CUREA 2013

The Consortium for Undergraduate Research and Education in Astronomy (CUREA) held its annual observational astronomy program at Mount Wilson Observatory July 28–August 10, 2013. The program is aimed at undergraduate students considering a career in science or science education who are interested in hands-on exploration of astronomy.

During the intensive two-week, on-site course, students used historic and modern facilities. Class sessions and telescopic observations emphasized how our present understanding of the Sun has been achieved and how it relates to the astrophysics of stars. Student-driven, hands-on experiences focused on observable solar, stellar, and deep-sky phenomena.

INSTRUMENTS AND TECHNIQUES

During the course, CUREA students used:

• The Snow solar telescope, in conjunction with a high-resolution spectrograph.

• A 16-inch Meade LX200 Schmidt–Cassegrain telescope with CCD camera and spectrograph.

• The historic 60-inch reflector: one half and one full night, studying planets, clusters, star pairs, and planetary nebulae.

• Image processing for true-color images, broadband photometry, and solar and stellar spectroscopy.

During the second week, each student pursued a unique observing project she or he had chosen, taking original observations, processing and analyzing the data, and reporting results to the group.

In this issue ...

Visit the Observatory

Mount Wilson Observatory is now open to public visitors every day from 10 a.m. to 5 p.m., weather and road conditions permitting. The Cosmic Café at the Pavilion is open Saturdays and Sundays, 10 a.m. to 4 p.m., offering a variety of fresh-made sandwiches and other treats to visitors to the Observatory. Here is where you may purchase tickets for the weekend walking tours or a National Forest Adventure Pass (required for parking in the Angeles National Forest, including Mount Wilson Observatory). Friends of Mount Wilson Observatory members enjoy a 10 percent discount on food as well as memorabilia. Come on up and enjoy a wonderful day of sunshine and mountain air!
ABOUT US

The Mount Wilson Institute operates Mount Wilson Observatory on behalf of the Carnegie Institution for Science. Mount Wilson Institute is dedicated to preserving the Observatory for scientific research and fostering public appreciation of the historic cultural heritage of the Observatory. Reflections is published quarterly by the Friends of Mount Wilson Observatory (FOMWO).

INFORMATION

For information about the Observatory, including status, activities, tours, and how to join the Friends of Mount Wilson Observatory, visit our website at www.mtwilson.edu.

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For the use of historical photographs of Mount Wilson, we thank the Observatories of the Carnegie Institution for Science, the Huntington Library, Don Nicholson, and other sources as noted.

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PAGE ONE BANNER PHOTOGRAPHS

A slice of an ultraviolet image of CW Leo, a runaway star plowing through space shedding its atmosphere, by the Galaxy Evolution Explorer (NASA). (Inset) Edwin Hubble at the Newtonian focus of the 100-inch Hooker telescope on Mount Wilson, circa 1923.

NEWS + NOTES

MOUNT WILSON OBSERVATORY IS NOW ON FACEBOOK

Have you visited Mount Wilson Observatory’s new Facebook page yet? If not, you’re in for a pleasant surprise. Be prepared to “like” and contribute to this fascinating new interactive way of experiencing the Observatory, its ongoing life, and its friends.

You can get there by going to the main Observatory website, www.mtwilson.edu, and clicking on the “Facebook” link. Check back frequently for news about the Observatory and items of astronomical interest.

A sampling of photos from the Observatory’s Facebook page. Go to www.mtwilson.edu to find the link.

FORMER JPL DIRECTOR BRUCE MURRAY REMEMBERED

Bruce Murray, the outspoken advocate of planetary exploration who served as JPL’s director during one of the most challenging periods of the Laboratory’s history in the late 1970s and early 1980s, died August 29.

A geologist, Murray became known as an expert in imaging on early Mars missions before being appointed JPL director in 1976. He argued vigorously for planetary missions and he saved the Galileo mission to Jupiter from cancellation. In 1979, he joined with Carl Sagan and JPL engineer Louis Friedman to found the Planetary Society.


One evening in the 1980s, Bob Eklund recalls, Murray again visited Mount Wilson, this time with a class from the Altadena school where his children were attending. “With my then-fiancée Laura Woodard operating the 60-inch that night, everyone had a fine view of a planet,” Bob notes, adding, “I’ve forgotten which planet we viewed, but I will never forget how enthusiastic he was in introducing those children to the sky.”

FOMWO Membership

Friends of Mount Wilson Observatory offers a variety of tax-deductible membership levels and benefits. For information on how to become a FOMWO member, visit www.mtwilson.edu. Also see page 8 of this issue of Reflections for more ways to support the Observatory. We welcome donations and volunteer efforts of all kinds, and we thank you.
Reflections by the Director

Whenever I’m on the mountain, I like to get out and walk around the Observatory grounds to soak in the wonderful juxtaposition among the Douglas-firs and ponderosa pines of the historic domes, towers, and other buildings that are the legacy of G. E. Hale, who is often attributed with having said, “Make no small plans.” I understand it was actually the legendary Chicago architect Daniel Burnham who made that statement and lived up to it in his supervisory role in the design and construction of the enormous 1893 World’s Columbian Exposition. Hale’s first great telescope, the Yerkes 40-inch refractor, was displayed at Burnham’s fair in the Manufactures and Liberal Arts Building, and, of course, Hale later contracted with Burnham to design the Hooker telescope building and dome. Both driven to achieve magnificence, Hale and Burnham were certainly birds of a feather. But, I digress.

I’ve walked among those trees and structures so many times that I can sit here at my desk and take that stroll in my head. Walk with me. Let’s go all the way out front to the Pavilion — the Observatory’s gateway — where we find under the open-air shelter two hikers sitting at one of the big picnic tables eating energy bars. One is pouring water into a container for their Jack Russell terrier who enjoyed trotting ahead of them up the Mount Wilson Toll Road. This Friday morning, they alone enjoy the peaceful scenic space and sunshade offered by the Pavilion. Tomorrow starts the Labor Day weekend, and hundreds of hikers, bikers, and auto passengers will occupy this space and take refreshment at the Cosmic Café. Many will walk back to the Observatory, and the 1:00 p.m. guided tours will likely sell out.

We walk to the east of the Pavilion in the upper parking lot, once the location of the swimming pool of the old Mount Wilson Hotel. Oddly enough, the hotel had no rooms. Instead, guests would rent small cottages distributed around the grounds, their foundations today showing here and there as ruins of what must once have comprised splendid weekends in the mountains for Angelenos. A round-trip ride on the “stage” all the way from Union Station to the top was $3.25. For $2.50, you could stay overnight in a dry cottage, and for $4.50 you could lavish yourself with accommodations that included hot and cold running water, a private toilet, and even a bath. On Friday nights, $1.25 would buy you a “table d’hôte dinner” in the hotel. Then, as now, the eastern view of the mountain was punctuated by the 60- and 150-foot solar tower telescopes with the “laboratory” building containing offices and machine shops sprawling down the ridge.

Strolling back toward the central grounds, we pause in the road in front of the Astronomical Museum where the history of the observatory is displayed by backlit transparencies. I often think of the intense and still-not-understood déjà vu moment I experienced upon my first entry into the building’s splendid 256-seat auditorium in the 1980s. Opened in 1937 in anticipation of vastly increased traffic that would be enabled by the completion of the Angeles Crest Highway and the Red Box Road, the museum was the venue for a Friday evening public lecture by a Mount Wilson astronomer followed by a viewing through the 60-inch telescope. This enormously popular program continued through Friday, December 5, 1941, but was never reinstated after the war. Today, the museum needs considerable renovative attention to upgrade its restrooms and to replace its defunct boiler with modern HVAC. What a wonderful space it will once again provide for any number of public programs and events.

Turning away from the museum, I can’t resist directing your attention to the ladder on the side of the 150-foot solar tower up which Charles Lindbergh once climbed to the top. Wisely, Lindbergh decided to ride the “bucket” elevator down. My last trip up and down in the bucket was with Huell Howser during the spring 2010 filming of his California’s Gold episode. By the way, if you haven’t seen that hour-long tour of the Observatory produced only as Huell Howser could, you can stream it from our homepage (www.mtwilson.edu).

Oops, a glance at my watch (well, actually, at Word’s “word count” tool) shows that it is time for us to move along. We’ll resume our walk at a later time. There’s so much more to see.

Hal

Harold A. McAlister, Director
Mount Wilson Observatory
Students also enjoyed an introduction to ongoing research at Mount Wilson, special lectures by Mount Wilson staff members and volunteers, and tours of research facilities at the Observatory.

**STUDENT PROJECTS**

Sofia Benitez, Arizona State University, used the 16-inch Meade to measure the light curve of supernova SN2013ej in M74, with various color filters. Measurements were taken on three nights using four different filters. She actually saw some of the rise of the light curve before it peaked. Her photometric results were sent to the American Association of Variable Star Observers (AAVSO) for use in plotting the supernova’s light curve. She also measured the supernova’s spectrum using a grism spectrometer — results were inconclusive, but there was some hint of hydrogen absorption lines, consistent with this supernova’s classification as a Type II SN.

Donald Peat, UC Santa Cruz, used the 16-inch Meade (with Starlock system for automatic tracking, provided by John Hoot) to observe two transiting extrasolar planets:

- TrES 1b — observed 0.02 magnitude dimming, with photometric uncertainty below 0.004 magnitudes.
- WASP 52b — observed 0.03 magnitude dimming, with photometric uncertainty similar to TrES 1b.

Donald was able to see signatures of all four contacts, with first contact being when the planet first started to block some light from the star.

**CUREA 2013**

**MOUNT WILSON OBSERVATORY**  
**JULY 28–AUGUST 10**

**Students**

- Ashan Ariyawansa — undergraduate in physics at University of Colombo, Sri Lanka
- Sofia Benitez — Arizona State University, getting a second major in math; first major complete, in physics
- Kristen Dage — Undergraduate in physics at University of Michigan, Dearborn
- Matthew Kehoe — Graduate student in math at University of Michigan, Dearborn
- Donald Peat — Just transferred to UC Santa Cruz, majoring in physics
- Jonathan Troville — Undergraduate in physics at Purdue University

**Volunteers**

- Paula Turner, Kenyon College, Gambier, Ohio — CUREA director and “darkside” instructor
- Jim LoPresto, Edinboro University of Pennsylvania (retired) — Solar instructor
- Jay Pasachoff — Guest lecturer
- Bob Buchheim — 16-inch telescope operator
- John Hoot — Telescope and software wrangler; advanced project facilitator
- Sara Martin — Visiting solar physicist
- Tom Meneghini — 60-inch and Snow solar telescope operator
- Mike Simmons, Astronomers Without Borders — Local organizer

**Special Thanks**

Mount Wilson Institute
Ken and Larry Evans
Dave Jurasevich
Hal McAlister
Don Nicholson
Nils Turner
Nick Wilson

* CUREA photos on pages 4, 5, and 6 were taken by Bob Buchheim, a.k.a. 16-inch telescope operator.

**COELOSTAT MIRRORS** on the Snow solar telescope track the Sun and send the beam into the telescope enclosure for analysis in the spectrograph.
and second and third contact being the start and end, respectively, of
the planet being fully on the disk of the star, and fourth contact being
the end of the transit, once the planet had moved completely off the
disk and was no longer blocking any light from the star.

Kristen Dage, University of Michigan, Dearborn, was the only solar
observer, working with the Snow solar telescope. She was trying to
detect Zeeman splitting of an absorption line in the solar atmosphere
due to the strong magnetic fields that cause sunspots. (George Ellery
Hale was never able to do this on the Snow. Paula Turner, CUREA di-
rector, called this “a notoriously difficult project for that telescope.”)
Kristen got better resolution than Hale did, by “stacking” multiple
short exposures. Her results clearly showed broadening of the line
from the sunspot region compared with the region surrounding it,
which is evidence that the magnetic field was stronger in the sunspot.
The complicated line profile, though, prevented her from using the
broadening to calculate a magnetic field strength — she would have
had to detangle the effect of pressure broadening (seen in and out of
the sunspot) from Zeeman splitting, which was more than she had
time for.

Matthew Kehoe, University of Michigan, Dearborn, did a very dif-
ficult project involving Perseid meteors, using both astrometry and
parallax computation to determine the height of the meteors. He
and John Hoot set up one observing station (tracking telescope and
camera) at Stony Ridge Observatory while Bob Buchheim simultane-
ously observed from Mount Wilson — giving a baseline distance of
6.5 miles for parallax measurements. As they had to observe well be-
fore the peak of the shower, conditions were not ideal.

They intended to observe on two nights, but one night was clouded
out. On their one good night, they took one-minute images all night,
and obtained two coincidences where the same meteor was recorded
with both cameras, enabling parallax (against background starfields)
to be calculated. Matthew did astrometric plate solutions and cal-
culated the ground path of each meteor track, but ran out of time
for making the final parallax calculations that would have yielded
altitudes for the start and end of each meteor trail. He hopes to finish
those calculations and perhaps publish his results at a later date.

Jonathan Troville, Purdue University, and Ashan Ariyawansa, Uni-
versity of Colombo, Sri Lanka, worked together, using the 16-inch
Meade on a project involving double star measurements. Their work
on a number of double stars with 4 to 5 arcsecond separation yield-
ed updated separations and position angles for those systems, includ-
ing some results that show significant orbital motion since the last
reported observations. These results will be submitted to the Journal
of Double Star Observing, with the guidance of CUREA staff member Bob
Buchheim, an accomplished double and variable star observer. The
team also made observations of closer star pairs (including epsilon
Lyrae, the “Double-Double”) with separations near to or smaller than
the seeing disk of the 16-inch, using fast exposures (fractions of a second) to try to resolve these close doubles in moments of excellent seeing. They reduced these data with an autocorrelation algorithm that was sensitive to the separation (at the expense of a 180-degree ambiguity in the position angle). Some of these data, too, may be suitable for publication.

**ADDITIONAL ACTIVITIES**

Students enjoyed a day off the mountain touring NASA’s Jet Propulsion Laboratory in La Cañada–Flintridge; a lunch at the Caltech faculty club, the Athenaeum, hosted by long-time Observatory volunteer Don Nicholson; and an afternoon visit to the private solar observatory of CUREA volunteer Sara Martin. On the weekend, the students spent an afternoon visiting Griffith Observatory and Hollywood Boulevard, and enjoyed a Thai dinner. The CUREA two-week course culminated with a celebratory dinner held at a Sushi restaurant in La Cañada.

Paula Turner, CUREA director, noted that “This year we had just a really good group of people. They were all wonderful — they hit the ground running and did some pretty ambitious projects. They all seemed excited, and thought it was the best two weeks they had spent in a long time.”

We asked Don Nicholson, who knows just about everything about Mount Wilson Observatory, to confirm where this photograph of George Ellery Hale was taken. (Don provided the photo for *Reflections.* ) Not only did he identify the location, but he provided an interesting botanical detail. He wrote:

“That photo was taken in the Monastery. Note the cylindrical object on the desk to the left. That is a section of the stalk of a dead California yucca (*Hesperoyucca whipplei*). The stalk has a soft pulp center with a hard exterior surface. Many southern California women (including my mother) used them for pin cushions. When the pulp became too chewed up to hold a pin they just tossed the implement and cut another. Hale is using his to hold drafting instruments. This yucca is unusual in that it takes many years to mature, sends up a single stalk, then flowers and dies. You will see a lot of them in the San Gabriels from late May to early July.”
In the 1880s, no fewer than four Pasadena groups proposed blazing a trail to the Mount Wilson summit, with corresponding plans to develop the land. In 1886, Theodore P. Lukens proposed a 4-foot-wide horse trail to Wilson’s Peak (as it was then known), a hotel at the summit, and a cog railway from Pasadena. Though his plan went nowhere, Pasadena land developers purchased 320 acres to build a wagon road, hotel, and cog-wheel railroad. Another venture firm called the Pasadena Railway Company announced plans in 1887. But it was not until 1889 that a road-building initiative took hold. Judge Benjamin Eaton financed improvement of the Sierra Madre Trail in order to allow transport of equipment for the Harvard College Observatory, established on the mountain in 1889 (it operated only until 1890 — but that’s another story). Recognizing the inadequacy of the trail, Eaton persuaded a group of Pasadena businessmen to contribute capital for building a wagon road starting at what is now called Eaton Canyon; thus, the Pasadena and Mount Wilson Toll Road Company was formed. A 10-mile “roadway” (a trail 4 feet wide) was completed in 1890. The Toll Road Company gradually expanded its holdings, buying up Henninger Flats, Martin’s Camp, and Strain’s Camp, and eventually gaining control of the summit.

The company became the Mount Wilson Toll Road and Hotel Company, and gradually enlarged its summit holdings to 1,050 acres. In January 1905, G. E. Hale leased 80 acres from the company on the southeast part of the summit for his solar observatory. The company realized that the presence of a world-famous observatory would increase the mountain’s value and the owners were happy to accommodate Hale. Though a railway was never built, the Mount Wilson Hotel was constructed in 1905. It burned down in 1913, was rebuilt in 1915, and operated until 1963. That year Metromedia Inc., owner of KTTV, purchased all the available Mount Wilson property. Under forest regulations, the old hotel was dismantled and carried off down the mountain piece by piece, to be replaced by a tourist attraction — Skyline Park, comprising a pavilion, children’s zoo, and landscaped walks, opening in 1967. Metromedia closed the unprofitable Skyline Park in 1976 and donated it to the U.S. Forest Service.

The renovated pavilion is now occupied by the Observatory-run Cosmic Café, which offers freshly made sandwiches and other treats to weekend lunchtime visitors. The Observatory’s Second Century Campaign is underway to raise funds for a new visitor center to be located in the pavilion area. Information on the campaign can be found at www.mtwilson.edu/SecondCentury.php, including architectural drawings and descriptions of the proposed visitor center complex.

— M. Morgan


An undated vintage postcard illustrating the Mount Wilson Hotel.
OBSERVATORY STATUS
The Observatory and Skyline Park are open to visitors from 10:00 a.m. to 5:00 p.m. daily through the fall, 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 4:00 p.m.

GUIDED WALKING TOURS
Guided walking tours are held on Saturdays and Sundays at 1:00 p.m.; meet at the Cosmic Café at the Pavilion to purchase a ticket. Guests are admitted to the telescope floor directly beneath the historic 100-inch telescope.

SPECIAL GROUP TOURS
Group daytime tours are available. Reservations are required and a modest fee is charged. For information, please visit the Observatory website — www.mtwilson.edu.

LOOK THROUGH THE 60-INCH TELESCOPE
Mount Wilson’s 60-inch telescope provides incredible views of some of the most beautiful objects in the night sky, and is among the largest in the world accessible to public viewing. Visit www.mtwilson.edu for information on how you can participate in a half or full night of viewing wonderful celestial objects.

DIRECTIONS TO MOUNT WILSON OBSERVATORY
From the 210 freeway, follow Angeles Crest Highway (State Highway 2 north) out of 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. 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. The U.S. Forest Service requires those parking within the Angeles National Forest (including Mount Wilson Observatory) to display a National Forest Adventure Pass. It can be purchased for $5 (one day) or $30 (season) at the Cosmic Café at Mount Wilson, or at Clear Creek Ranger Station, Red Box Ranger Station, or major sporting goods outlets. Passes are also available for purchase online at National Forest websites. Display of a National Parks Senior Pass or Golden Age Passport is also acceptable.

FRIENDS OF MOUNT WILSON OBSERVATORY MEMBERSHIP
Please visit www.mtwilson.edu/join.php for information on FOMWO membership and benefits.

THREE WAYS TO SUPPORT MOUNT WILSON OBSERVATORY
Mount Wilson 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 in one of three ways —
★ Join the Friends of Mount Wilson Observatory (FOMWO) to receive a variety of member benefits and stay informed on the latest scientific and other activities on the mountain. All levels receive a membership packet, a one-year subscription to Reflections, a Mount Wilson—Window on the Stars video, and a 10 percent discount at the Cosmic Café as well as on Observatory merchandise purchased at the Café.
★ Contribute to our Fire Recovery Fund to assist with repairs resulting from the massive 2009 Station fire, to provide resources for mitigation of our continuing exposure to fire danger, and to make up for income losses due to long-term closure of the Observatory to public access.
★ Contribute to our Second Century Campaign. As Mount Wilson continues into its second century, a capital campaign is being developed to preserve this great Observatory for future generations. The major element of the Second Century Campaign is a wonderful new Visitor Center that will transform Mount Wilson into an important Southern California destination.

Please visit our website at www.mtwilson.edu for more details. Your support is deeply appreciated and is essential to the preservation of this world-class treasure of science and engineering. We thank you!