Grand Traverse Astronomical Society

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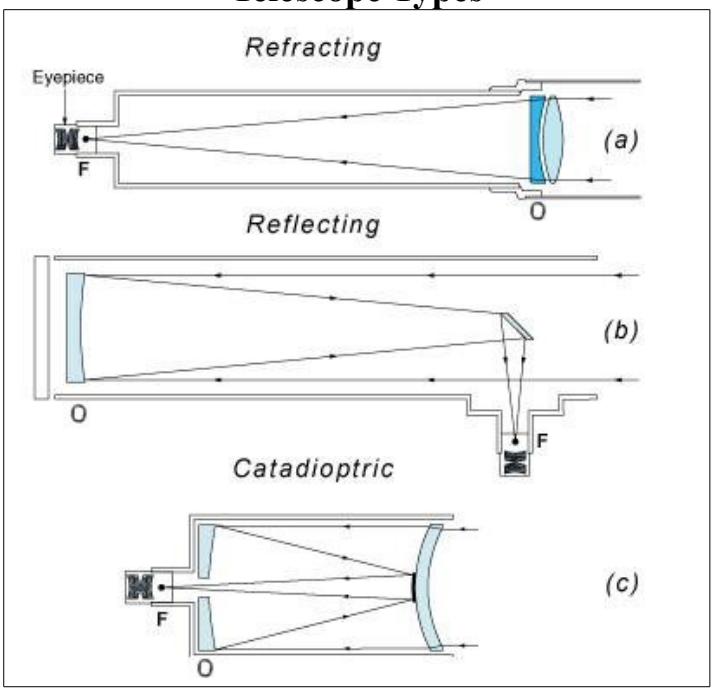
Telescope Basics

Telescope Types

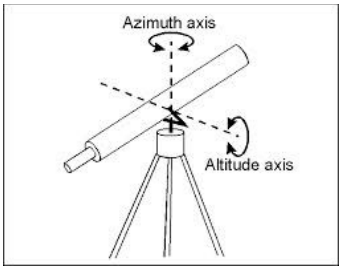
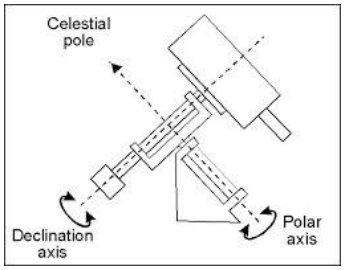


There are two basic telescope types: The refractor or refracting telescope and reflector or reflecting telescope. The reflecting type shown is a Newtonian telescope, is the simplest and most inexpensive reflector. The Catadioptric (Mirror-Lens) telescope uses a corrector plate in front of the telescope. The one shown is a type called a Maksutov-Cassegrain. The more popular type is the Schmidt-Cassegrain which uses a thin, nearly flat corrector plate. The Cassegrain design uses a convex secondary mirror the sends the light back through a hole in the Primary mirror (O) to an eyepiece.

Refracting telescopes get expensive in a hurry as the diameter of the objective (O) lens increases due to the requirements of at least 4 lens surfaces of the at least two lenses that make it up. The reason for it is to correct for color fringes that would result around bright objects seen through it (chromatic aberration), and the optical quality of the glass required. Reflectors primary mirror have a single surface and the glass simply supports it. The corrector plates of the catadioptric telescopes don't create chromatic aberration because they don't bend light much. Telescopes are rated by the diameter of their objectives (O). One could purchase an 11 inch Newtonian telescope for less than $1,000, An 11" Schmidt-Cassegrain for $2,500, or an 11" refractor for the cost of a Lexus.

The reason astronomers go for wider telescopes (greater aperture) is two-fold: To gather more light to better see faint objects, and to increase resolving power, the ability of the telescope to see fine detail and be able to use higher magnification. We'll see the rules when we talk about eyepieces.

Telescope Mounts

			
Alt-Azimuth	German Equatorial	Fork (Can be either Alt-Az or Equitorial)	Dobsonian (Alt-Azimuth)

There are four basic mounts. Equatorial mounts have to be aligned to the earth's axis in order to work properly to follow objects in the sky. Alt-Azimuth mounts are the simplest and easiest to set up, but all but the most sophisticated cannot be made to track objects in the sky as the Earth rotates. A relatively new addition to mounts is the computerized "Go To" feature allows the telescope to find objects itself when the mount is properly aligned to the sky. Telescopes with Dobsonian mounts have the largest aperture for the buck. Cheap telescopes tend to have cheap mounts that are hard to use and wobbly, especially the ones with German equatorial mounts. An alt-azimuth mount would be steadier in this case.

Finder Telescopes

The telescope eyepiece covers so little area of the sky to make finding anything virtually impossible. So all telescopes have small finder scopes attached of 6 to 10 power, or 1 power devices that put a finder circle or red dot on the sky when you look through them. A newer finder idea is a mount for a green laser that projects a beam in the atmosphere toward the object to be located. The author prefers a finder with an aperture of at least 50mm to be able to see most of the dim objects he's looking for. In the main telescope, use the lowest power eyepiece because it has the widest field of view.

Eyepieces

Magnifying power or magnification is not a telescope property. The eyepiece is essentially a magnifying glass to view the real image that the objective lens or mirror produces at the focal plane (F) in the telescope type diagram on the first page. The focal length of the objective lens or mirror or the effective focal length of the mirrors of the catadioptric telescope divided by the focal length of the eyepiece gives the magnification of that particular combination of telescope and eyepiece. The focal length of the eyepiece is marked on the eyepiece. The telescope focal length may or may not be stamped or marked on the telescope, if not, check the owner's manual for that quantity.

A telescope will generally come with one or two eyepieces, The lowest power eyepiece will generally be a 25mm eyepiece of some kind. Eyepieces come in 2 standard barrel sizes, 1 ¼ inch and 2 inch. There are some old telescopes that only accept sub 1 inch eyepieces. You may have to hunt to see if any of those size eyepieces are still around. The cheaper the telescope the crummier the eyepiece. Decent eyepieces start at around $50 and go up from there. The best way to tell which eyepiece fits your needs is to ask an astronomer what eyepiece he or she is using at a star party.

About magnification. The highest usable magnification in a telescope is calculated as the aperture in millimeters times 2.4 or aperture in inches times 60. After that the image becomes fuzzy and dim. It's due to the wave nature of light. The author halves those values in his experience. He'd rather have small crisp images than big fuzzy ones devoid of contrast.

A handy accessory to have is a Barlow lens, a negative lens in a tube, that the eyepiece is slipped in before inserting the pair in the eyepiece holder. It will double the power of the eyepiece. So with two eyepieces and a Barlow four separate magnifications are available. The author would rather us a lower power eyepiece with a Barlow than a high power eyepiece of the same power. In that same vane a good low power wide angle eyepiece is generally the first extra eyepiece astronomers purchase. More expensive ones can be like viewing the universe in IMAX. Here is a truism: Amateur astronomers use their telescope's lowest power 90% of the time.

Solar filters that fit over the front of the telescope and finder is a fine addition to any telescope and allow viewing of our star close up. Some old telescopes have a solar filter that fits in an eyepiece. For your visual health take the filter, go down to the bay and see how many times you can skip that sucker on the water. There are also filters that can filter out some of the light pollution for dim nebulae. There are filters also to bring out detail in planets.

Above all, have fun! If you have any questions ask that friendly amateur astronomer over there standing by his or her telescope.

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