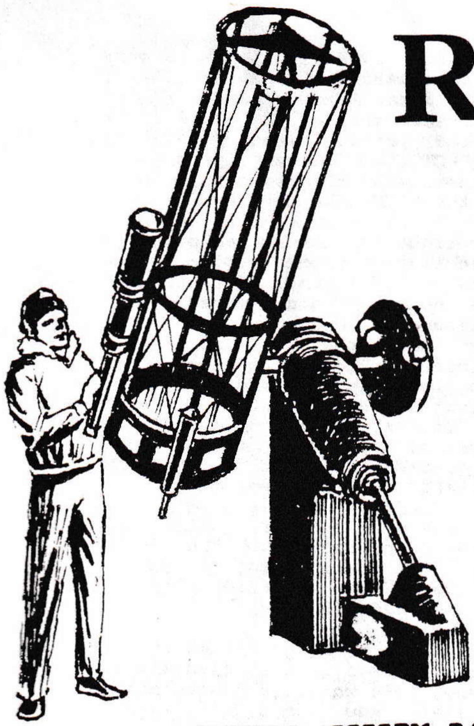


REFLECTIONS

of the

UNIVERSITY

LOWBROW

ASTRONOMERS

EDITOR JEFFERY BASS

vol. V no. II

PREVIEW

This Friday's meeting of the University Lowbrow Astronomers will feature a talk by former club president Doug Nelle on his and other club member's trip to the South East to view May 30th's broken annular eclipse. Apparently, they did a little more driving than they bargained for while trying to find a spot with clear weather from which to photograph the fleeting eclipse.

Also, club president Peter Challis will report on his touring of the Soviet Space Museum and other places of interest he visited while in the U.S.S.R. last month.

OPEN HOUSE

Make your plans now to attend the next Open House at Peach Mountain on Saturday, June 30. If the weather is clear we can expect upwards of 150 to 200 people to attend. It's alot of fun, plus here is your opportunity to wax poetic on astronomy and what-not since most of the people who venture out there know very little about the sky.

DUES

Dues are due for the new Lowbrow fiscal year. They are $7.00 per year per member, $10.00 for families and couples. This is the last mailing of the newsletter to any club member that has not yet renewed his or her membership. You can pay the club Treasurer at the meeting or mail a check to:

Jeffery Bass/Treas.
1587-8 Beal Ave.
Ann Arbor, MI 48105

Make the check out to:

University Lowbrow Astronomers

FOR SALE

A nice telescope is up for sale. It looks like a steal for the price asked. Here is the pertinent info:

Celestron C90 (no wedge or tripod)
6 X 30 finder
45mm Plossl eyepiece
.965" to 1.25" star diagonal

$150

call: Mike Dosch
776-5762 (Detroit)

call between 5-7 P.M.

TELESCOPES

by

Jeffery Bass

Many new club members are unfamiliar with various aspects of astronomy. Since one usually absorbs bits of astronomical knowledge at a leisurely pace, it's hard to know just how much of an astronomy background club members actually have. This article is for the new (or old) club member who isn't really all that interested in getting a massive dose of astronomy but would just like a few ideas cleared up.

It's a good idea for newcomers to astronomy, especially AMATEUR astronomy, to at least know something about telescopes. This article briefly describes how a telescope actually works and presents a few of the more common telescope designs used by amateurs today.

A telescope is a light collector. There are light photons zipping around us all of the time in all different directions. How can you get this light into one place so that you can examine it? A LENS does this nicely.

A lens is just a clear piece of glass that has been ground into a convex shape in such a way that light passing through it is bent and focused to a small point. The distance from the lens to this "focal point" is called the FOCAL LENGTH, which can be any distance depending on the curvature of the focusing lens. Often the focal length is described in terms of lens diameters, or "f" values. If a 2 inch diameter lens focuses light to a point 10 inches away from the lens (or 5 lens diameters) then the focal ratio is f5.

The bigger the lens is, the more light it will be able to focus. The human eye has a lens and an opening in front of the lens (the pupil or APERTURE) that is about a half inch in diameter. Any lens bigger than a half inch in diameter will obviously be able to collect alot more light than the human eye. This has the effect of making what appears as a dim blob to the unaided eye into a bright object when focused by a large lens.

The focused light forms an IMAGE at the focal point. Great! We've got a bright image that we can look at. Except that the image formed by a single lens is usually so small that you need a magnifying glass to see it clearly. Well, fine. Get a magnifying glass.

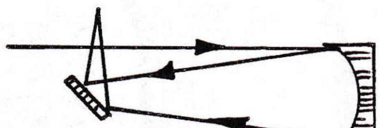
So, now you have a large lens which focuses light entering it into a bright, though tiny, image which you can view with another lens, a magnifying glass. You have just built a TELESCOPE. The specific type of telescope, in this case, is called a REFRACTOR. All telescopes that focus their PRIMARY IMAGE by passing light THROUGH A LENS are called refractors. The lens that forms the primary image is called the OBJECTIVE. The magnifying glass used to examine the primary image is called the EYEPIECE.

Passing light through curved glass to form an image has one problem. The different colors that light is made of are not bent and focused by the same amount. Hence, you get a primary image that has all sorts of colored fringes around it. This problem is only overcome by passing the light through another piece of glass (of just the right density) in the hopes of correcting the bad color focus before the rest of the image is formed. This correcting lens (usually FLINT) is placed just behind the first lens (called the CROWN when paired with the FLINT glass). This combined unit of color-correcting CROWN and FLINT glass is called the OBJECTIVE proper.

With the light passing through all of this glass, there is a certain amount of light loss which is undesirable. Also, since you don't want any obstructions in the light path, the objective lens can only be supported around its edges, which introduces another problem as the lens begins to warp and flex under its own weight, producing bad images. And since the objective has FOUR surfaces (2 on the crown and 2 on the flint) that have to be accurately ground out, refractors tend to be quite difficult and expensive to manufacture. The solution to all of these problems is to collect and focus the light not by passing it THROUGH glass, but instead by bouncing or REFLECTING it OFF the glass. A mirror which has been ground with the same curve that a lens has (only backwards; i.e. concave instead of convex) will focus all of the light, REGARDLESS OF ITS COLOR, to the same point. A mirror has only ONE optical surface that need be ground instead of four, which is easier and cheaper to do than grinding a lens. And since a mirror has only one REFLECTING surface, it can be supported IN ITS ENTIRETY from the back, thereby reducing the problem of sagging and warping which critically limits the useful size in which a lens can be made. A REFLECTING telescope can be constructed much larger and cheaper than a REFRACTING telescope.

There is one drawback to the reflector design; since the light is reflected to a point IN FRONT of the mirror, how can you examine the primary image without getting in the way of the incoming light? All sorts of ingenious methods have been designed to solve this problem.

The simplest reflecting telescope design is called the Newtonian reflector. I guess Isaac Newton invented it. Anyway, in this design incoming light goes down a tube. At the bottom of the tube lies a mirror (as with a lens, also called the OBJECTIVE) which focuses the light back up the tube. Just before the light focuses to a point, it is deflected diagonally out the side of the tube by a flat mirror called the SECONDARY. The primary image is formed outside the side of the telescope tube where it is examined by an eyepiece. This telescope design never fails to flabbergast non-astronomers who expect to find a lens at the front of the telescope and an eyepiece at the back and instead find the whole arrangement to be "backwards" with the objective at the bottom and the eyepiece at the top!



Newtonian

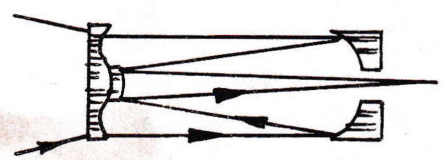
The actual three-dimensional shape that the primary mirror is ground into is a paraboloid, or sometimes a simple sphere. Paraboloids are relatively easy to grind, although it must be done by hand. Spheres are the easiest shapes to grind and can be mass produced by machines.

The Newtonian reflector is a great design! Because of its simplicity of construction in having only ONE curved optical part (the objective) and a flat secondary, the Newtonian design is very cheap to build and is thus the all-time favorite among amateur astronomers.

The next step up in complexity is the Cassegrain reflector. I guess a guy named Cassegrain invented it. Anyway, in this design a paraboloid primary mirror reflects and focuses the light up a tube. Instead of deflecting the light out the side of the tube like a Newtonian, the Cassegrain reflects the light from a secondary mirror STRAIGHT BACK towards the primary mirror. If the secondary were flat, the light would focus somewhere in the middle of the lightpath, halfway down the tube. To keep the light from focusing "too soon", the secondary mirror in a Cassegrain is actually a CONVEX curve (a hyperboloid) which serves not to focus the light, but to spread it out. The amount of spread, though, is still less than the amount of focus; so the light eventually forms an image outside the BACK of the telescope tube behind a hole drilled into the primary mirror. Using this telescope is similar to using a normal Refractor because in both designs the eyepiece is at the back end of the telescope instead of at the front as in the Newtonian. Because of the light stretching antics of the convex secondary mirror it is possible using the Cassegrain design to "squeeze" the optics of a much larger, simpler optical design like the Newtonian into a smaller volume of space. Hence, you can construct a larger, more powerful telescope without the heavy bulk that a Newtonian would have. Of course, because of the complexities of the optical system, a Cassegrain is more expensive and difficult to construct. The club's 24-inch telescope at Peach Mountain is a Cassegrain design.

Cassegrain

The desire to compress the optics of large telescopes into tiny lightpaths has led to the development of many complex optical designs. One popular complicated design is the Schmidt-Cassegrain. Telescopes using this design are similar to normal Cassegrains except that they have wider fields of view. In the Schmidt-Cassegrain, incoming light passes through a complex, 4th order curved correcting LENS before falling onto a spherical primary mirror. The correcting lens at the front of the telescope helps to focus off-axis light into the otherwise parallel lightpath, thus focusing a wider view of the sky. The light bounces off the primary mirror back up towards the correcting lens. There is usually a tiny spot on the correcting lens that is silvered which serves as the secondary mirror. The light bounces off of this ersatz curved secondary (a quasi-hyperboloid) and focuses past a hole in the primary mirror, as in a normal Cassegrain. This complex mixture of lenses and mirrors is called a Catadioptric design. Popular catadioptric telescopes are the Celestron and the Questar. And if you've ever priced a Questar, you KNOW that the catadioptric design is the most expensive of all.



Catadioptric

There are scores of different optical designs for telescopes. They are all modifications of the 4 basic types that have been described; refractors, Newtonians, Cassegrains, and catadioptrics. The telescopes owned by various Lowbrow members represent examples of ALL of these different types. Of course, optical design comprises only half of a telescopes total performance and function. The manner in which a telescope is MOUNTED exhibits even more variation than optical design. But that is an article for another day.

--- Jeffery Bass

Monthly Meeting

JUNE 8 *7:30 p.m.*

Detroit Observatory Classroom

program: Doug Nelle
"May 30 Annular Eclipse"

and

Peter Challis
"The Soviet Space Museum"

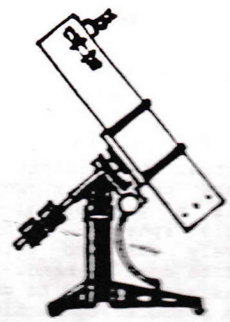
club address:

MSA Office Michigan Union

Ann Arbor, MI 48104

The deadline on submission of articles for the July issue of REFLECTIONS is July 1. Send your articles to:

Jeffery Bass Editor
1587-8 Beal Ave.
Ann Arbor, MI 48105



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