Sunset Astronomical Society

The Sunset *Gazette*

Serving the Tri-Cities since 1975

Volume 10, Issue 8 April, 2013

Meeting information

Meetings are generally in the theater in the Delta College Planetarium in Bay City. The meetings will usually be on the 2nd Friday of each month at 7:00 PM. Watch the newsletter for changes in dates and times. Membership is not required to participate in meetings and activities. See last Page for this month's meeting site.

Membership Information

Our club has switched to e-mailing our newsletters. For those wishing to receive a hard copy mailed an additional dues of $10.00 per year is required.

New Membership Rates:

5$ per Year

Treasurer's address for renewals and subscriptions:

Tom Smith, 3423 Hidden Road,

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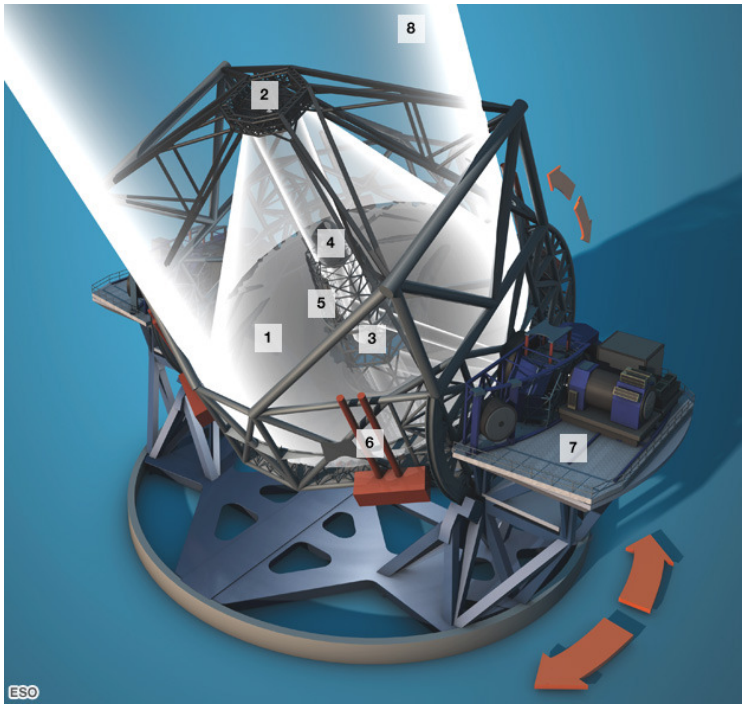
The Technology of large and super large Telescopes

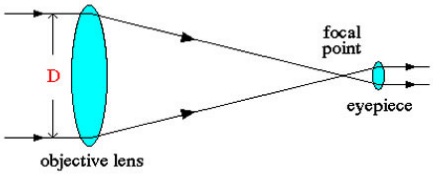
Time to start a new series in the SAS newsletter! The themes of the last series were rather historical or even pre-historical so we are jumping into the presence and even near future to look at the engineering and optical technology of the current large 8 - 10 m class of telescopes and the even larger ones who are either in the planning state or whose construction has already begun.

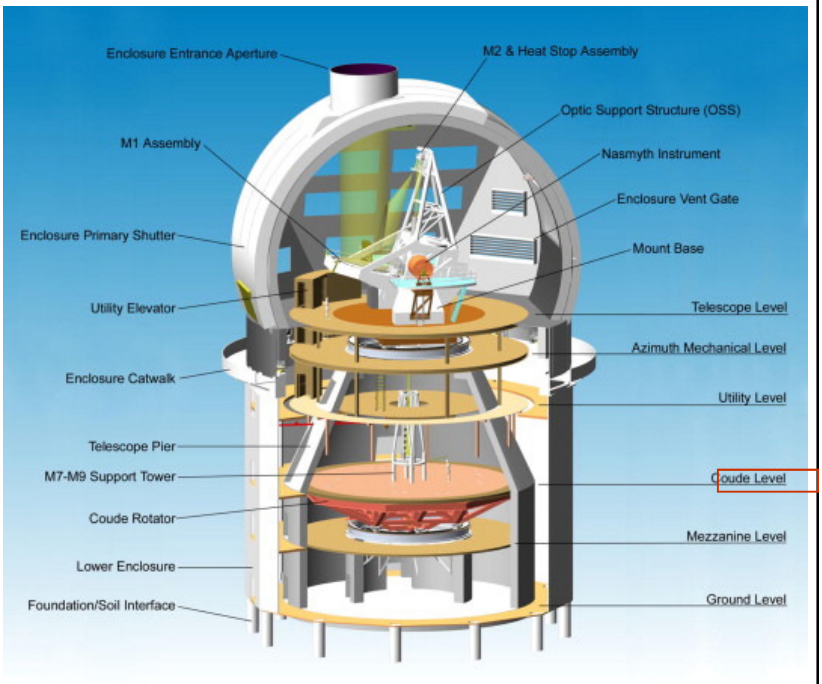
But as the saying goes "we are standing on the shoulders of giants" we cannot start the series without looking back in history to see how the current technology has developed over the past 400 years. If we look at the development of the telescope astronomers always wished for a range of things often not possible to combine in one single design: large viewing fields, large light collecting capacity, high spatial and spectroscopic resolution , low cost, light weight, great structural stability, easy to use … just to mention a few points on the wish list. Over the centuries this led to a range of solutions how to place the lenses, mirrors and focal points and you may have heard some of names of the astronomers, opticians , physicists and engineers who were involved in their development: Isaac Newton, Galileo Galilee, William Herschel, James Gregory, James Nasmyth, Laurent Cassegrain, George Willis Ritchey, Henri Chrétien, Bernhard Schmidt and many more. You may have seen design sketches of the new European Extremely Large Telescope (E-ELT) (see picture left side) and the American Thirty Meter Telescope (TMT): both have huge Nasmyth platforms besides their elongation bearings and the American Advanced Technology Solar Telescope (see schematic next page) and the European Solar Telescope have huge rotating Coudé platforms at their basements. By the way Coudé is not a person (as I thought) but the French word for an elbow-like angle 'le coudé'! If you start to have a closer look at different optical designs you soon



European Extremely Large Telescope (E-ELT): 1) The 39.3m-wide primary mirror (M1) is made up of almost 800 segments. 2) Secondary mirror M2 is 4.2m wide and hangs upside down. It will weigh less than 12t. 3) 3.8m-wide mirroe M3 sits in a hole in M1. M3 moves with M2 and M4 to focus. 4) The 2.4m-wide mirror M4 can deform its shape to remove twinkling in stars. 5) Mirror M5 is 2.6m x 2.1m. It stabilises the light on to the instrument detectors. 6) Lasers make artificial stars on the sky to help correct the imaging. **7) Nasmyth platforms**: E-ELT will have two instru-

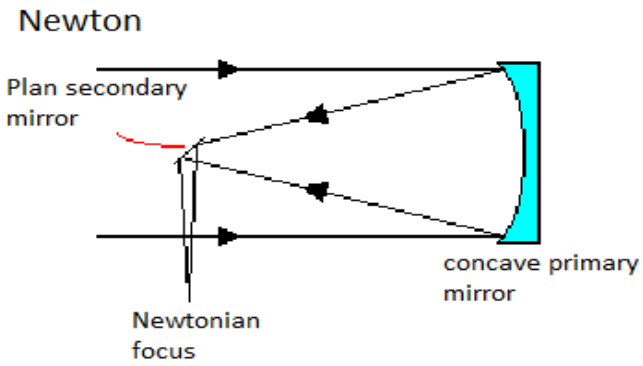
realize that the Coudé, Nasmyth, Cassegrain and other systems have very different optical pathways and therefore tremendous impact on the way the telescope axes and attached instruments are placed and finally on the construction of the telescopes. The first telescopes build by Galilei and Kepler were relatively simple designs consisting of the objective lens and at the front where the light entered and an eyepiece at the back where the object is observed.

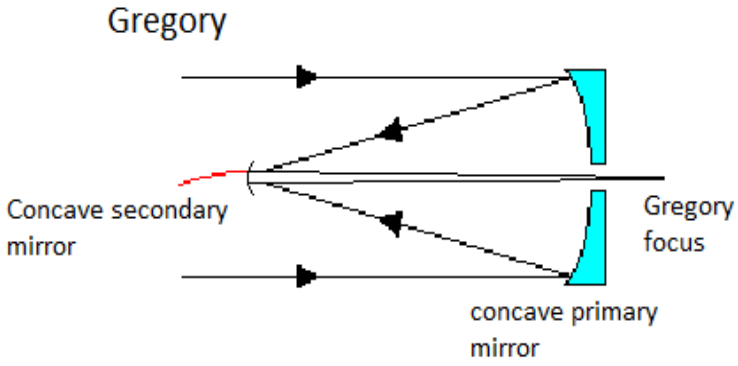




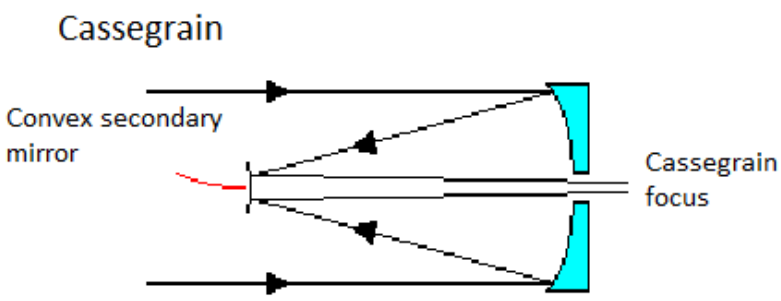
Advanced Technology Solar Telescope (ATST) will have a 4 m mirror and capable of observing objects on the Sun that are 30 km across. It is planned to be built atop the Haleakala volcano on the Pacific island of Maui.

To avoid the strong chromatic aberration of the early lens- based telescopes Newton replaced the light collecting front lens with a parabolic mirror and a secondary plane mirror to make the picture generated by the primary mirror accessible to the viewer. James Gregory then replaced the plan secondary mirror with a concave one directing the light through a central hole in the primary mirror. The

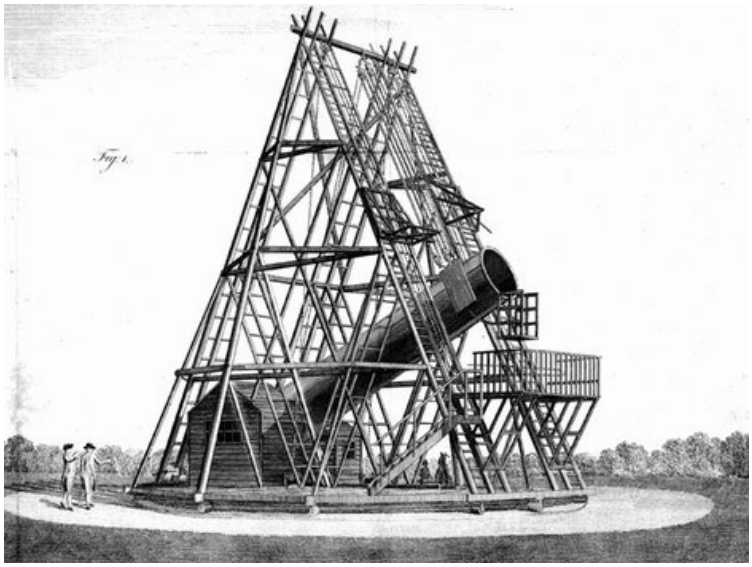




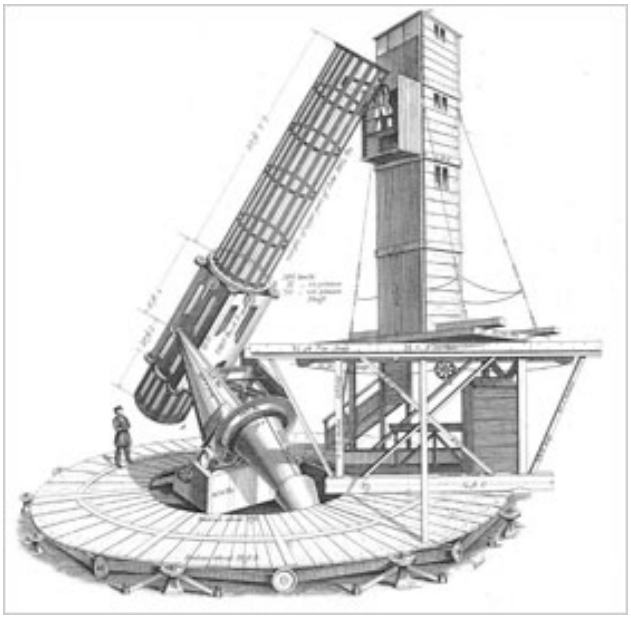
difference to the Cassegrain principle is the use of a concave secondary mirror which produces a real picture (no upside/downs) whereas Laurent Cassegrain (born around 1629 in region of Chartres) used a convex mirror which produces an upside/down or virtual picture of the object.



The next important point in the history of the telescope was its mount. In the last issues we heard about William Herschel and how he developed an azimuth mount where he could control the movement of the telescope with a range of winches, pulleys and lots of dedicated assistants. Because the large Herschel telescopes were 'front viewers' he constructed a movable 'Herschel platform' which could be raised and lowered and kept the observer on level with the eyepiece (see left picture on the next page). In a way this platform had the same function as the Nasmyth platforms to create a space for the instruments or observer at the focal point of the telescope.

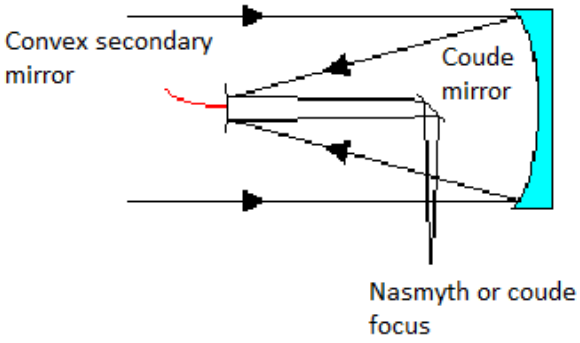


The Herschel mount had some distinctive disadvantages: its image stability as the telescope tended to swing especially in stronger winds and the image rotation. So it is not surprising that just 9 years after Galilei pointed his telescope to the stars the first equatorial mount was developed. It was the Jesuit Pater Andreas Scheiner in Augsburg, Germany who build the first equatorial cross with one axis pointing to the celestial north pole. To track the stars (in this case the sun because the first equatorial mounted telescope was actually a sun telescope for the observation of the newly discovered sun spots) the telescope had to be rotated only in one axis and the image rotation was canceled, too.



The 19th century was the great age of the equatorial mounted refractor mainly due to the pioneering work of Johannes Fraunhofer who not only revolutionized the manufacturing of optical glass but also build ingenious equatorial mounts who soon became known as German equatorial mounts. The advantage of the equatorial mounted refractor was clear: the eyepiece was easily accessible by ladders or by ingenious hydraulic movable floors as used with the Lick refractor in California or the Yerkes refractor in Chicago. The early equatorial mounted Newton reflectors demanded a serious sense of heights because the observer had to be at the top of the telescope in any position. In 1863 William Lassell (1799 - 1880) found the solution for his reflector situated on the island of Malta in the Mediterranean sea: he constructed a wooden azimuth platform with a wooden tower and elevator in which the observer was sitting (see picture on the right side). Also visible is the new fork mount which would be the future design for most of the large reflectors until the advent of the 8 - 10 m class telescopes.

All these disadvantages lead to the development of the Nasmyth platform (see James Nasmyth with his 20" reflector observing at the Nasmyth platform) and the Coudé-laboratory. As you can see the observer is sitting on a chair which is following the azimuth and looking through an eye piece which is placed exactly in the center of the declination axis and therefore does not move either (see also scheme below).



Next time: More about telescope systems and engineering problems of ever bigger telescopes.

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This issue can be accessed in color on the website of the SAS!!!
http://www.sunsetastronomicalsociety.com

SAS Meeting

Start: 7:00 PM

Friday, April 11th, 2013

Delta Planetarium

Welcome members and guests

New and old business

Club Business

Treasure report

Refreshments Break

Presentation:

TBD

If clear we will observe on the observation deck.

Watch out for announcements for a Messier marathon!

What's up in the Sky

Apr 3: Last Quarter Moon

Apr 10: New Moon

Apr 17 *Early Evening*: Watch out for a thin crescent Moon between Aldebaran and the Pleiades with Jupiter above it.

Apr 14 *Evening*: Moon and Jupiter pair up.

Apr 18: First Quarter Moon

Apr 22 *Early Morning*: The Lyrid meteor shower peaks in the early morning hours before dawn.

Apr 24 *Evening and Night*: Spica can be found very close to the nearly full Moon and is occulted by the Moon in parts of Central and Southern America.

Apr 25: Full Moon

Apr 25 *Evening and Night*: Saturn can be found to the upper left of the full Moon.

Apr 27-28 *All Night*: Saturn is in opposition, opposite the Sun in the Sky and closest to Earth for 2013.

May 5 *Early Morning*: The Eta Aquarid meteor shower (best for southern latitudes) will be at its strongest just before dawn.

May11, 12 *Dusk*: Watch out for a very thin crescent Moon very close to Venus low in the west-northwest shortly after the sun sets.

UPCOMING EVENTS