Mount Wilson Restores Warner & Swasey Refractor to Dome

by JOHN W. BRIGGS

After some 20 years packed away in the far back of the Snow solar telescope building, Mount Wilson’s famous 6-inch refractor, originally housed in the Burnham-style dome near the 60-inch in 1914, has finally returned to its original setting. It had been dearly missed by many former users. Its builder, the Warner & Swasey firm of Cleveland, Ohio, was the Rolls Royce of telescope engineering, and its 6-inch objective, made by the John A. Brashear Company, is unusually excellent. The telescope’s iron pillar and weight-powered sidereal drive governor were reinstalled by CHARA Site Manager Larry Webster. Professor Paula Turner, Director of the CUREA program, leveled the pillar on its masonry foundation. John W. Briggs, a former Mount Wilson resident and a staff observer on the long-running HK Project, drove in from New Mexico and attended to mechanical details of the equatorial head.

The telescope tube was lifted and secured in place on June 15, 2015, by Steve Golden, Webster, and Briggs. A small but critical brass part, a declination clamp friction block, had been found missing as the telescope was uncrated. Its replacement was skillfully and expeditiously made by Golden in the CHARA machine shop. The 16-inch Meade Schmidt-Cassegrain telescope that had most recently occupied the 6-inch dome now resides in the dome close to the monastery that originally housed a 10-inch Cooke-triplet astrograph.

While many old telescopes have had their weight-powered drives replaced by synchronous motors and the like, the 6-inch remains original. As Louis Bell wrote in his 1922 book, The Telescope, “It is really remarkable that clockworks of so simple character as these should perform as well as experience shows that they do.” Indeed, the 6-inch tracked extremely well before it was removed from service circa 1995. The German equatorial mounting is equipped with coarsely and finely graduated setting circles, the fine scales read with four illuminated verniers and magnifiers. The original electric bulbs are missing, as well as two of the simple magnifiers. But these parts can be easily replicated. The equatorial also includes an easy-to-use slip-ring right ascension circle. With these features, finding daytime targets like Venus, other planets, and the brighter stars is relatively simple with the 6-inch.

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NEWS + NOTES

100-INCH TELESCOPE PUBLIC OBSERVING

The historic Mount Wilson 100-inch telescope is once again serving a great purpose. Instead of redefining our ideas of our universe by measurements, now it is serving to delight the public by direct observation through the telescope. Last year the Observatory conducted two successful pathfinder 100-inch telescope sessions to launch this program, thanks to a cadre of extraordinary volunteers updating the telescope’s systems and developing safe run-rules. This telescope’s resolution makes viewing the sky’s treasures through it an experience like no other. And it is quite common for everyone in the dome to be gazing at the telescope when not looking through it. In 2015, the first full season for this program, the Observatory has held numerous 100-inch telescope sessions, including four Public Ticket Nights (for individuals). At this point of the 2015 season, we have noticed a shift in the balance of Mount Wilson Observatory’s telescope sessions from all/mostly 60-inch telescope sessions to equal or more 100-inch telescope sessions. We hope we will have the pleasure of seeing you in an upcoming session! For information on how you can schedule a session for yourself or your group, go to: www.mtwilson.edu/100in.html.

MOUNT WILSON SPEAKER’S BUREAU EXTENDS PUBLIC OUTREACH

A Speaker’s Bureau has been established to facilitate setting up educational talks on Mount Wilson Observatory’s history for service clubs, schools, neighborhood organizations, astronomy clubs, and other appropriate groups. To engage a speaker, send email to Don Nicholson — dnich@alumni.caltech.edu.

JPL’S OPEN HOUSE IS OCTOBER 10–11

NASAs Jet Propulsion Laboratory will hold Open House on Saturday and Sunday, October 10–11, 9 a.m.–4 p.m. See a life-size model of the Mars Science Laboratory rover, learn about current missions, tour the Microdevices Lab, and more. Free. Information: www.jpl.nasa.gov/events/open-house.php.

CARNEGIE OBSERVATORIES’ 14TH ANNUAL OPEN HOUSE — OCTOBER 18

Celebrate the wonders of astronomy — past, present, and future — at the Carnegie Observatories’ Open House on Sunday, October 18 from 2 to 5 p.m. at 813 Santa Barbara Street, Pasadena. Meet astronomers, see photos from Las Campanas observatory, visit the machine shop to see how instruments are made for the observatory in Chile, view the Sun through a solar telescope, tour the historic Hale Library, get the latest update on the Giant Magellan Telescope, and enjoy refreshments and music in the outdoor courtyard. Be sure to RSVP by Tuesday, October 13 at 626-304-0250 or rsvp@obs.carnegiescience.edu. Visit the website for more information — www.obs.carnegiescience.edu.

—Bob Eklund

FOMWO Membership

★ All are invited to join the Friends of Mount Wilson Observatory. The Observatory receives no continuing state or federal support. You can help ensure the continued operation of this science heritage site with your tax-deductible gift. FOMWO offers a variety of membership levels and benefits. For information on how to become a FOMWO member, visit www.mtwilson.edu. The Observatory welcomes donations and volunteer efforts of all kinds, and we thank you.
George Ellery Hale’s 1912 Cadillac

Cadillac produced 13,995 model year 1912 cars. This was the first production car to have an electric starter and lights. The car had right-hand steering, a four-cylinder 40 horsepower in-line engine, and 36×4 tires. The basic price was $1800. Hale bought one of them. It must have been the electric starter. This is the car that Ferdinand Ellerman is lubricating in the 1915 photograph featured in the June 2015 issue of Reflections. Hale used the Cadillac for a period of time and then gave it to another astronomer.

Around 1920, the car had run out of its useful life. It was then pushed, most likely without a commitment service, over the side into a canyon. Over time a number of cars would join it.

In 1972, the Mount Wilson Observatory superintendent, Larry Bornhurst, found the car graveyard while looking for water. He was later able to identify the Cadillac, with a tree growing through its chassis, as George Ellery Hale’s.

Contact was made with members of the Horseless Carriage Club of America (HCCA). On Saturday, July 28, 1973, they removed smaller parts of the car and then paid $600 for a helicopter to airlift the transmission, chassis, and rear wheels from the canyon. Mr. Jim Renzulli (1918–2006) of the HCCA, who became the principal restorer, told the Los Angeles Times reporter covering the story that many of the parts brought out were in fine shape and that the car would be on the road in two years.

This turned out to be a highly over-optimistic pair of statements. The facts are that very few of the recovered parts could be restored, but those that were are now part of Mr. Renzulli’s completed restoration.

This restoration is still around. It is in private ownership in San Diego, California. George Ellery Hale’s 1912 Cadillac, in a small way, is still with us.

1 www.motorera.com/cadillac
3 Author’s personal contact with Mr. Les von Nordheim (HCCA) on July 10, 2015.
4 Author’s personal contact with Mr. Jim Colley (HCCA) of the Colley Museum, San Diego, California, July 13, 2015. He was a close friend of Jim Renzulli, and is now 105 years old.
5 Author’s personal contact with Mr. Fred Enstrom, present owner of the car, July 13, 2015.

The Mount Wilson 1912 Cadillac Retrieval. These photographs, provided by Mr. Fred Enstrom (the current owner of the restored vehicle), document the retrieval of what was left of G. E. Hale’s Cadillac. Mr. Jim Renzulli is shown standing next to the twisted carcass of the vehicle. He is the person who paid for the helicopter and later restored the car to what it is today (shown in the top left “showroom” photograph). The middle and bottom photos show a large piece of the vehicle and its removal from the mountain.
According to the 1914 annual report of the Observatory director, George Ellery Hale, the 6-inch came to Mount Wilson in connection with the solar program. Equipped with an Evershed solar spectroscope by Adam Hilger, the refractor allowed a visual patrol for interesting solar eruptions. Outbursts could then be targeted and recorded with the Snow telescope, the newer tower telescopes, and their spectrographs.

The 6-inch was also an asset for visiting student groups. A century ago, for example, there were annual expeditions to Mount Wilson from Pomona College. These are recounted in one of America’s more obscure astronomical journals, *Publications of the Astronomical Society of Pomona College*, edited by F. P. Bracket. A 1915 description, recorded by a Pomona student, testifies to the strenuous adventure of Mount Wilson in that era:

By nine o’clock the climb up the trail from Sierra Madre was begun. The impedimenta, as well as some of the party, had been consigned to animals. Fortunately for us, the weather was not entirely clear and the trail was not so hot as it is sometimes. We arrived at the “Halfway House” by eleven o’clock. Here the pack mule was relieved of the lunch.

The article goes on to relate a detailed tour and special nighttime viewing, including an account of the 6-inch:

Professor W. S. Adams now took us to the six-inch refractor. This instrument is new since last year, its purpose is for solar observation, for exploration rather than research. It is equipped with a small prism spectrograph [sic] giving a considerable dispersion. Fortunately by this time the fog was vanishing, so that we were able to observe the Fraunhofer lines in the solar spectrum.

The high-dispersion Evershed spectroscope allowed viewing chromospheric structure — prominences — as emission features inside the wide hydrogen-alpha absorption line. This classic technique of solar astronomy is described by Charles A. Young in his 1881 book, *The Sun*.

Using the Telescope

During the late 1920s and early 1930s, the 6-inch telescope, while predominately used as a solar instrument, was available to staff members’ families for recreational use. During this period Don Nicholson, son of staff astronomer Seth Nicholson, had many opportunities to use the telescope for personal viewing. He remembers it as an easy-to-use, high-quality instrument.

By 1941, Mount Wilson astronomer Edison Pettit employed breakthrough technology to build a solar “interference polarizing monochrometer” for the 6-inch. This was a revolutionary device for viewing in hydrogen-alpha light and was easier to use than the Evershed spectroscope. The delicate monochrometer survives with the 6-inch and was able to show prominences as recently as April 1988, its last recorded use. Trying the Pettit filter again will be among the first projects with the resurrected 6-inch.

Even given the rich history of the 6-inch from Mount Wilson’s early days, probably no one did more to make it famous today than the late staff member Thomas A. Cragg, who was active with the American Association of Variable Star Observers. Cragg’s success following variables as faint as 15th magnitude using only a 6-inch telescope was astonishing to colleagues in the AAVSO. Few of them, however, had experienced the rare combination of excellent optics in perfect seeing — “seeing” being astronomer’s jargon for atmospheric steadiness that, at Mount Wilson, often allows very high-resolution viewing.

Discovery of the Logbook

An unexpected but very happy surprise during the reinstallation of the telescope was the discovery of the long-lost 6-inch logbook, started in 1987, that evidently had been removed for safekeeping by someone shortly after the 6-inch was dismounted to make way for a Meade Schmidt camera. The logbook documents a general reactivation of the 6-inch in the late 1980s, including activities from the
first years of CUREA. It also records several memorable Mount Wilson Observatory Association sessions with the 60-inch.

Among visitors recorded in the log are AAVSO members John W. Griesé III, Peter Collins, Father Ronald E. Royer, and John E. Bortle; Hank Bonney of Sky & Telescope; MWOA members Bob Eklund, Connie J. Chrones, and optical engineer Greg Smith; many Mount Wilson staff, family, and friends; visiting amateurs like Ron Parmentier and George H. McCourt from Wisconsin; Craig R. Robertson, then of the Harvard-Smithsonian Center for Astrophysics; Dan Zuras of Group 70, Inc.; and Wendy A. Whiting of NASA’s Kuiper Airborne Observatory. Especially impressive are drawings by Stephen J. O’Meara, conductor of the Amateur Astronomers department of Sky & Telescope magazine, recording visual sessions at the 60-inch observing Saturn, Mars, and various nebulae. Also recorded in scrapbook fashion are prints from Steve Golden’s early image-processing experiments. Golden’s system ran with his tripod-mounted Celestron 14 Compustar telescope that occasionally shared the dome with the refractor. The Celestron’s microprocessor-powered motion control, designed by Mike Simmons (later known as Max Reason, and no relation to Mount Wilson’s Mike Simmons, the founding president of MWOA), used microstepped motors and was a revolutionary product in its time.

LOGBOOK DRAWINGS AND NOTES

Especially memorable for some observers are logbook drawings recording an inferior conjunction of Venus in 1988. Viewed during midday with the refractor’s aperture in a shadow (created by a large sheet of cardboard clamped to the dome aperture), Venus revealed itself as a remarkable razor-thin extended arc some 225 degrees long — much as shown in classic texts. The Sun was only about 4 degrees away during this observation. Other drawings show interesting diffraction phenomena visible only in near-perfect seeing, for example, a first-order diffraction arc accompanying the sharp limb of Venus — but without a matching artifact on the terminator side. This was explained by the terminator’s much softer gradation. Likely related to this phenomenon, on May 9, 1988, Mount Wilson solar observer Steve Padilla, observing with Briggs, noticed an interesting apparent flattening of the Venustian cusps.

Of the 60-inch sessions run for MWOA, observations of many objects are noted in the logbook. An account of planetary nebula NGC 7027 is especially compelling. From an entry July 9, 1988:

The remarkable “Potato Planetary,” so named last summer by MWOA members. Irregular, complex structure; off-center star (could be double?) in a blue-green nebula. Remarkable object.

In a 60-inch session September 26, 1987, Briggs recorded of Jupiter:

ONE OF THE MOST ARTISTIC PAGES in the Mount Wilson 6-inch logbook was entered by Stephen James O’Meara during a visit with the author August 5–7, 1988. The views recorded show Mars in poor seeing with the 60-inch, and the Sun in hydrogen-alpha light using Steve Golden’s Celestron 14-inch and Daystar filter, tripod-mounted on the south floor of the 6-inch dome.
Absolutely a fantastic, Voyager-style view, much better than last time, and surely the best view I’ve ever had of the disk and moons. Swirls & festoons & a herd of white ovals. JIII [Ganymede] hints of surface features and began a slow shadow transit as I watched. Shadow was elongated as it entered the planet’s disk. Moon disks are huge with very sharp edges. The geometry of the shadow as it made contact with Jupiter was very sharp and well defined [inserted sketch]. No red spot now, but some large festoons have a funny color, described as ashen grey-blue, very distinct to the rest of the disk. What causes the strange color? Some compared the view to be better than a memorable one with the 100-inch. Used 55-mm eyepiece and tried 40-mm with a 0.3 neutral density filter. Of any sight possible with a telescope, it’s hard to imagine one better than this.

Seeing at Mount Wilson is not always excellent. Such a night was March 23, 1988, when Padilla and Briggs had access to the 60-inch at its f/16 Cassegrain focus. Briggs wrote:

Venus with 55-mm [eyepiece]. Bad seeing — planet too far to the west. No ashen light. Messier 42 — not too hot in bad seeing... Alpha Leonis with visual spectroscope, then with 4.8-mm eyepiece! [The resulting magnification was about 5,080.] Steve Padilla said it was “like trailing the backside of a comet.” Was a fiery image in the bad seeing, the air whipping the starlight around, but inside the core of the fire it was mottled or granulated, the granulation changing as fast as the seeing. Almost like the core of a well-resolved globular [cluster], but of course not at all static. Was this an interference effect? [It certainly was.] Looked like 1,000 Airy disks swarming in the air, black between the disks.

As Padilla and Briggs realized, they were indeed seeing firsthand the interference pattern that is at the heart of speckle interferometry.

**THE 1987 WHITTIER NARROWS EARTHQUAKE**

On August 13, 1988, senior Mount Wilson observer Jim Frazer recorded a curious phenomenon he witnessed 10 months earlier while sitting on the observing floor just north of the 60-inch telescope, operating the HK spectrophotometer:

Oct. 3, 1987. [Magnitude] 5.0 aftershock of the Oct. 1 earthquake. Moon 3 days past first quarter. Time of the aftershock was around 1:00 AM PST. I was observing the Hyades stars. The telescope was about 1/2 hour west in hour angle, and the sky was clear. The aftershock lasted about 10–15 seconds. Most of that time I was looking at the TV monitors [that revealed the telescope’s vibration]. But during the last few seconds of the aftershock I decided to look over at the telescope.

I looked out through the dome slit at the sky. I could see alpha Tauri [Aldebaran], but the rest of the constellation was washed out by earthquake light. The light was bright enough that it seemed like a full Moon was out. The light switched off suddenly when the shaking stopped. So I witnessed the earthquake light for about 1–2 seconds. I did not see any colors or any structure to the light.

Briggs had recorded of the main earthquake:

Major earthquake R = 6.1 hit Los Angeles this morning and moved the north pier of the 100-inch about 0.5 mm. We could tell by the paint line. A bit of mercury leakage at both 100-inch and 60-inch — just a few beads. Later in the day, lightning hit a pine near the 60-inch, just as Victoria Scott was walking about 10 feet away! A bad day for day sleepers.

Frazer’s account was eventually published in the April 1999 issue of Astronomy & Geophysics magazine of the Royal Astronomical Society.

**THE BRASHEAR’S SECOND FIRST LIGHT**

The 6-inch has thus inspired a diary that includes notes, sketches, and snapshots from hundreds of personal experiences at Mount Wilson. The earliest CUREA students are recorded, including descriptions of how the refractor served them for various hands-on observations and demonstrations, both day and night. While much has changed,
many of the telescope’s former users continue a presence at Mount Wilson. The resurrection of the instrument was eagerly anticipated. The most recent logbook entry is an insert from Don Nicholson. Now that the telescope has been returned to its original dome, he hopes to have many more opportunities to use it again. As a start, he was privileged [as he put it] to be in attendance, with Sam Hale, Larry Webster, and Tom Meneghini, at its second “first light” on July 11, 2015. So the logbook’s informal record of interesting and fun experience now continues.

Postscript
A technical detail regarding the 6-inch is that its optical design features a flint-glass-forward achromatic lens. This was typical of many produced by Brashear’s firm in consultation with optical designer Charles S. Hastings. Flint-forward lenses are often misassembled to become backwards in their cells, because the crown-glass-forward mode is much more common and is typically the only one illustrated in textbooks. (Misassembled achromats still focus, but not sharply.) At some point, an engraving was added to the Brashear lens cell noting that it is a flint-forward design. The inscription mentions the Ross company. But because everything about the lens and its distinctive cell is consistent with it being a Brashear, and because it was historically known as a Brashear by Mount Wilson staff, the inscription “Ross” is more likely an error than an accurate reference to the manufacturer. The unusual long-focus finderscope on the 6-inch, by the way, has mechanical features unequivocally distinguishing it as a Brashear tube assembly.

The Author
John W. Briggs has lived and worked at observatories across the country in various technical capacities, including Mount Wilson, Yerkes, National Solar, Maria Mitchell, Venezuelan National, and others. In the 1980s he was an assistant editor at Sky & Telescope magazine and built Bogsucker Observatory in Massachusetts. In 1994, he was a winter-over scientist at South Pole Station working for University of Chicago’s Center for Astrophysical Research in Antarctica. In the later 1990s, he was a team member in the final commissioning of the Sloan Digital Sky Survey, and with his family he lived near Sunspot, New Mexico, altogether some seven years. An active collector of astronomical history, he has recently committed to serve a second term as president of the Antique Telescope Society, and he is active with the Historical Astronomy Division of the American Astronomical Society. Currently he is organizing the Astronomical Lyceum, a new astronomical museum in Magdalena, New Mexico, where he serves as a board member of the Chamber of Commerce.

Notes
1 The original Burnham dome that inspired the design used for the 60-foot, 150-foot, and 6-inch telescopes is illustrated in volume I of Publications of the Yerkes Observatory of the University of Chicago, opposite page xiv.
2 The Center for High Angular Resolution Astronomy (CHARA) is operated by Georgia State University.
3 The Consortium for Undergraduate Research and Education in Astronomy (CUREA) is an annual two-week program for undergraduates held at Mount Wilson.
4 Olin Wilson began the HK Project in 1966 to see if stars showed decade-long sunspot cycles like the Sun. The HK Project was named after the two specific spectral lines of ionized calcium (H and K) that allow us to derive information on magnetic variations. In 1977 the project moved from the 100-inch to the 60-inch and was automated with a photometer designed by Arthur Vaughan. In 1981, the first woman hired as a telescope operator at Mount Wilson worked on the HK Project: Laura Woodard.
5 In “Early Days at Mount Wilson” (Publications of the Astronomical Society of the Pacific, October 1947), Walter S. Adams wrote “...the general term of ‘animal’ was applied to the miscellaneous and picturesque assortment of burros, mules, and occasional horses which were maintained...at the foot of the old trail in Sierra Madre for carrying visitors and supplies to the various mountain camps.” Ordering an animal” was the regular expression for engaging a beast of burden...”
VISITOR INFORMATION

OBSERVATORY STATUS
Welcome hikers, bikers, star-gazers, visitors of all interests! The Observatory and Skyline Park are open from 10:00 A.M. to 5:00 P.M. daily until November 30, 2015, weather permitting. The Cosmic Café at the Pavilion, offering fresh-made sandwiches and Observatory memorabilia, is open Saturdays and Sundays from 10:00 A.M. to 5:00 P.M. You may purchase a National Forest Adventure Pass at the Café for parking.

DOCENT-LED WALKING TOURS
Two-hour weekend tours of the Observatory are held on Saturdays and Sundays at 1:00 P.M. Meet at the Cosmic Café at the Pavilion to buy a ticket. Guests on these tours are admitted to the telescope floor beneath the historic 100-inch telescope.

SPECIAL GROUP TOURS
Group daytime tours are available. Reservations are required and a modest fee is charged. Groups can also place orders in advance for box lunches from the Cosmic Café. For information, please visit www.mtwilson.edu.

LOOK THROUGH THE TELESCOPES
Mount Wilson’s 60-inch telescope and 100-inch telescope provide incredible views of some of the most beautiful objects in the night sky. For details on scheduling a viewing session, see www.mtwilson.edu.

PARKING AT THE OBSERVATORY
The U.S. Forest Service requires those parking within the Angeles National Forest and the National Monument (including the Observatory) to display a National Forest Adventure Pass. For information, visit www.fs.usda.gov/angeles/. Display of a National Parks Senior Pass or Golden Age Passport is also acceptable.

HOW TO GET TO MOUNT WILSON OBSERVATORY
From the 210 freeway, follow Angeles Crest Highway (State Highway 2 north) from La Cañada Flintridge to the Mount Wilson–Red Box Road; turn right, go 5 miles to the Observatory gate marked Skyline Park, and park in the lot below the Pavilion. Visit the Cosmic Café at the Pavilion, or walk in on the Observatory access road (far left side of parking lot) about 1/4 mile to the Observatory area. The Museum is opposite the 150-foot solar tower.