FOR SALE
Small Rich Field Reflector

This Bausch and Lomb telescope was donated by Tom Dorff, one of our previous presidents. It has been refurbished and remounted as an equatorial. Our shop director tested the mirror and discovered that it has a smooth parabolic figure. It was used at the December 10th public star party where it gave very good images.

Primary Mirror Diameter – 130 mm (5.1”)
Focal Length – 715 mm (28.1”) f/5.5
Secondary Mirror – 1.3” elliptical
Finder – full aperture achromatic 6x30.
Focuser is a 1.25” helical with a removable extension tube about 2” long.
Mount is an older Jaegers light duty equatorial with 5/8” shafts which has been upgraded with bronze bushings on both axes.
Drive is a modified Edmund with a 96 tooth bronze gear and a 1/15 RPM synchronous motor.
Tripod legs are all aluminum (no plastic here).
The telescope comes equipped with a Meade 25 mm Modified Achromatic eyepiece.

Note: There is a scratch in the coating of the primary that does not affect performance. The mirror was inspected from the rear to verify that the scratch did not extend to the glass.

Asking $175 (proceeds go to the LAAS).
Contact Dave Sovereign at (626) 794 – 0646 ♦

The LAAS Board of Directors would like you to take a brief look at the address page of your bulletin. Near the bottom right is your dues date and a note if we have your correct email address on file. In the event that you have "No Email Address on File" or have a "Bad Email Address on File," we would like for you to send us your correct email address to admin@laas.org. Email addresses are not shared with anyone and are used by the Board to occasionally send out notices in regards to LAAS activities.

Additionally, if it is convenient for you, the Board would like for you to elect to receive an email notification for the presence of the bulletin online. The online version of the bulletin usually comes out several days prior to you receiving the print copy and saves the club a great deal of money in printing and mailing costs.

Finally, take a look at your Dues Date. If it is coming up soon, please send our Treasurer the renewal funds so that we may update our records accordingly. Thank you for your time.

The LAAS Board of Directors. ♦
Editor’s Message

The 80th year of the LAAS kicked off successfully with our annual banquet. Lots of photographic coverage in this issue.

Since Penny and Jim are now in the warm reaches of the Gulf coast of Florida, please send all written correspondence to:

LAAS
4800 Western Heritage Way
Los Angeles, CA 90027.

There will be one more change of address when Griffith Observatory re-opens.

A change was made to the outreach program contacts; Don DeGregori is the sole contact now. Also, we need a new youth liaison contact person.

For those wishing to submit material for the bulletin, the deadline is the 10th of each month to provide the necessary the time to prepare all material into the bulletin and get it to our printers in time.

David Nakamoto

The Outreach Program

There are three upcoming outreach dates, but only one has a fixed date press time.

- Feb 23rd — Irwin Elementary, La Puente
- April 20th — El Marino Language School in Culver City
- Nestle Ave. Elementary School
- Kester Ave. Elementary Magnet

Don DeGregori

About This Issue

Membership Annual Dues:

Youth $20.00
Regular (18-65) $35.00
Senior Citizen (65 and up) $20.00
Senior Family $30.00
Family $50.00
Group or Club $50.00
Life $500.00

Additional fees:

Charter Star member $30.00
Star member, with pad $70.00
Star member, no pad $60.00

(Membership due date is indicated on the mailing label)

Handy Phone List

LAAS Home Page: http://www.laas.org
LAAS Bulletin Online: http://www.laas.org/bulletin.html

EVENTS CALENDAR

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 4th (Sat)</td>
<td>Public Star Party</td>
<td>Griffith Observatory Satellite</td>
</tr>
<tr>
<td>Mar 13th (Mon)</td>
<td>General Meeting</td>
<td>The speaker has yet to be determined at the press time.</td>
</tr>
<tr>
<td>Mar 25th (Sat)</td>
<td>Dark Sky Night</td>
<td>Lockwood Valley</td>
</tr>
<tr>
<td>Apr 1st (Sat)</td>
<td>Public Star Party</td>
<td>Griffith Observatory Satellite</td>
</tr>
<tr>
<td>Apr 10th (Mon)</td>
<td>General Meeting</td>
<td>The speaker is tentatively scheduled to be Amanda Mainzer of JPL</td>
</tr>
<tr>
<td>Apr 29th (Sat)</td>
<td>Dark Sky Night</td>
<td>Lockwood Valley</td>
</tr>
</tbody>
</table>

A reminder — The board meeting is held on the Wednesday night prior to the general meeting, at Garvey Ranch Park. It starts at 8:00 pm.
The Monday general meetings starts at 7:30 pm
LOANER CORNER

Saturn is just past opposition and is in a good position for viewing in the evening. Orion and Taurus have regained control of the winter nights and spring is only two months away. Check out one of the LAAS loaner telescopes and take advantage of the clear winter nights.

LAAS-1 - 4.5" f/8 Celestron reflector on a solid Polaris equatorial mount. It comes equipped with a Kellner eyepiece, two Orthoscopics, and a collimation tool. These two 4.5" reflectors are good telescopes for beginners to learn with since they are both small enough to be easily carried and set up, but with enough aperture to provide good views.

LAAS-2 - 4.5" f/8 Tasco reflector on a motorized Edmund equatorial mount. This telescope has been upgraded with 1.25" accessories, a 6x30 finder, and very solid wooden legs. It comes fully equipped with a set of three Kellner eyepieces and a collimation tool.

LAAS-4 – 6” f/5 reflector by Telescopics on a low Dobsonian mount. It is equipped with a set of three Orthoscopic eyepieces.

LAAS-8 – 80 mm f/11.4 Selsi refractor on an equatorial mount. It is equipped with two Plossl eyepieces and an Orthoscopic.

For further information concerning these loaner telescopes call: David Sovereign at (626) 794-0646.

THIS MONTH IN HISTORY

March 2
1972 Pioneer 10 also called Pioneer F.
Pioneer 10 was launched on March 2, 1972, on top of an Atlas/centaur/Te 364-4 launch vehicle. The Atlas-Centaur as a three-stage launch vehicle. The third stage was required to push Pioneer 10 to the speed of 32,400 mph needed for the flight to Jupiter. This made Pioneer the fastest manmade object to leave the Earth, fast enough to pass the Moon in 11 hours and to cross the orbit of Mars in just 12 weeks. This mission was the first to be sent to the outer solar system and the first to investigate Jupiter. With the help of Jupiter’s gravity, Pioneer speed increased to 82,000 mph, after which it followed an escape trajectory from the solar system. The spacecraft is now heading towards Aldebaran a distance of 68 ly. at it speed it will take 2 million years. Last signal from Pioneer 10 was received on January 22, 2003, originally designed as a 21 month mission it has lasted more than 30 years. At last contact Pioneer was 7.6 billion miles from Earth light travel time 11 hrs, 20 min.

March 3rd
The Bruce Medalists Charlotte Emma Moore Sitterly
Born September 24, 1898 – March 3, 1990
After completing her B.A. in mathematics at Swarthmore College in 1920 Miss Moore took a job as assistant to Henry Norris Russell at Princeton University. There she audited courses and became coauthor of papers on binary stars and influential books on the masses of stars. Starting in 1925 she worked at Mt Wilson Observatory with Charles E. St. John and Harold D. Babcock on the solar spectrum. She earned her Ph.D. at Berkeley using Mt. Wilson plates to analyze atomic lines in the sunspot spectrum. Some of her many awards and honors include: the William F. Meggers Award of the Optical Society of America in 1972. She was elected an Associate of the Royal Astronomical Society in 1949, And the American Astronomical Society, Annie Jump Cannon Award 1937.

March 7th
Johann Bayer
Born 1572 - March 7, 1625
A German astronomer born in Rain Bavaria. Bayer produced the star atlas Uranometria which was published in 1603 this was the first catalogue of stars to cover the entire sky. He introduced 12 new constellations that were created by Keyser and Houtman. Bayer also split four constellations into eight, developed a star naming system called Bayer Designation.

Mary Brown
primary mirror, the dimmer you can see. Everyone who has looked through an 8” and a 10” side by side has already caught the disease that we call aperture fever, the extreme desire for a bigger telescope! Just check out RTMC and see how many telescopes there are now, in excess of 20”, or even 30” in diameter.

Well, professional astronomers have the same fixation on going deep. When the year 1900 rolled around, the largest telescope in the world was the 40” refractor at Yerkes Observatory. When the year 2000 rolled around, the largest telescopes in the world were the 400” (10 meter) Keck I & Keck II reflecting telescopes on Mauna Kea, in Hawaii. The Keck telescopes introduced a new concept: segmented mirrors. The 10 meter mirrors of the Keck telescopes are made from 36 hexagonal segments put together like a jigsaw puzzle, instead of a single piece mirror. The same technology was used to make the 91 segment, 11 meter primary mirror for the Hobby-Eberly telescope, at the McDonald observatory of the University of Texas. But it can’t move in elevation, only in azimuth. It uses a coelostat to track objects, so it needs an 11 meter primary to cover the motion of its 9.2 meter optical spot. That’s why the Keck telescopes are still the largest single telescopes in the world. The new South Africa Large Telescope (SALT) is a copy of the Hobby-Eberly telescope. See the Keck Observatory web page at http://www.keckobservatory.org/ and the Hobby-Eberly webpage at http://www.as.utexas.edu/mcdonald/het/het.html and the SALT webpage at http://www.salt.ac.za/

But the idea of segments comes from an earlier idea: multi-mirror telescopes. The original Multi-Mirror Telescope (MMT) was dedicated in 1979, and consisted of six identical 1.8 meter (72 inch) primary mirrors working together. They had the combined area of a single 4.5 meter (176 inch) mirror. An innovative design, but still smaller than the venerable 5 meter (200 inch) telescope on Palomar Mountain. Moving from multiple mirrors to segments opens the door to arbitrarily large telescopes. Both ideas are now at work in the planning for a new generation of Extremely Large Telescopes (ELTs). See the MMT webpage at http://www.mmto.org/

The Canadian Very Large Optical Telescope (VLOT) is an ELT planned to replace the Canada-France-Hawaii Telescope (CFHT) on Mauna Kea, with a segmented 20 meter primary mirror, in a Ritchey-Chretien configuration. I don’t know how many segments it will use. It is the least ambitious of the ELT projects, being only twice the size of the Keck telescopes. See the VLOT webpage at http://www.hia-iha.nrc-cnrc.gc.ca/projects/VLOT_e.html

The Giant Magellan Telescope (GMT) is an ELT designed on the multi-mirror model. The GMT will have seven 8.4 meter (331 inch) mirrors. It will have the diffraction limited resolving power of a single 24.5 meter (965 inch) mirror. The mirrors will have 18 meter focal lengths, and will be arranged as an f/8.4 Gregorian. The GMT is a combined effort of the Carnegie Institution of Washington, Harvard University, M.I.T., the Smithsonian Astrophysical...
This image and its caption is a correction to February’s image and caption associated with the article “Going Deep.” Both are provided by Tim Thompson.

The large panel on the left is the HUDF. The three panels on the right all coincide with the small blue rectangle in the HUDF panel. The top panel shows that HUDF-JD2 is not there in the visible image. The center panel shows that it is visible to the NICMOS instrument on HST. The bottom panel shows that it is significantly brighter to the IRAC instrument on the Spitzer Space Telescope.

---

**PUNS**

Two hydrogen atoms meet. One says "I've lost my electron," The other says, "Are you sure?" The first replies "Yes, I'm positive."

Did you hear about the Buddhist who refused Novocain during a root canal? His goal: transcend dental medication.

And finally, there was the person who sent ten different puns to his friends, with the hope that at least one of the puns would make them laugh. No pun in ten did.

Luis Ashelford

---

Observatory, Texas A&M University, the University of Arizona, the University of Michigan, and the University of Texas at Austin. The GMT is currently planned to start operation in 2015. See the GMT webpage at http://www.gmto.org/

The American Giant Segmented Mirror Telescope (GSMT, not to be confused with the GMT), is an ELT with 618 hexagonal segments, each 1.15 meters across, which will combine to create a 30 meter filled aperture, in a Ritchey-Chretien configuration. An anticipated completion date would be “in the next decade”, but this one is much more in the early planning stages than other ELT projects. See the GSMT webpage at http://www.aura-nio.noao.edu/book/index.html

The Thirty Meter Telescope (TMT) is an ELT designed on the segmented mirror model. The current design calls for 738 hexagonal segments, each 1.2 meters in diameter, which will be put together just as the Keck segments are, to create a 30 meter (1,181 inch) diameter, f/1 primary mirror. The telescope’s final configuration will be an aplanatic Gregorian, f/15. The TMT consortium consists of the Association of Canadian Universities for Research in Astronomy (ACURA), the Association of Universities for Research in Astronomy (AURA), the California Institute of Technology (Caltech), and the University of California. The TMT is currently planned to begin operation in 2016. See the TMT webpage at http://www.tmt.org/

The European 50 Meter Telescope (Euro50) is a collaborative effort between Sweden, Finland, Ireland, the United Kingdom and Spain. Its anticipated location is La Palma, in the Spanish Canary Islands. This ELT will use 618 2 meter segments to create a 50 meter filled aperture, in a Gregorian configuration with an f/0.85 primary, and an f/15 exit f-ratio. It will weigh in at 3500 tons, and reach 85 meters high. See the Euro50 webpage at http://www.astro.lu.se/%7Etorbens/euro50/index.html

But the most ambitious of the current crop of ELTs comes not from a large consortium, but from the European Southern Observatory (ESO). This is the Overwhelmingly Large Telescope (OWL). The OWL will use hexagonal segments, like Keck and the TMT, but in this case, they will put together about 3,000 segments, to create a 100 meter (3,937 inch) primary mirror. The primary will be roughly f/1, in a Gregorian configuration. The current plan is for OWL to begin operations as a 60 meter in 2016 or 2017 (to keep from being scooped by GMT & TMT). It will then be expanded, as funding permits, to 100 meter size by about 2020. It might even grow as large as 120 meters. See the OWL webpage at http://www.eso.org/projects/owl/

The science goals of ELTs are the same as for any large observatory. But the ELTs have the capability of doing things those smaller telescopes can’t do. The higher resolving power of the bigger telescopes means they can resolve and explore the (Continued on page 6)
structure of debris disks around stars, the environments where planets form. They should even be able to directly detect extrasolar planets, aside from expanding the radial velocity searches that are now used, to dimmer stars. They can observe asteroids & Kuiper belt objects, seeing more of them because they can see those that are smaller, dimmer, and farther away. They can measure dimmer supernovae light curves, and nail down whether or not the expansion of the universe is really accelerating. They can gather spectra of dimmer stars, and so study stellar & galactic evolution in more detail. They can observe the dimmer, more distant, high redshift galaxies, and see closer to the big bang. In short, they can see farther because they can see dimmer.

ELTs are the next logical step in the evolutionary history of the astronomical telescope. George Ellery Hale introduced the first large, glass mirror reflecting telescope, when he put the 60 inch telescope of Mt. Wilson Observatory to work in 1908. It was the ELT of its day, exceeding the collecting area of the 40 inch refractor by more than a factor of 2. And he continued to drive the development of ELTs with the 100 inch & 200 inch telescopes, on Mt. Wilson and at Palomar Mountain, respectively. But the 200 inch mirror was about as big as technology could then push the monolithic mirror. Today, spin casting technology has allowed the fabrication of single piece mirrors as large as 8 meters (315 inches, comparable to the 300 incher that Hale was already thinking about when he was forced to settle for 200 inches). But once again we are running into the limit of monolithic mirror technology. The multi-mirror and segmented mirror concepts open the way for telescopes limited only by imagination & money. All of these ELTs expect to be looking up within about the next decade. I look forward to looking up with them. See the Mt. Wilson Observatory webpage at http://www.mtwilson.edu/

Two Mirrors Need Happy Homes

Jack Warford is trying to find the gentleman who was interested in a 4-inch mirror blank and tool he acquired from one of the raffles at a general meeting. He remembers this gentleman was about 5’ 6” with a moustache. He would be happy to give the mirror and blank to him.

He also has a partially ground 6” mirror. It has a small chip on one edge but it would have no effect on the final result. It may be a little rich field, since it seems to have a focal length of about three feet.

Please contact Jack directly at jackwarf@sbcglobal.net.

4th Annual Desert Sunset Star Party

This news is from Pat and Arleen Heimann.

The 4th annual Desert Sunset Star Party will be held April 26-30, 2006. Please check details at our website

http://www.chartmarker.com/sunset.htm

Registration is now open. Caballo Loco RV Ranch gives us a special camping rate for this group event. There is no star party fee this year but we will sell door prize tickets. The residents of Caballo Loco will also be serving breakfast ($3) and dinner ($5) on Saturday. We are located between Kitt Peak Observatory and Whipple Observatory, both excellent day trips.
surface of the tube which would produce glare in the final image. There can be any number of stops. The author usually uses 2 or 3, depending on the size of the instrument. Some inexpensive imported telescopes use only 1 stop that is usually too small which vignettes the outer edges of the objective. The diameter of the aperture can be found using the same equation used to size a Newtonian secondary. The value of “A” is replaced with “Ds”, the distance from the focus to the stop. When placing the stops, make sure that the drawtube does not hit the first glare stop when in its innermost position. A graphical approach also works by drawing the optical path on graph paper. Most amateur telescopes can be drawn full size in diameter. The length, however, must be scaled to fit the page, unless you have a very long piece of paper. The equation for a glare stop would be:

\[ H_s = D_f + \frac{(D_o - D_f) \times (D_s)}{F_o} \]

As an example, consider a 4” f/15 refractor with a focal length of 60”. Assume a desired fully illuminated field of 0.5”. Assume three stops at 15”, 30”, and 45” from the prime focus.

The first stop diameter would be

\[ H_1 = \frac{(4.0 - 0.5) \times (15)}{60} \]
\[ H_1 = \frac{3.5 \times (15)}{60} \]
\[ H_1 = 1.375” \]

The other two stops are calculated in the same manner.

This article finishes the series on the basic layouts and design equations for the most common types of amateur telescope. The more exotic designs such as the Yolo, Shieffspigler, the folded refractor, and even the Maksutov have not been covered. This is not to say you should not try to design and build one of them. Although most amateurs today buy their instruments, it is still rewarding to use one of your own design and manufacture. ✷
Above, Tim Hogle tells of his adventures as a member of the Voyager Science Team. Below, Tim Thompson holds a bag of spare parts, the “reward” to David Sovereign for restoring so many telescopes.

---

**TELESCOPE LAYOUTS (REFRACTORS)**

*By David Sovereign*

The first telescopes were refractors. According to legend, the principle of a refracting telescope was discovered by Jan Lippershay, a Dutch eyeglass maker in 1608. He held a pair of eyeglass lenses in front of his eyes and “beheld a distant church steeple as if it were in his own shop”. He saw this discovery as an aid to the military who could spy on distant troops. When Galileo Galeli, the great Italian scientist and mathematician, heard of this, he built one of his own in 1609 and first turned it toward the skies. This ushered in the second age of astronomy, instrumented observation. His telescopes were crude by today’s standards, but we must crawl before we can walk and walk before we can run. Galileo would be amazed with even the simplest department store telescope from K-mart. These early designs used a positive objective lens and a negative eye lens. These yielded erect images but a very narrow field. This design is still used today in low power opera glasses and toy telescopes. They are called Galilean telescopes, although he did not discover the principle. Perhaps they should be called Lippershayean.

Today, the refractor is considered the optimum telescope for lunar and planetary observation. This is due to the fact that there is no central obstruction to degrade the image by reducing contrast and resolution. The price for this increased contrast is some residual false color (known as chromatic aberration), especially in a fast doublet. Higher priced refractors use three and four element lenses or special glass to reduce this false color to a negligible amount. Also they are more expensive because of the multiple surfaces that have to be ground and polished. Also the objective requires special types of glass that have to be exceptionally clear since the light passes through it, instead of being reflected from the front surface. Few amateurs are brave enough, or masochistic, to actually grind and polish an achromatic objective. This article will describe how to layout and build a refractor around a purchased objective.

The basic layout is shown on the next page:

The objective lens is held in a lens cell that is secured to the front of the tube. Some larger refractors employ cells that are adjustable to precisely align the optical axis of the objective with the axis of the tube assembly. Refractors smaller than about 100-mm rarely have this feature. The focuser at the rear must have enough travel to accommodate the use of a star diagonal. Most 1.25” diagonals take up about 2.5” of the light path. A 2” diagonal can take up over 4”. Considering 1” of out travel of the drawtube beyond focus when using only an eyepiece and another 1” of in travel when using a star diagonal, the total focus travel of the drawtube should be at least 4.5”. A 2” focuser should have at least 6” or 7” of travel.

The glare stops in the tube prevent unwanted light from reflecting off of the inner

(Continued on page 10)
Above, Tim Hogle tells of his adventures as a member of the Voyager Science Team. Below, Tim Thompson holds a bag of spare parts, the “reward” to David Sovereign for restoring so many telescopes.

TELESCOPE LAYOUTS (REFRACTORS)

By David Sovereign

The first telescopes were refractors. According to legend, the principle of a refracting telescope was discovered by Jan Lippershay, a Dutch eyeglass maker in 1608. He held a pair of eyeglass lenses in front of his eyes and “beheld a distant church steeple as if it were in his own shop”. He saw this discovery as an aid to the military who could spy on distant troops. When Galileo Galilei, the great Italian scientist and mathematician, heard of this, he built one of his own in 1609 and first turned it toward the skies. This ushered in the second age of astronomy, instrumented observation. His telescopes were crude by today’s standards, but we must crawl before we can walk and walk before we can run. Galileo would be amazed with even the simplest department store telescope from K-mart. These early designs used a positive objective lens and a negative eye lens. These yielded erect images but a very narrow field. This design is still used today in low power opera glasses and toy telescopes. They are called Galilean telescopes, although he did not discover the principle. Perhaps they should be called Lippershayean.

Today, the refractor is considered the optimum telescope for lunar and planetary observation. This is due to the fact that there is no central obstruction to degrade the image by reducing contrast and resolution. The price for this increased contrast is some residual false color (known as chromatic aberration), especially in a fast doublet. Higher priced refractors use three and four element lenses or special glass to reduce this false color to a negligible amount. Also they are more expensive because of the multiple surfaces that have to be ground and polished. Also the objective requires special types of glass that have to be exceptionally clear since the light passes through it, instead of being reflected from the front surface. Few amateurs are brave enough, or masochistic, to actually grind and polish an achromatic objective. This article will describe how to layout and build a refractor around a purchased objective.

The basic layout is shown on the next page:

The objective lens is held in a lens cell that is secured to the front of the tube. Some larger refractors employ cells that are adjustable to precisely align the optical axis of the objective with the axis of the tube assembly. Refractors smaller than about 100-mm rarely have this feature. The focuser at the rear must have enough travel to accommodate the use of a star diagonal. Most 1.25” diagonals take up about 2.5” of the light path. A 2” diagonal can take up over 4”. Considering 1” of out travel of the drawtube beyond focus when using only an eyepiece and another 1” of in travel when using a star diagonal, the total focus travel of the drawtube should be at least 4.5”. A 2” focuser should have at least 6” or 7” of travel.

The glare stops in the tube prevent unwanted light from reflecting off of the inner

(Continued on page 10)
surface of the tube which would produce glare in the final image. There can be any number of stops. The author usually uses 2 or 3, depending on the size of the instrument. Some inexpensive imported telescopes use only 1 stop that is usually too small which vignettes the outer edges of the objective. The diameter of the aperture can be found using the same equation used to size a Newtonian secondary. The value of “A” is replaced with “Ds”, the distance from the focus to the stop. When placing the stops, make sure that the drawtube does not hit the first glare stop when in its innermost position. A graphical approach also works by drawing the optical path on graph paper. Most amateur telescopes can be drawn full size in diameter. The length, however, must be scaled to fit the page, unless you have a very long piece of paper. The equation for a glare stop would be:

\[ Hs = Df + ((Do - Df) x (Ds)) / Fo \]

Hs is the diameter of the hole in the center.

As an example, consider a 4” f/15 refractor with a focal length of 60”. Assume a desired fully illuminated field of 0.5”. Assume three stops at 15”, 30”, and 45” from the prime focus.

The first stop diameter would be

\[ H1 = ((4.0 - 0.5) x (15)) / 60 \]
\[ H1 = (3.5) x (15) / 60 \]
\[ H1 = 1.375” \]

The other two stops are calculated in the same manner.

This article finishes the series on the basic layouts and design equations for the most common types of amateur telescope. The more exotic designs such as the Yolo, Shiefspigler, the folded refractor, and even the Maksutov have not been covered. This is not to say you should not try to design and build one of them. Although most amateurs today buy their instruments, it is still rewarding to use one of your own design and manufacture. ✯
structure of debris disks around stars, the environments where planets form. They should even be able to directly detect extrasolar planets, aside from expanding the radial velocity searches that are now used, to dimmer stars. They can observe asteroids & Kuiper belt objects, seeing more of them because they can see those that are smaller, dimmer, and farther away. They can measure dimmer supernovae light curves, and nail down whether or not the expansion of the universe is really accelerating. They can gather spectra of dimmer stars, and so study stellar & galactic evolution in more detail. They can observe the dimmer, more distant, high redshift galaxies, and see closer to the big bang. In short, they can see farther because they can see dimmer.

ELTs are the next logical step in the evolutionary history of the astronomical telescope. George Ellery Hale introduced the first large, glass mirror reflecting telescope, when he put the 60 inch telescope of Mt. Wilson Observatory to work in 1908. It was the ELT of its day, exceeding the collecting area of the 40 inch refractor by more than a factor of 2. And he continued to drive the development of ELTs with the 100 inch & 200 inch telescopes, on Mt. Wilson and at Palomar Mountain, respectively. But the 200 inch mirror was about as big as technology could then push the monolithic mirror. Today, spin casting technology has allowed the fabrication of single piece mirrors as large as 8 meters (315 inches, comparable to the 300 incher that Hale was already thinking about when he was forced to settle for 200 inches). But once again we are running into the limit of monolithic mirror technology. The multi-mirror and segmented mirror concepts open the way for telescopes limited only by imagination & money. All of these ELTs expect to be looking up within about the next decade. I look forward to looking up with them. See the Mt. Wilson Observatory webpage at http://www.mtwilson.edu/
This image and its caption is a correction to February’s image and caption associated with the article “Going Deep.” Both are provided by Tim Thompson.

The large panel on the left is the HUDF. The three panels on the right all coincide with the small blue rectangle in the HUDF panel. The top panel shows that HUDF-JD2 is not there in the visible image. The center panel shows that it is visible to the NICMOS instrument on HST. The bottom panel shows that it is significantly brighter to the IRAC instrument on the Spitzer Space Telescope. 🧵

**PUNS**

Two hydrogen atoms meet. One says "I've lost my electron," The other says, "Are you sure?" The first replies "Yes, I'm positive."

Did you hear about the Buddhist who refused Novocain during a root canal? His goal: transcend dental medication.

And finally, there was the person who sent ten different puns to his friends, with the hope that at least one of the puns would make them laugh. No pun in ten did. 🧵

Luis Ashelford

Observatory, Texas A&M University, the University of Arizona, the University of Michigan, and the University of Texas at Austin. The GMT is currently planned to start operation in 2015. See the GMT webpage at http://www.gmto.org/

The American Giant Segmented Mirror Telescope (GSMT, not to be confused with the GMT), is an ELT with 618 hexagonal segments, each 1.15 meters across, which will combine to create a 30 meter filled aperture, in a Ritchey-Chretien configuration. An anticipated completion date would be “in the next decade”, but this one is much more in the early planning stages than other ELT projects. See the GSMT webpage at http://www.aura-noao.edu/book/index.html

The Thirty Meter Telescope (TMT) is an ELT designed on the segmented mirror model. The current design calls for 738 hexagonal segments, each 1.2 meters in diameter, which will be put together just as the Keck segments are, to create a 30 meter (1,181 inch) diameter, f/1 primary mirror. The telescope’s final configuration will be an aplanatic Gregorian, f/15. The TMT consortium consists of the Association of Canadian Universities for Research in Astronomy (ACURA), the Association of Universities for Research in Astronomy (AURA), the California Institute of Technology (Caltech), and the University of California. The TMT is currently planned to begin operation in 2016. See the TMT webpage at http://www.tmt.org/

The European 50 Meter Telescope (Euro50) is a collaborative effort between Sweden, Finland, Ireland, the United Kingdom and Spain. Its anticipated location is La Palma, in the Spanish Canary Islands. This ELT will use 618 2 meter segments to create a 50 meter filled aperture, in a Gregorian configuration with an f/0.85 primary, and an f/15 exit f-ratio. It will weigh in at 3500 tons, and reach 85 meters high. See the Euro50 webpage at http://www.astro.lu.se/%7Etorben/euro50/index.html

But the most ambitious of the current crop of ELTs comes not from a large consortium, but from the European Southern Observatory (ESO). This is the Overwhelmingly Large Telescope (OWL). The OWL will use hexagonal segments, like Keck and the TMT, but in this case, they will put together about 3,000 segments, to create a 100 meter (3,937 inch) primary mirror. The primary will be roughly f/1, in a Gregorian configuration. The current plan is for OWL to begin operations as a 60 meter in 2016 or 2017 (to keep from being scooped by GMT & TMT). It will then be expanded, as funding permits, to 100 meter size by about 2020. It might even grow as large as 120 meters. See the OWL webpage at http://www.eso.org/projects/owl/

The science goals of ELTs are the same as for any large observatory. But the ELTs have the capability of doing things those smaller telescopes can’t do. The higher resolving power of the bigger telescopes means they can resolve and explore the (Continued on page 6)
primary mirror, the dimmer you can see. Everyone who has looked through an 8” and a 10” side by side has already caught the disease that we call *aperture fever*, the extreme desire for a bigger telescope! Just check out RTMC and see how many telescopes there are now, in excess of 20”, or even 30” in diameter.

Well, professional astronomers have the same fixation on going deep. When the year 1900 rolled around, the largest telescope in the world was the 40” refractor at Yerkes Observatory. When the year 2000 rolled around, the largest telescopes in the world were the 400” (10 meter) Keck I & Keck II reflecting telescopes on Mauna Kea, in Hawaii. The Keck telescopes introduced a new concept: *segmented mirrors*. The 10 meter mirrors of the Keck telescopes are made from 36 hexagonal segments put together like a jigsaw puzzle, instead of a single piece mirror. The same technology was used to make the 91 segment, 11 meter primary mirror for the Hobby-Eberly telescope, at the McDonald observatory of the University of Texas. But it can’t move in elevation, only in azimuth. It uses a coelostat to track objects, so it needs an 11 meter primary to cover the motion of its 9.2 meter optical spot. That’s why the Keck telescopes are still the largest single telescopes in the world. The new South Africa Large Telescope (SALT) is a copy of the Hobby-Eberly telescope. See the Keck Observatory web page at http://www.keckobservatory.org/ and the Hobby-Eberly webpage at http://www.as.utexas.edu/mcdonald/het/het.html and the SALT webpage at http://www.salt.ac.za/

But the idea of segments comes from an earlier idea: *multi-mirror telescopes*. The original Multi-Mirror Telescope (MMT) was dedicated in 1979, and consisted of six identical 1.8 meter (72 inch) primary mirrors working together. They had the combined area of a single 4.5 meter (176 inch) mirror. An innovative design, but still smaller than the venerable 5 meter (200 inch) telescope on Palomar Mountain. Moving from multiple mirrors to segments opens the door to arbitrarily large telescopes. Both ideas are now at work in the planning for a new generation of Extremely Large Telescopes (ELTs). See the MMT webpage at http://www.mmto.org/

The Canadian Very Large Optical Telescope (VLOT) is an ELT planned to replace the Canada-France-Hawaii Telescope (CFHT) on Mauna Kea, with a segmented 20 meter primary mirror, in a Ritchey-Chretien configuration. I don’t know how many segments it will use. It is the least ambitious of the ELT projects, being only twice the size of the Keck telescopes. See the VLOT webpage at http://www.hia-iha.nrc-cnrc.gc.ca/projects/VLOT_e.html

The Giant Magellan Telescope (GMT) is an ELT designed on the multi-mirror model. The GMT will have seven 8.4 meter (331 inch) mirrors. It will have the diffraction limited resolving power of a single 24.5 meter (965 inch) mirror. The mirrors will have 18 meter focal lengths, and will be arranged as an f/8.4 Gregorian. The GMT is a combined effort of the Carnegie Institution of Washington, Harvard University, M.I.T., the Smithsonian Astrophysical

---

**“Shake-It”**

flashlight requires no batteries. It uses Faraday’s Principle of Magnetic Induction and a bright LED to produce light without batteries. A 30-second shaking can recharge the capacitor to produce enough energy to provide about 5 minutes of light.

Larry Guerra has also added a red filter behind the front lens and shield around the LED to make the flashlight night observing compatible. The flashlight come in two version, one is decorated with LAAS club name or Logo, one is undecorated. It is sold at $12 – profits go to the LAAS– (compare to $13-15, plus shipping online or $19 at Big 5 Sporting store, which comes without red filter, shield, or LAAS logo).

Orders can be placed by sending a check or money order in the amount of $12.00 + $2.00 S&H paid in the order of Rachel Llamas at P.O BOX 1320 SOUTH GATE, CA 90280

---

Map to Monterey Park Observatory

(The place to build your telescope)

Vol 80, issue 3
Saturn is just past opposition and is in a good position for viewing in the evening. Orion and Taurus have regained control of the winter nights and spring is only two months away. Check out one of the LAAS loaner telescopes and take advantage of the clear winter nights.

LAAS-1 - 4.5" f/8 Celestron reflector on a solid Polaris equatorial mount. It comes equipped with a Kellner eyepiece, two Orthoscopics, and a collimation tool. These two 4.5" reflectors are good telescopes for beginners to learn with since they are both small enough to be easily carried and set up, but with enough aperture to provide good views.

LAAS-2 - 4.5" f/8 Tasco reflector on a motorized Edmund equatorial mount. This telescope has been upgraded with 1.25" accessories, a 6x30 finder, and very solid wooden legs. It comes fully equipped with a set of three Kellner eyepieces and a collimation tool.

LAAS-4 – 6” f/5 reflector by Telescopics on a low Dobsonian mount. It is equipped with a set of three Orthoscopic eyepieces.

LAAS-8 – 80 mm f/11.4 Selsi refractor on an equatorial mount. It is equipped with two Plossl eyepieces and an Orthoscopic.

For further information concerning these loaner telescopes call: David Sovereign at (626) 794-0646.

March 2
1972 Pioneer 10 also called Pioneer F.  
Pioneer 10 was launched on March 2, 1972, on top of an Atlas/centaur/Te 364-4 launch vehicle. The Atlas-Centaur as a three-stage launch vehicle. The third stage was required to push Pioneer 10 to the speed of 32,400 mph needed for the flight to Jupiter. This made Pioneer the fastest manmade object to leave the Earth, fast enough to pass the Moon in 11 hours and to cross the orbit of Mars in just 12 weeks. This mission was the first to be sent to the outer solar system and the first to investigate Jupiter. With the help of Jupiter’s gravity, Pioneer speed increased to 82,000 mph, after which it followed an escape trajectory from the solar system. The spacecraft is now heading towards Aldebaran a distance of 68 ly. at it speed it will take 2 million years. Last signal from Pioneer 10 was received on January 22, 2003, originally designed as a 21 month mission it has lasted more than 30 years. At last contact Pioneer was 7.6 billion miles from Earth light travel time 11 hrs, 20 min.

March 3rd
The Bruce Medalists Charlotte Emma Moore Sitterly  
Born September 24, 1898 – March 3, 1990  
After completing her B.A. in mathematics at Swarthmore College in 1920 Miss Moore took a job as assistant to Henry Norris Russell at Princeton University. There she audited courses and became coauthor of papers on binary stars and influential books on the masses of stars. Starting in 1925 she worked at Mt Wilson Observatory with Charles E. St. John and Harold D. Babcock on the solar spectrum. She earned her Ph.D. at Berkeley using Mt. Wilson plates to analyze atomic lines in the sunspot spectrum. Some of her many awards and honors include: the William F. Meggers Award of the Optical Society of America in 1972. She was elected an Associate of the Royal Astronomical Society in 1949, and the American Astronomical Society, Annie Jump Cannon Award 1937.

March 7th
Johann Bayer  
Born 1572- March 7, 1625  
A German astronomer born in Rain Bavaria. Bayer produced the star atlas Uranometria which was published in 1603 this was the first catalogue of stars to cover the entire sky. He introduced 12 new constellations that were created by Keyser and Houtman. Bayer also Split four constellations into eight, developed a star naming system called Bayer Designation.
Editor’s Message

The 80th year of the LAAS kicked off successfully with our annual banquet. Lots of photographic coverage in this issue.

Since Penny and Jim are now in the warm reaches of the Gulf coast of Florida, please send all written correspondence to:

LAAS
4800 Western Heritage Way
Los Angeles, CA 90027.

There will be one more change of address when Griffith Observatory re-opens.

A change was made to the outreach program contacts; Don DeGregori is the sole contact now. Also, we need a new youth liaison contact person.

For those wishing to submit material for the bulletin, the deadline is the 10th of each month to provide the necessary time to prepare all material into the bulletin and get it to our printers in time.

— David Nakamoto

The Outreach Program

There are three upcoming outreach dates, but only one has a fixed date:

- Feb 23rd — Irwin Elementary, La Puente
- April 20th — El Marino Language School in Culver City
- Nestle Ave. Elementary School
- Kester Ave. Elementary Magnet

Don DeGregori

EVENTS CALENDAR

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 4th (Sat)</td>
<td>Public Star Party</td>
<td>Griffith Observatory Satellite Moon and Saturn</td>
</tr>
<tr>
<td>Mar 13th (Mon)</td>
<td>General Meeting</td>
<td>The speaker has yet to be determined at the press time.</td>
</tr>
<tr>
<td>Mar 25th (Sat)</td>
<td>Dark Sky Night</td>
<td>Lockwood Valley</td>
</tr>
<tr>
<td>Apr 1st (Sat)</td>
<td>Public Star Party</td>
<td>Griffith Observatory Satellite Moon and Saturn</td>
</tr>
<tr>
<td>Apr 10th (Mon)</td>
<td>General Meeting</td>
<td>The speaker is tentatively scheduled to be Amanda Mainzer of JPL. The topic is Brown Dwarfs.</td>
</tr>
<tr>
<td>Apr 29th (Sat)</td>
<td>Dark Sky Night</td>
<td>Lockwood Valley</td>
</tr>
</tbody>
</table>

A reminder — The board meeting is held on the Wednesday night prior to the general meeting, at Garvey Ranch Park. It starts at 8:00 pm. The Monday general meetings start at 7:30 pm.

LAAS Home Page: [http://www.laas.org](http://www.laas.org)
LAAS Bulletin Online: [http://www.laas.org/bulletin.html](http://www.laas.org/bulletin.html)

Membership Annual Dues:

<table>
<thead>
<tr>
<th>Membership</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youth</td>
<td>$20.00</td>
</tr>
<tr>
<td>Regular (18-65)</td>
<td>$35.00</td>
</tr>
<tr>
<td>Senior Citizen (65 and up)</td>
<td>$20.00</td>
</tr>
<tr>
<td>Senior Family</td>
<td>$30.00</td>
</tr>
<tr>
<td>Family</td>
<td>$50.00</td>
</tr>
<tr>
<td>Group or Club</td>
<td>$50.00</td>
</tr>
<tr>
<td>Life</td>
<td>$500.00</td>
</tr>
</tbody>
</table>

Additional fees:

- Charter Star member | $30.00
- Star member, with pad | $70.00
- Star member, no pad | $60.00

*(Membership due date is indicated on the mailing label)*

HANDY PHONE LIST

LAAS Answering Machine: (213) 673-7355
Griffith Observatory
Program (232) 664-1191
Offices (232) 664-1181
Sky Report (323) 663-8171
Lockwood Site (661) 245-2106

(Not answered, arrange time with caller. Outgoing calls – collect or calling card)

Mt. Wilson Institute (626) 793-3100
FOR SALE
Small Rich Field Reflector

This Bausch and Lomb telescope was donated by Tom Dorff, one of our previous presidents. It has been refurbished and remounted as an equatorial. Our shop director tested the mirror and discovered that it has a smooth parabolic figure. It was used at the December 10th public star party where it gave very good images.

Primary Mirror Diameter – 130 mm (5.1”)
Focal Length – 715 mm (28.1”) f/5.5
Secondary Mirror – 1.3” elliptical
Finder – full aperture achromatic 6x30.
Focuser is a 1.25” helical with a removable extension tube about 2” long.
Mount is an older Jaegers light duty equatorial with 5/8” shafts which has been upgraded with bronze bushings on both axes.
Drive is a modified Edmund with a 96 tooth bronze gear and a 1/15 RPM synchronous motor.
Tripod legs are all aluminum (no plastic here).
The telescope comes equipped with a Meade 25 mm Modified Achromatic eyepiece.

Note: There is a scratch in the coating of the primary that does not affect performance. The mirror was inspected from the rear to verify that the scratch did not extend to the glass.

Asking $175 (proceeds go to the LAAS).
Contact Dave Sovereign at (626) 794 – 0646 ✦

Aperture Fever
By Tim Thompson

Typical public star party question: How far can you see with that telescope? Of course, those of us in the know can see over 2 million light years with our naked eyes. But the aperture of a naked eye is only about 5 mm in diameter, which, along with the sensitivity of the retina, limits us to seeing things that are about 6th magnitude and brighter. So we know it’s not how far you can see with a telescope that counts, it’s how dim you can see that counts. The bigger the area of your

Inside this issue
Aperture Fever (Tim Thompson) .............................. 1,4-6
Contact Information ............................................. 2
Editor’s Message (David Nakamoto) ....................... 2
Outreach Program (Don DeGregori) ....................... 2
This Month In History (Mary Brown) ....................... 3
Images from the Banquet ...................................... 6-8
Telescope Design, Refractors (David Sovereign) .... 9-10
Two Mirror Blanks .............................................. 11
Desert Sunset Star Party ....................................... 11
Lunar Image (David Pinsky) .................................. 11
Correction to Going Deep Article Image (Tim Thompson) .................................................. 12
Puns (Luis Ashelford) .......................................... 12
“Shake It” flashlight ............................................ 13
Monterey Park Observatory Map ........................... 13
Loaner Corner (David Sovereign) ......................... 14
Events Calendar ................................................ 15
Membership Information .................................... 15
Telescope for Sale (David Sovereign) .................... 16
Message From the Board (Peter DeHoff) ................ 16

Notes, corrections, questions, ideas, articles? All are welcome at: BulletinEditor@laas.org.