit 18 The cloud/rain date is Saturday, September 10. Contact Paul Alimena at waa-membership@westchesterastronomers.com if you are interested in participating.

Astrophotography Exhibition Greenburg Public Library August 2nd to September 9th

Deep Space and Northern Lights photographer Scott Nammacher, a Westchester based amateur astrophotographer, will be exhibiting his photos in The Howard and Ruth Jacobs Exhibition Hall at the Greenburgh Public Library. The exhibition opens August 2nd and extends to September 9th. It is called "Treasures of the Night Skies."

The Artist Reception will happen August 6th between 2 and 4 pm. It is open to the public.

Mr. Nammacher's photographs are taken from his up-state observatory (Starmere) and two remotely operated observatories (one in Australia and the other in New Mexico). He has been photographing nebulas, galaxies, along with cloud and gas regions, and more local solar system targets since the early 2000s.

Greenburgh Library information:
300 Tarrytown Road, Elmsford, NY 10523
Phone: 914-721-8200
Website: www.greenburghpubliclibrary.org

Artist Information
Website: Starmere.smugmug.com
Email: snammacher@msn.com

Scott took this image of the Northern Lights from Churchill, Manitoba

ALMANAC
For August 2016 by Bob Kelly


Aug 2 Aug 10 Aug 18 Aug 24

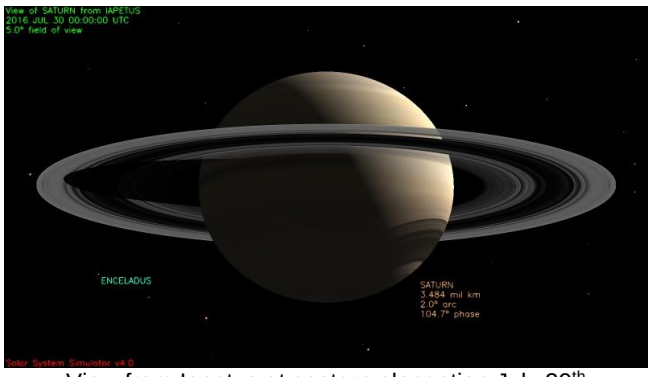
Saturn and Mars dance on the head of a Scorpion this month. This planetary dance, combined with the expanse of the Milky Way rising higher in the evening, and summer warmth team up with slightly longer nights to help overcome any frustration at the difficulty of finding the two brightest planets as they jockey for position low in the bright solar glare.

But first, let's look at prospects for the Perseids meteor shower – peaking on the morning of the 12th. A fat Moon hinders the view for evening astronomical adventurers, but it sets about 1am. Also around 1am on the 12th, the shower may get an extra burst of sparklers with the arrival of a stream of particles from Comet Swift Tuttle. This stand of comet pieces was redirected over the years by Jupiter's gravity and may run into our planet this year. If this concentrated bunch of stragglers doesn't show up, you still have a nice meteor shower until the sky brightens about 4:30am EDT. If the forecast is cloudy for the peak night, there are lots of Perseids in the days before and after the peak.

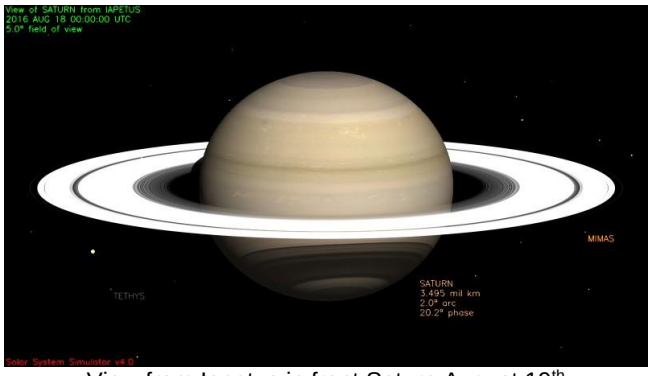
Back to the brighter stuff. In August, as the Earth makes the turn toward the Sun from Mars' point of view, the reddish planet returns to zipping leftward against the starry background from our point of view. What a nice background! It's low in our southern skies, but well marked with a variety of bright stars and various star line-ups. Let's start with Mars crossing the western threshold of Scorpius. Three moderately bright stars form a vertical line, practically daring Mars to break through. Reminds me of one of those games at recess in the schoolyard. Back in those days, these three suns were about the same brightness in our skies. Then in 2000, Delta Scorpii, the middle star, brightened by half a magnitude, making it stand out from the other two stars and giving hope to middle children across the galaxy. Delta Scorpii has dimmed since then, but is it still brighter than the other two. Mars breaks though, passing close by Delta on the 9th. By the 3rd of August, Mars is sitting pretty over Antares. Even with Mars dimming another half-magnitude this month, it's still a magnitude brighter than its rival. Compare and decide for yourself.

Saturn is low in the south, looking like it's keeping an eye on Mars' shenanigans in Scorpius. As if to show the vertical line in western Scorpius how it's done, Saturn, Mars and Antares make a vertical line around the 24th. Set your camera on something sturdy and shoot some time exposures of these three bright objects, especially if you haven't done this before. Saturn's rings are even more impressive than usual, open 26 degrees toward Earth, slightly increasing the rest of the year.

Iapetus, my second favorite Saturian satellite, makes a complete east to west pass in front of Saturn from maximum eastern elongation on July 30th to maximum western elongation on September 8th. At elongation, Iapetus is about 1/5 degree from Saturn; its orbit, as seen from Earth, is almost the width that our Moon looks in our sky. In Iapetus' sky, Saturn and its rings are a nice-looking five degrees wide, with Iapetus moving as much as fifteen degrees above and below Saturn's ring plane. No other large moon of Saturn has this array of views of light and shadow of Saturn and its rings.



View from Iapetus at eastern elongation July 29th



View from Iapetus in front Saturn August 19th

Mercury continues in the evening sky for another month, but it's not very far out of the solar glare as seen from our northern hemisphere. It gets farther out than Venus as the two warily pass each other at five

degrees apart on the 28th. Jupiter gets so low that on the 19th it passes Mercury as Jupiter exits the evening sky for the year. Its final bow is on the evening of the 27th, when it passes very close to Venus; this month's two brightest planets may surprise even casual observers blessed with a clear, clean view of the western horizon as they set 45 minutes after the Sun. They are worth a try in daytime, if can do that safely, but they are only 20 degrees east of the Sun. The two planets are only 8 Jupiter widths (or 24 Venus) widths apart.

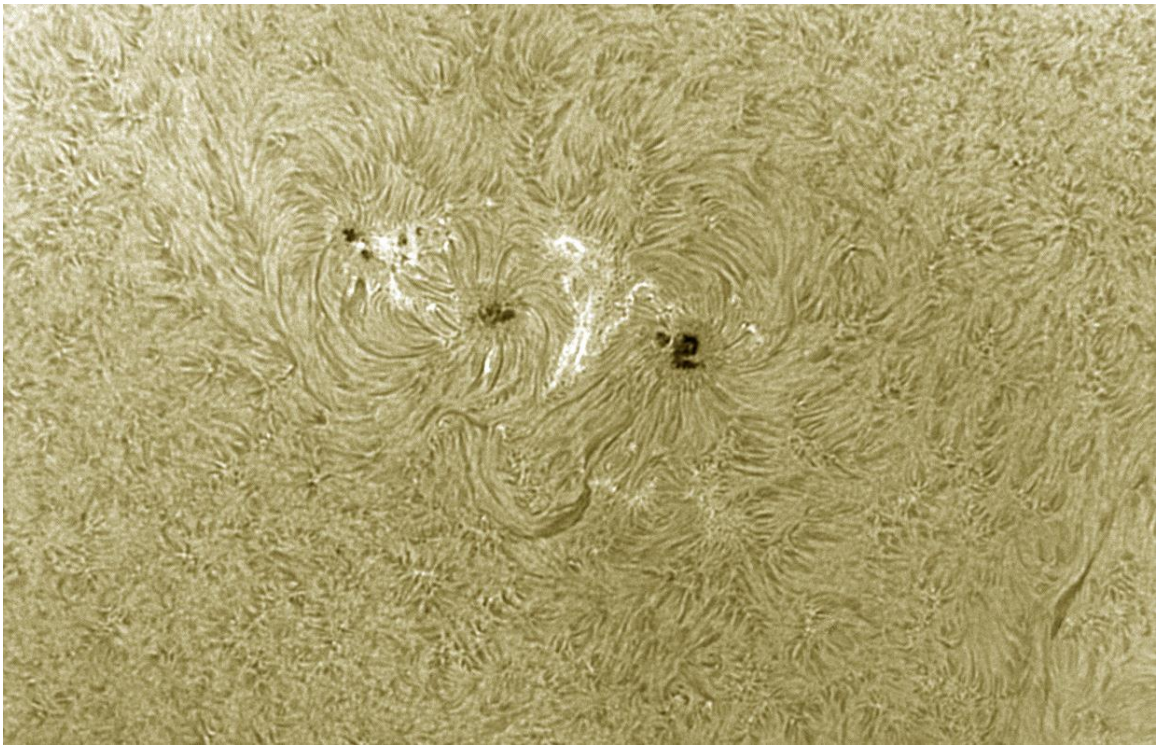
Earth made its annual closest approach to Pluto last month. No matter whether you call it a planet or not, at magnitude +14.2, in a field of many stars of similar brightness, it's hard to find. But once again, the sky serves Pluto up in the 'teaspoon' to the upper left of the 'teapot' of Sagittarius.

It's cool to show people you know exactly where Pluto is in the sky and then talk about the New Horizons spacecraft speeding away from Pluto at 32 thousand miles per hour on its way to its next trans-Neptunian object.

Let's not forget the ice giants of the solar system. Neptune, in Aquarius, traverses the lower southeastern sky in the evening, followed by Uranus in Pisces before midnight.

The International Space Station is visible in the evening through the 18th.

Our month ends with an annular eclipse of the Sun, on the other side of the world, starting two hours thirteen minutes after midnight on September 1st our time. Three percent of the Sun remains uncovered, so no corona will be seen.



John Paladini took this solar image through a Williams Optical 66mm scope using a Daystar Combo quark eyepiece filter.

We Visit Mount Wilson Observatory

Larry Faltz

Immediately after our tour of the Jet Propulsion Laboratory (see the July 2016 SkyWAAtch), Elyse and I drove down to Mount Palomar with Dr. Charles Lawrence, the Chief Scientist for Astronomy and Physics at the Jet Propulsion Laboratory, but to tell the story of the large telescopes in Southern California in the right sequence, it makes sense to first report our visit to Mt. Wilson Observatory, which took place two days later.

George Ellery Hale (1868-1936)

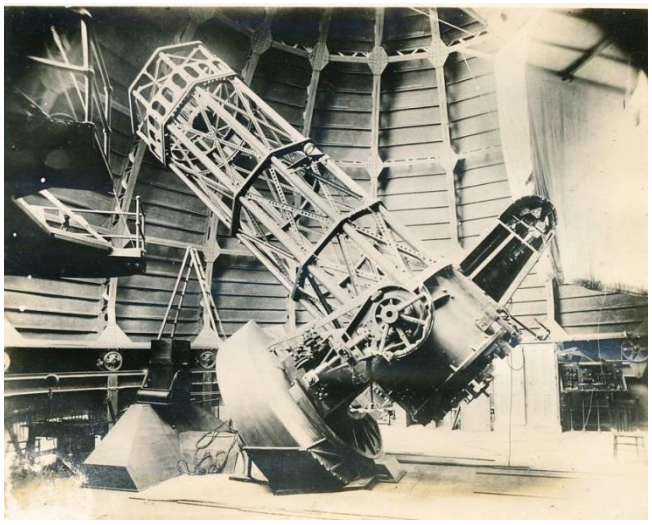
That there are three great telescopes in Southern California, each in its time the largest in the world, is the result of the vision and perseverance of one man, George Ellery Hale. Hale was the son of a wealthy businessman who made his fortune installing elevators in the skyscrapers that rose in Chicago, literally from the ashes of the great fire of 1871. Hale became interested in astronomy after reading Jules Verne's *From the Earth to the Moon*. Already a scientific gearhead (he owned a spectroscope and a fine microscope), at age 14 he convinced his father to buy him a slightly used 4" Alvan Clark refractor, with which he viewed the transit of Venus in 1882. After graduating from MIT, Hale visited the Lick Observatory near San Jose, California on his honeymoon, and decided to become a professional astronomer. Declining an offer from Lick, he convinced his father to build and equip a private observatory near Chicago with a 12" Clark refractor as its main instrument. This facility, the Kenwood Observatory, was eventually given to the University of Chicago and Hale joined the faculty.

At a meeting of the American Association for the Advancement of Science (I'm proud to be a member) in Rochester, NY in 1894, Hale overheard Alvan Clark mention that he had in his possession two 40-inch glass blanks that had been cast by the French firm of M. Mantois. These were the largest blanks of their kind ever made. Clark had been contracted in 1887 to build a large refractor with a mount by Warner & Swazey for the University of Southern California, but the Panic of 1893 caused the backers to cancel the project. Hale was able to convince Chicago transportation magnate Charles Yerkes to fund not only the purchase and figuring of the lenses but also the building of what became the University of Chicago's Yerkes Observatory. The scope would be the largest refractor ever built.

Even before Yerkes opened in 1897, Hale was contemplating even larger telescopes. He was to make, consecutively, the three largest telescopes in the world, and his magnum opus, the 200" at Palomar, was not surpassed in size until 1975 (by a poorly made 6-meter Russian telescope that was an astronomical failure). The Yerkes scope made Hale realize that refractor telescope design was at an end: the tubes were too long for effective balance and viewing positions were too difficult. More importantly, large glass lenses couldn't keep their figure because they sagged in their centers. He grasped that larger telescopes had to be reflectors and in 1896 was able to convince his father to fund the pouring of a 60" mirror blank by another French firm, St. Gobain. Eventually, Hale connected with the newly-established Carnegie Institution of Washington, which had been funded in 1902 by a then-astronomical gift of $10 million from the great steel magnate Andrew Carnegie. Hale convinced the Institution management to fund the telescope and site it not near Chicago but at Wilson's Peak near the southern California city of Pasadena.

Mt. Wilson is not named for an astronomer, or a businessman, or a president. It was first developed by a transplanted Tennessean, Benjamin Davis Wilson, who came to the Pasadena area while it was still in Mexican hands. He married into the Hispanic aristocracy and was known as Don Benito Wilson. Needing wood for wine casks, he built a primitive logging road

up to the summit of the nearest large mountain overlooking the Los Angeles basin above Pasadena. This route became a popular hiking trail and a hotel was built at the top. Eventually a toll road was hewn out of the mountainside, and with the improved access several institutions planned observatories at the site. Hale visited in 1903 and was thrilled at the location and the excellent seeing. Mt. Wilson is purported to have the best seeing in the United States. The combination of the lack of foothills along the San Gabriels and frequent temperature inversions in the LA basin cause winds to rise with laminar flow, minimizing turbulence. An interesting aside is that Don Benito was the grandfather of General George S. Patton.



A 1910 photograph of the 60" telescope

As an astronomer, Hale was primarily interested in the sun. His first instrument on Mt. Wilson was the Snow solar telescope, which used a coelostat and lens to project an image horizontally through a long, narrow building to a spectroscope. This structure is still standing and was used as Nikolai Tesla's laboratory in the 2006 film "The Prestige" (Tesla was played wonderfully by David Bowie). While he did good work with this instrument, Hale realized that the solar image in the Snow was degraded by ground heating. Placing the objective far above the ground would ameliorate that problem. He built a 60 foot tower, projecting the image down a tube to a room underneath. With this telescope, in 1908, Hale recorded Zeeman splitting in the iron line, proving that magnetic fields exist on the sun. An even bigger tower, the 150-foot (actually 176 feet tall), was opened in 1912.

With the funding from the Carnegie Institution in place, figuring of the 60-inch mirror, which had been languishing in the basement at Yerkes, began in 1904 and construction began at Mt. Wilson. The 60-inch telescope saw first light on December 8, 1908. But Hale had already been dreaming of something even bigger, and with seed money from wealthy businessman and amateur astronomer John D. Hooker and more backing from the Carnegie Institution, he had St. Gobain cast a 100" mirror blank, a difficult two-year project. It was delivered before first light of the 60". Figuring the mirror and constructing the telescope, monumental projects for their time, took 9 years. The 100-inch Hooker telescope saw first light on November 2, 1917.

View southwest from the parking lot, across LA to the Pacific

Tours of Mt. Wilson are given from April through October on weekends at 1 PM. Elyse and I arose early on Saturday, April 16th and after breakfast drove west on the I-210 freeway 13 miles from our hotel in Monrovia. We turned onto California Route 2, the Angeles Crest Highway, which is just a 4-lane street through the town on La Cañada Flintridge for about a mile until it narrows to two lanes and starts twisting and climbing up the San Gabriel Mountains. On this bright, clear Saturday morning, hordes of fabulously fit bicyclists were chugging their way up the considerably steep grade. As we rose higher we began to get grand vistas of the Los Angeles basin stretching into the hazy distance, the famous smog less of a problem in the past few decades but never completely gone except perhaps right after a winter rain. After 14 serpentine miles, we turned right onto the Mt. Wilson access road, even curvier, narrower and more precipitous than the Crest Highway. Five miles later, a vast forest of communications towers appeared, marking the summit of the mountain. These towers can be seen from almost everywhere in the Los Angeles area. Curving to the right is the road to the Observatory, and in a few hundred yards we entered a large parking lot overlooking Los Angeles and Pasadena with a

view out to the Pacific Ocean 30 miles to the southwest. Further up the hill was the Cosmic Café, a bare-bones eatery that serves as the focal point for the many visitors to the mountain, only some of whom seemed interested in the observatory. There were large numbers of day hikers and cyclists coming and going throughout the day. We parked in the more convenient upper lot. The mountaintop is a typical California pine forest at an elevation of 5,175 feet. As the crow flies, it's only 7 miles from the center of Pasadena even though it took the better part of an hour to drive there.

We took our time wandering around the observatory in the crisp, sunny morning. Our first stop was of course the 100-inch, which has a visitor's gallery with a nice view of the telescope and the wooden chair on which Edwin Hubble was famously photographed. The chair is on a platform that moves up and down on a track on the inside of the dome to facilitate access to the Cassegrain focus of the telescope. I'll say more about the instrument when I relate the docent tour that we took later.

Hubble at the Cassegrain focus of the100-inch

In the Mt. Wilson Observatory museum

On our way back to the Cosmic Café, we stopped at the observatory's excellent museum. It houses a large number of back-lit displays illustrating the history of the observatory and showing many astronomical images taken with the 60- and 100-inch telescopes. Several pieces of equipment were also on display. A table-top model of the site helped us visualize the layout of the mountaintop.

After lunch at the Cosmic Café (the vegetable chili was acceptable), we met up with Nik Arkimovich, our docent, and about 25 other interested folks. Nik is one of the telescope operators and was an enthusiastic, knowledgeable and at times quite humorous guide.

Docent Nik Arkimovich and our group

Nik gave a lengthy presentation on the history of the observatory. Among the details he related was that the main living quarters for astronomers, out on a promontory overlooking Pasadena, was originally off limits to women and so was nicknamed "The Monastery", which is now its official name. The living quarters at Mt. Palomar are similarly named.

The 150-foot (L) and 60-foot (R) solar telescopes

We first stopped at the dome of the 60-inch telescope, which unfortunately was not open for inspection. It's a Cassegrain reflector on a fork mount whose primary mirror has a focal ratio of f/16 and focal length of 960 inches or 24,380 mm. In other words, it's a "slow"

telescope with a narrow field, not surprising since it was designed primarily for stellar research. It is currently equipped for visual use with 4-inch diameter eyepieces of 100 mm and 50 mm focal lengths. The 100 mm eyepiece produces a magnification of 240x and a true field of view of 11 arc-minutes, and the 50 mm has a magnification of 480x and a true field of view of 6 arc-minutes. Given the small fields of view, the instrument is not well suited for viewing large galaxies or nebulae, and smaller galaxies with low surface brightness suffer from the vast amount of light pollution in the LA basin. Nik told us it does really well with the moon, planets, double stars, globular clusters and planetary nebulae. The telescope is available for an evening's rental with a staff member operating the instrument. The current cost is $950 for a half-night's viewing or $1700 for a full night for a group of up to 25 people. A group that large would require a lot of waiting time, though, but dividing the cost among maybe 10 people would be a reasonable way to do it and still be quite a bargain.

George descending in the external elevator of the 150-foot solar telescope

The most important discovery made with this telescope was Harlow Shapley's determination that the Milky Way was much larger than previously thought and that the sun was not at its center. Shapley examined Cepheid variables in the globular clusters that we now know surround the center of the galaxy. Although right about our place in the galaxy, Shapley did not appreciate that the "spiral nebulas" were outside our own galaxy. History's judgment is that he "lost" the "Great Debate" with Lick Observatory's Heber Curtis in 1920 at the National Academy of Sciences. Curtis held that the nebulae were other Milky Ways, far distant from ours. One of the goals in building the 100-inch was to definitively settle this question.

Next we stopped outside the Snow solar telescope and heard about Hale's interest in solar astronomy. Hale was a visionary and understood the need for large telescopes for astrophysical research, but he did little night-time observing himself, and no night-time science. Nik explained the reasoning behind the progression from the Snow to the 60-foot tower and then to the 150-foot. The visible tower of the 150 foot is actually just an external sheath over the real support structure, so that the mounting maintains its rigidity in the wind: the exoskeleton flexes but the real scaffold is unaffected.

George explaining the operation of the solar telescope

When we got to the 150-foot instrument, we watched as George, the long-time telescope operator, descended in a small open elevator after having fiddled with the optics at the top. Our group accompanied him into the control room of the telescope, which was a rather tight fit once we were all inside. A beautiful, chromatically perfect 2-foot diameter white-light image of the sun was projected on a piece of heavy bright-white drawing paper. George makes exquisite drawings of sunspots every clear day and they are posted on the Mt. Wilson web site. The optical path extends 80 feet below the surface, where a grating can reflect the light

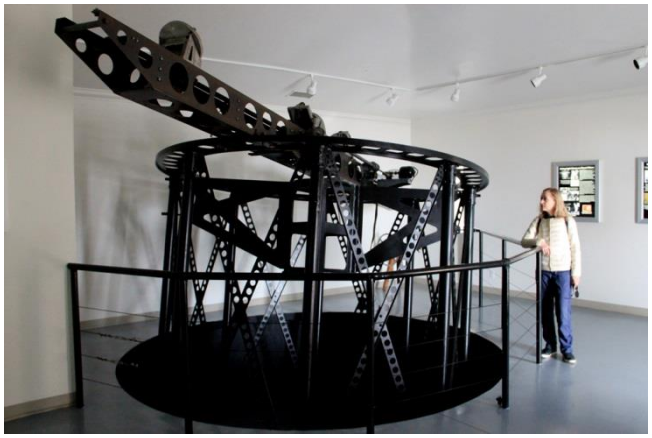
back up for spectroscopy. A room behind the observing area was a museum of out-of-date computer equipment, and we learned that there's little actual solar research done by this telescope anymore. Funding is minimal and the existence of space-based solar telescopes (SOHO, SDO) has made many earth-based solar facilities obsolete. Quite a few are in danger of closing. The 60-foot is still used for research under the auspices of UCLA, while the Snow is a training instrument for graduate and undergraduate students.

One wall of the small control area was festooned with solar diagrams and sunspot data. On another wall, a display of old photographs included one commemorating a visit by Albert Einstein in 1931.

Photograph of Einstein on the wall of the 150-foot

We stopped next at a small dome housing one of the six 1-meter CHARA array telescopes, managed by Georgia State University. The beams are carried through foot-wide pipes to a long building behind the dome of the 100-inch telescope that houses a complex arrangement of mirrors on long optical benches that can be finely adjusted to permit the images to be perfectly combined. We learned that CHARA has a resolution of 0.0005 arc-seconds. In 2007 CHARA imaged the surface of Altair, the first stellar surface other than the sun's to be resolved.

One of the CHARA array telescopes with the dome of the 100-inch in the background



A beam reduction track of the CHARA array on display in the CHARA Visitor's Center.

Finally we entered the dome of the 100-inch. The telescope was, in a word, massive. It is clearly a product of the great industrial age of the late 19th-early 20th century. Weighing 100 tons, its polar-aligned yoke is all plates of steel and rivets, as is the tube and secondary support at the top. It's not surprising that many of the parts were made in a shipyard.

The English yoke mounting does not permit the telescope to get closer than 15 degrees from the pole. This was a necessary compromise to provide sufficient rigidity for an instrument carrying a 4½-ton, 13-inch thick mirror. The designer, Francis Pease, made many innovations, not the least of which was to float the weight-bearing lower end of the polar axis on a film of mercury. The optical fabrication of the mirror, which contained significant flaws, was under the direction of the temperamental George Ritchey (the front half of the later, innovative Ritchey-Chrétien telescope design). It took 5 years of work in the optical shop in Pasadena to achieve an acceptable figure.

View from the Visitor's Gallery. Hale's chair is on the platform to the left.

The mirror, made from the same kind of glass used for wine bottles, was thick enough to retard effective temperature equilibration, and the 100-inch had a reputation for being somewhat difficult to use as a result. Nevertheless, Nik noted that there were more important astronomical discoveries made with this instrument than any other in the world (I know what Nik meant, but I was tempted to cite Galileo's 1-inch cardboard-tube refractor in opposition to this statement).

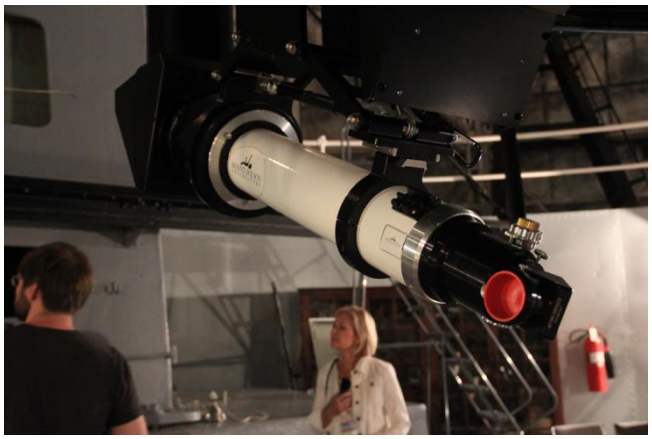
Observations could be made at the prime focus in the observing cage at the top (with the secondary moved out of the way), or at the Cassegrain focus underneath the primary mirror. The prime focus is f/5, while the Cassegrain focus is f/16. There is also a Coudé focus at f/30 used for stellar spectroscopy.

Originally silvered, the mirror received the world's first aluminum coating in 1935 and it was refigured in 2001. While it was a productive research instrument well into the 1960's, in the past few decades it has primarily been used for public outreach. The light pollution in the LA basin is just too great for meaningful deep sky observing.

View from the upper level of the dome.

We went upstairs to inspect the telescope from the mezzanine gallery where the control center is located. This level is actually connected to the dome and rotates with it. Nik, as one of the official scope operators, was allowed to rotate the dome for us, and we had the eerie sensation of standing still while the scope moved, although it was the other way around. The simple wooden control desk still holds some original hardware, including an old 1930's radio, the original clock and some no-longer connected telescope controls. Modern digital technology is now used by the operators.

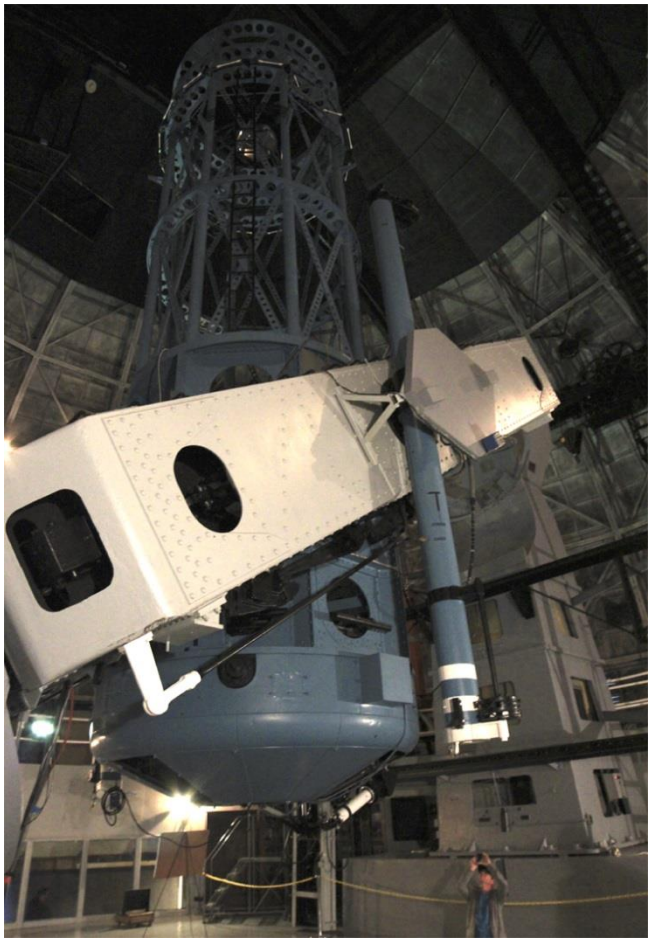
The 100-inch, like the 60, is available for rental, $2,700 for a half-night and $5,000 for a full night, for up to 18 persons (but no children under 12). The Cassegrain focus is used for visual observing, with a system of relay lenses routing the light beam to a refractor underneath the mirror cell. With a focal length of 40,640 mm, the field of view is going to be extremely narrow. If you used a 30 mm 70° eyepiece, you'd be observing at 1,333x with an actual field of view of just 3.1 arc-minutes. Hubble's great discoveries were made primarily from photographs and spectrograms at the Cassegrain and Coudé foci. In spite of its sophisticated and exacting construction, the telescope still required manual guiding for long exposures, memorialized in the photo of Hubble at the eyepiece.



Observing location below the mirror cell

In 1923, Hubble proved that the Andromeda nebula was external to the Milky Way, based on measurements of Cepheid variables in M31. Six years later, he and Milton Humason published their finding that the universe was expanding and estimate of the expansion rate, based on red shifts in the spectrograms of galaxies. In the 1930's, the curmudgeonly Caltech professor Fritz Zwicky found the first evidence for dark matter by calculating the mass of the Coma galaxy cluster

and finding it to be many times greater than could be accounted for by extrapolation of mass from the cluster's luminosity. In the 1940's, Caltech professor Walter Baade made ground-breaking observations of distinct stellar populations. Baade's story is actually quite wonderful, and Nik related it to us in detail. Baade was a German citizen who came to the U.S. in the early 1930's to join the Caltech faculty. Being a prototypical absent-minded professor, he forgot about processing his naturalization papers, so when World War II broke out, he was officially classified as an enemy alien and restricted to the area within 10 miles of his home. Since Mt. Wilson is only 7 miles as the crow flies from Pasadena, he was allowed to observe with the 100-inch telescope. He got a lot of time on the instrument because most of the other astronomers were off working on war-related research, which as an enemy alien he was prohibited from doing. Not only that, because Los Angeles was routinely blacked out during the war for fear of attracting Japanese bombers, Baade was able to observe night after night without any light pollution!



Note the massive north pier (to the right of the photo) upon which the north end of the yoke rests

After the tour we schmoozed with Nik for a while, and then before leaving we went over to an area where other Mt. Wilson docents had set up two Lunt hydrogen-alpha telescopes (50 and 100 mm) and a 60 mm refractor with a Baader white-light filter for solar viewing. We spoke with Bruce Padgett, the impresario for this operation, and we traded amateur astronomy experiences and our enthusiasm for solar observing. Bruce told us about a sidewalk event that was to take place that night in the center of Monrovia, not far from our hotel, and we went over after dinner, meeting members of the Old Town Sidewalk Astronomers led by JPL employee Jane Houston Jones and her husband Morris, a.k.a. "Mojo." They had been long-time associates of John Dobson. Jane writes JPL's "What's Up" podcast.

Solar outreach at Mt. Wilson

The moon (upper left) rising over the San Gabriel Mountains, from the Mt. Wilson access road.

The groundbreaking 60- and 100-inch telescopes on Mt. Wilson are no longer the great research instruments that they were in their primes. But then again, neither is Galileo's cardboard-tube refractor. They are maintained and utilized for the benefit of the public, and by their sheer size and complexity they dazzle as examples of state-of-the-art technology of their time. The constructors, Hale, Pease, Ritchey and many others, leapt into the unknown when they took the audacious step of creating these beautiful behemoths. ■

Venus and Jupiter Prepare for their Close-up this August

Ethan Siegel

As Earth speeds along in its annual journey around the Sun, it consistently overtakes the slower-orbiting outer planets, while the inner worlds catch up to and pass Earth periodically. Sometime after an outer world—particularly a slow-moving gas giant—gets passed by Earth, it appears to migrate closer and closer to the Sun, eventually appearing to slip behind it from our perspective. If you've been watching Jupiter this year, it's been doing exactly that, moving consistently from east to west and closer to the Sun ever since May 9th.

On the other hand, the inner worlds pass by Earth. They speed away from us, then slip behind the Sun from west to east, re-emerging in Earth's evening skies to the east of the Sun. Of all the planets visible from Earth, the two brightest are Venus and Jupiter, which experience a conjunction from our perspective only about once per year. Normally, Venus and Jupiter will appear separated by approximately 0.5º to 3º at closest approach. This is due to the fact that the Solar System's planets don't all orbit in the same perfect, two-dimensional plane.

But this summer, as Venus emerges from behind the Sun and begins catching up to Earth, Jupiter falls back toward the Sun, from Earth's perspective, at the same time. On August 27th, all three planets—Earth, Venus and Jupiter—will make nearly a perfectly straight line.

As a result, Venus and Jupiter, at 9:48 PM Universal time, will appear separated by only 4 arc-minutes, the closest conjunction of naked eye planets since the Venus/Saturn conjunction in 2006. Seen right next to one another, it's startling how much brighter Venus appears than Jupiter; at magnitude -3.80, Venus appears some *eight times brighter than* Jupiter, which is at magnitude -1.53.

Look to the western skies immediately after sunset on August 27th, and the two brightest planets of all—brighter than all the stars—will make a dazzling duo in the twilight sky. As soon as the sun is below the horizon, the pair will be about two fists (at arm's length) to the left of the sun's disappearance and about one fist above a flat horizon. You may need binoculars to find them initially and to separate them. Through a telescope, a large, gibbous Venus will appear no more distant from Jupiter than Callisto, its farthest Galilean satellite.

As a bonus, Mercury is nearby as well. At just 5º below and left of the Venus/Jupiter pair, Mercury achieved a distant conjunction with Venus less than 24 hours prior. In 2065, Venus will actually occult Jupiter, passing in front of the planet's disk. Until then, the only comparably close conjunctions between these two worlds occur in 2039 and 2056, meaning this one is worth some special effort—including traveling to get clear skies and a good horizon—to see!

To teach kids more about Venus and Jupiter, visit the NASA Space Place webpages titled "All About Venus" [http://spaceplace.nasa.gov/all-about-venus/en/] and "All About Jupiter" [http://spaceplace.nasa.gov/all-about-jupiter/en/].

This article is provided by NASA Space Place. With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology. Visit spaceplace.nasa.gov to explore space and Earth science!

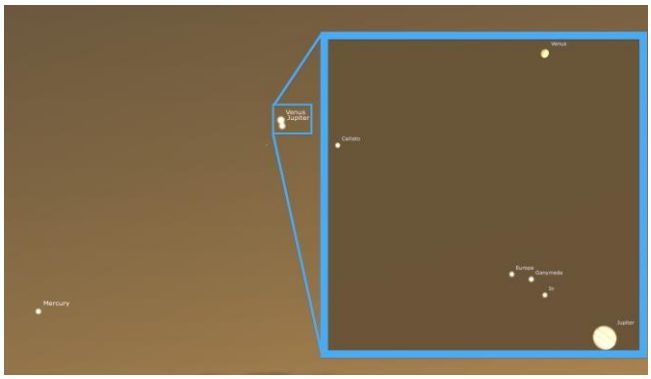


Image credit: E. Siegel, created with Stellarium, of a small section of the western skies as they will appear this August 27th just after sunset from the United States, with Venus and Jupiter separated by less than 6 arc-minutes as shown. Inset shows Venus and Jupiter as they'll appear through a very good amateur telescope, in the same field of view.

Cygnus from Camp Hale

The heart of Cygnus, showing 1st magnitude Deneb (Alpha Cygni) just left of center. Below it is the North American Nebula (NGC 7000) and to its right the fainter Pelican Nebula (IC 5070). In the upper right, surrounding the 2.24 magnitude star Sadr (Gamma Cygni) are several other emission nebulae glowing in the red light of hydrogen.

Taken at Camp Hale, Colorado (9,235 feet) on around 11:30 pm on July 6, 2016. Sky SQM 21.71 (Bortle 3). Stack of two 4 minute exposures with Canon T3i, 50 mm f/1.8 lens at f/4, ISO 1600 (effective focal length 80 mm with APS-C sensor). Camera mounted on iOptron SkyTracker. Stacked with DeepSkyStacker and finished with Photoshop Elements.

Larry Faltz

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

Crescent Nebula

Olivier Prache captured this Ha-LRGB image of the Crescent nebula last month with his Hyperion 12.5" astrograph in Pleasantville. Notes Olivier: Even though our human eyes cannot see in Ha (such a pity…) and I typically prefer to get "real" images, in this case it does enhance the subject. And it is not likely we'll get the chance to get closer in our lifetimes, so why not?

Olivier processed the image in PixInsight with a script that handles the integration of Ha into RGB and prevents an overly reddish tint to the image (although it does put most of it in the red channel). All in all, it took Olivier about 9 hours of exposure.

The Crescent nebula (NGC 6888) is an emission nebula in Cygnus and lies at a distance of about 5000 light years.