



# AU AstroNews

## The Newsletter of the Astronomical Unit

February 2017

Sponsored by the Santa Barbara Museum of Natural History



“Whaddya think, fellas? Should I enter this beauty in the bake sale next week? It’s very chewy!” Photo: T. Totton

### THE FEBRUARY GENERAL MEETING

Our speaker for our Friday, February 3<sup>rd</sup>, general meeting will be Michael Malaska from the Jet Propulsion Laboratory. The title of Michael’s talk is: “Titan: an Earthlike world in the Outer Solar System.” He summarizes: “Saturn’s moon Titan has been revealed by the Cassini spacecraft to be a hydrocarbon world that is both alien and eerily Earth-like. Titan has a thick hazy atmosphere with methane rains that fill rivers and channels that flow into hydrocarbon lakes, vast dissected canyonlands of organics, icy mountains, and organic dunes and plains. Our exploration of Titan has only started, but it is revealing itself to be the Earth of the Outer Solar System.”

### JANUARY OUTREACH SUMMARY

Since the last newsletter, and despite plenty of rain, AU volunteers Peter Angeloff, Tim Crawford, Joe Doyle, John Edkins & Susan Jackson, Art Harris, Baron Ron Herron, Jürgen Hilmer, Pat & Chuck McPartlin, Janet & Martin Meza, Bruce Murdock, Edgar Ocampo, Javier Rivera & his Quasars, Dianne & Russell Ruiz, Tom Totton, Tom Whittemore, and Jerry Wilson managed to show cool things in the sky to 395 viewers.

### FEBRUARY OUTREACH EVENTS

Here's the schedule so far for February. Remember, the events are subject to change and cancellation, so for the latest updates, contact Chuck at 964-8201 or [macpuzl@west.net](mailto:macpuzl@west.net).

The Telescope Workshop meets on Tuesday evenings at 7:30 PM at the Broder Building at SBMNH. Contact Tim Crawford at [tcrawf3@cox.net](mailto:tcrawf3@cox.net) for information. Listen to the AU on the radio at KZSB 1290 AM at 9 AM on the second and fourth Monday of each month.

### WEDNESDAY, FEBRUARY 1, SETUP 5:30 PM

Telescopes for kids and parents at St. Andrews preschool, on Arroyo Road near Auhay Drive in Goleta. The official address is 4575 Auhay Drive, but the entrance is off Arroyo.

### THURSDAY, FEBRUARY 2, SETUP 4:30 PM

Telescopes for Science Night at Hope School, 3970 La Colina Road. We set up in the plaza by their auditorium. Tacos for volunteers.

### FRIDAY, FEBRUARY 3, 7 PM

Catch a quick planetarium show, followed by our monthly meeting at 7:30 in Farrand Hall at SBMNH.

### TUESDAY, FEBRUARY 7, 7 PM

Telescope Tuesday at the Camino Real Marketplace in Goleta. We set up in the plaza by the theater.

### SATURDAY, FEBRUARY 11, 5 PM

Monthly AU planning meeting in the classroom outside Javier's office at SBMNH.

### SATURDAY, FEBRUARY 11, 7 PM

Monthly Public Star Party at SBMNH, next to Palmer Observatory.

### MONDAY, FEBRUARY 13, SETUP 4 PM

Telescopes for an Astronomy Night at Santa Ynez Valley Charter School, 3525 Pine Street in Santa Ynez. This is the campus on the eastern side - the one toward the west is Santa Ynez Elementary. Tacos for telescopers at 5 PM.

### FRIDAY, FEBRUARY 17, 7 PM

Monthly Westmont Public Telescope Night at their observatory by the baseball field.

### SATURDAY, FEBRUARY 18, SETUP 6 PM

Astronomy night for the residents of the Encina Meadows apartment complex, which covers several blocks just north of (behind) the Calle Real shopping mall. We'll be set up in part of their central parking lot. The approximate address is 5743 Encina Road.

### THURSDAY, FEBRUARY 23, SETUP 4 PM

Telescopes for Ellwood Elementary School's Science Night. They're at 7686 Hollister Avenue in Goleta. We set up on the blacktop out back.

### IN MEMORIAM

Mike "Jug" Jogoleff, a longstanding member of the Santa Barbara Astronomy Club and the SBAU, passed away on January 7, 2017, after a long illness.

### **From the Workshop**

Editor's note: Tim Crawford continues with his series on the 200" Hale Telescope...

Telescope mirrors have a coefficient of expansion of glass that is directly related to the quality of images they yield. The 100" Hooker mirror on Mt. Wilson, having champagne bottles for the makeup of the glass, yielded distorted images or even double images due to large coefficients exhibited in plate glass. It wasn't till the temperatures of the glass equalized with the ambient temperatures that the images became sharp. Hale learned it is imperative that the glass have a low coefficient of expansion. This would give the huge monolithic glass monsters a chance to equalize much faster. For the Hale telescope mirror his first choice was fused quartz for the substrate. The coefficient of this material is about 15 times less than plate glass. It has qualities that make it almost impervious to great heat differentials. The job of creating a fused quartz went to Elihu Thomson, director of Thomson Laboratory for The General Electric Company in

Lynne, Massachusetts. Quartz fuses at 1650<sup>0</sup>C. The quartz vaporizes at a slightly lower temperature. The idea is to use a quartz slab and spray clear quartz over the substrate using an oxy-hydrogen flame-gun. 25" and 66" slabs were created. The larger discs were not acceptable. After \$600,000 spent on these experiments, Hale stepped in and reluctantly looked to his second choice - Pyrex.

Most people are familiar with borosilicate glass. Corning Ware are the oven proof baking dishes we use in the kitchen. Also, in the lab there are the flasks and test tubes used that also have the heat-resistant qualities. Typical Pyrex has a coefficient of expansion 5 times that of fused quartz. Adding quartz to the mix can further reduce the coefficient. The 200" mirror mix had a coefficient only 3 times that of fused quartz. I have heard it said glass is technically a liquid. From Scientific American, I found that glass is an amorphous solid, somewhere in between a solid and a liquid. I say that now because there was another factor to think about with these huge mirrors - deformation of the glass. That's a huge mass and a lot of weight to move around. The design of the Hale mirror included 36 cavities in the rear of the mirror, giving it a honeycomb look. Not only would they yield substantial reduction in weight, but also provide a way to compensate for the deformation of the wavefront in slewing the mirror around. The huge weight of this mirror would change shape as the mirror moved to different areas of the sky, acting kind of like a liquid. Compensating levers were installed in the cavities, acting like a mechanical computer to counter the slewing action.

From "Optics of the 200- Inch Hale Telescope" John A. Anderson refers to this: "It is important to recall that if the 200-inch disk were simply supported horizontally around the edge, its deflection at the center owing to gravity would be about two-and one-half-thousandths of an inch, which expressed in optical terms is 125 wavelengths of light. Since each one of the 36 levers must support on the average some 850 pounds, and since for perfect results the force actually exerted by each lever should be correct to one or two tenths of one percent, it is not surprising that a few difficulties were encountered." The ribbing was formed by placing silica firebrick cores in the mold. During the casting process, sufficient glass was poured to fill the spaces between the

cores and then to cover them with a solid layer of the desired thickness. One hundred fourteen cores were fixed with heat resistant bolts.

The glass posed problems of its own. It would not flow through the complex mold unless it was maintained at a much higher temperature than that normally employed with high-expansion glasses. To address this concern, McCauley devised a series of domed ovens that resembled large igloos. A huge tank 50 feet long and fifteen feet wide contained some 65 tons of molten glass. Huge ladles were filled with 750 pounds of molten glass at 2700°C. On March 25, 1934 the first attempt to pour the mirror began. Every six minutes half of each ladle was poured into the mold kept at a high temperature. The glass left behind was chipped back into the melted vat. At some point of the pouring some of the firebricks broke loose in the mold. A mad scramble ensued to break up the brick but it didn't work. They finished the pour. It took ten hours and 105 ladles of glass to pour some 21 tons of glass. Because of the firebrick coming loose, it was uncertain how the finished mirror would look. The mirror was transferred to a special annealing oven but the long term cooling planned for the mirror was reduced 10-fold. By May, the mirror was cool and intact. However, the result was determined to not be the best and modifications would be time consuming and cracking of the large blank was not a guarantee. So this mirror blank was sidelined and I believe still on exhibit at the Corning Museum. To be continued...



*The second successful mirror blank casting.*

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## February 2017

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1 ST. ANDREWS PRESCHOOL 5:30PM	2 HOPE SCHOOL 4:30PM	3 AU GENERAL MEETING 7PM	4
5	6	7 CAMINO REAL MARKETPLACE 7PM	8	9	10	11 PLANNING MEETING 5PM STAR PARTY 7PM SBMNH
12	13 SANTA YNEZ VALLEY CHARTER 4PM *	14	15	16	17 WESTMONT COLLEGE 6PM	18 ENCINA MEADOWS 6PM
19	20	21	22	23 ELLWOOD ELEMENTARY 4PM	24	25
26	27	28				

### The Astronomical Unit

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