Buying Your First Telescope
By Mike Usher

The first thing to understand is that a telescope is a high quality optical device and high quality optical devices are not inexpensive. One does not have to mortgage your home to buy one, but you are unlikely to find one that is truly useful for under $300 – and then only in certain styles. Many well meaning parents have given their offspring a cheap department store telescope and it winds up in the closet; the children are simply unable to see anything with it and give up in frustration. There is however an easy way to spotting a cheap department store telescope; any telescope advertised based on the number of times it can magnify an object must be avoided.

Aperture (the diameter of the lens or mirror) is the way quality telescopes are sold. In general the larger the aperture the better the telescope assuming all other things are equal. (Often things are not equal, but we will get into that later).

The purpose of a telescope is to look at objects; the addition of electronics, while sometimes a convenience, does not make the object look any brighter or more detailed. Electronics do however make the telescope significantly more expensive. Inexperienced adults and especially children find electronics (except possibly for the top of the line models) rather difficult to calibrate. Electronics have another fault; many times club members have taken their telescopes far outside of town, but find out upon arrival they have a dead battery or forgot some crucial electrical connection leaving their telescope worthless.

Types of Telescopes

There are three kinds of telescopes commonly encountered today:

Refractors
Reflectors
Catadioptrics

Each kind has their own advantages and disadvantages.

Refractors look like a traditional telescope; a lens at one end and an eyepiece at the other. When one casually mentions a telescope in conversation it's the image of a refractor that immediately leaps to mind. Of all the kinds of telescopes a good refractor will produce the sharpest, clearest image with the best contrast The key word here is "good"-department store refractors are, without exception, poor. All refractors suffer from a defect called chromatic aberration caused by the various colors of light not coming to a sharp focus. Careful engineering can eliminate chromatic aberration almost entirely, but such engineering comes at a high cost. A good refractor can cost 5 or 10 times as much per inch of aperture as other kinds of telescopes. In addition defect free glass is difficult to make which also increases the cost. In general, refractors are best left for advanced amateurs.

Reflectors are probably the most popular type of telescope today. Almost all large observatory telescopes are reflectors. (Including the Hubble) A large mirror, called the primary, reflects light back to a much smaller mirror called the secondary which then reflects the light to an eyepiece. Unlike a normal mirror the reflective coating is on top of the glass, not under it. While this makes the mirror very fragile, it eliminates all chromatic aberration and since the light does not go through glass, quality of the glass is not much of an issue. The addition of a secondary mirror does reduce contrast of the image somewhat and the wires supporting the secondary produce diffraction spikes on bright stars. Photos taken with reflectors are published so often though that people have come to regard the diffraction spikes as natural looking. (Indeed tiny defects in your eye can give stars similar spikes even without a telescope). Reflectors are the least expensive telescope per inch of aperture.

Catadioptrics are a compromise between the above two types, they have both lenses and mirrors. They come in several different styles, perhaps the Schmidt-Cassegrain is the most common. Catadioptrics are much valued for their compactness, being much shorter than reflectors or refractors of the same aperture. The contrast is a little worse than reflectors because the secondary mirror is relatively larger.

	Refractors	**Reflectors**	**Catadioptrics**
Contrast	excellent	good	fair
Cost per inch	High	Low	Medium
Compact	No	No	Yes
Image	Upright and reversed	Upside down and normal	Upright and reversed

Mounts

A proper mount is an absolute necessity for astronomical viewing. A mount must hold the telescope rock steady or vibration will render the scope unusable. Except for Dobsonian mounts the rule of thumb is that the mount must cost the same as the telescope. (or more)

Types of Mounts

Alti-azimuth
Equatorial
Fork

Alti-azimuth mounts tend to be shipped with inexpensive telescopes, they do not follow the stars through the sky without constant human attention. Except for the Dobsonians they tend not to be very steady. All types are unsuitable for photography. Dobsonians are a special classification of alti-azimuth mounts, they are both inexpensive and extraordinarily stable and a good choice for beginners and advanced users alike as long as photography is not an issue. Dobs, as they are called, are almost always used in conjunction with reflectors.

Equatorial mounts are rather heavy and comparatively difficult to set up, but are indispensable for photography. A motor will enable this mount to turn the telescope and follow the stars. They are often computerized. Any type of scope may be paired with an equatorial.

Fork mounts are almost always seen on Schmidt-Cassegrain telescopes and are typically fully computerized. They will follow the stars once properly set up but are unsuitable for photography as they do not "roll over" as the sky does. Despite being fully computerized they can be remarkably difficult for the beginner to set up.

So Which Kind Do I Buy?

The proper kind of telescope to own is the one that you will actually use; all other considerations are meaningless unless you can be motivated to drag it outside on a regular basis. Bigger is better for a telescope, but if it is so heavy you can't move it there is no point in owning it. Conversely small scopes are easily portable, but you just can't see as much with them; you will be disappointed with the scope and it will remain in the closet. If you love photography, you probably won't like a Dob. The point is to find a happy medium.

There are several purely practical considerations that are completely down to earth:

1. How much money can you afford?
2. What is your physical condition? (How heavy an item can you lift?)
3. Where can you store it?
4. What kind of vehicle is available to transport it?

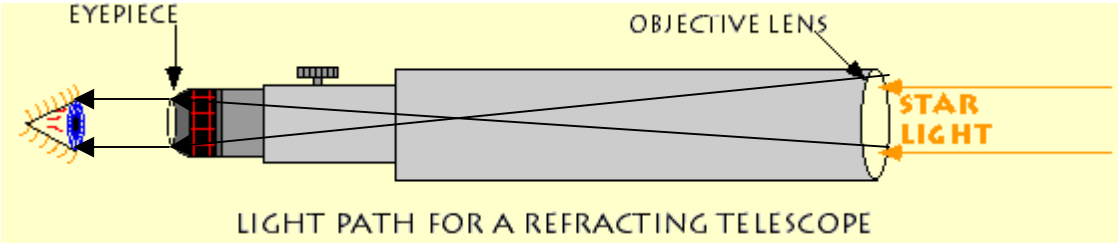
Ask any telescope owner and he/she will tell you several workarounds to all these questions, but in the final analysis you are going to run up hard against at least one of these questions.

The Solution

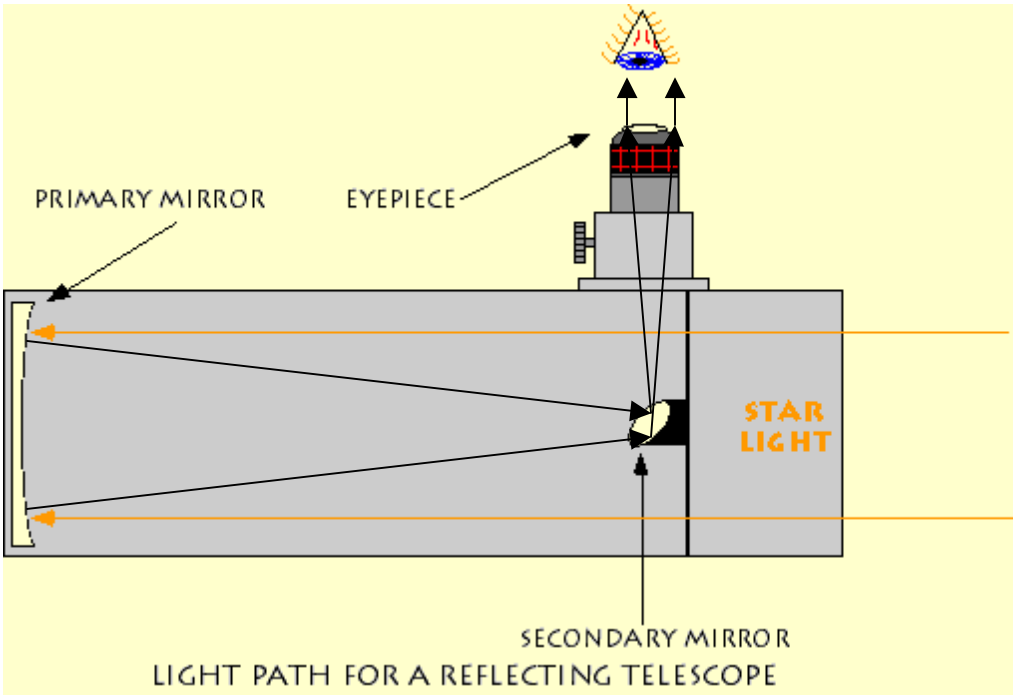
The solution is fairly simple: Try before you buy! Come out to the Fakahatchee on one of our viewing nights. There you will find at least a dozen different kinds of telescopes with owners happy to show you how to use them. Soon you will find a telescope type that suits you.

Glossary of Common Telescope Terms

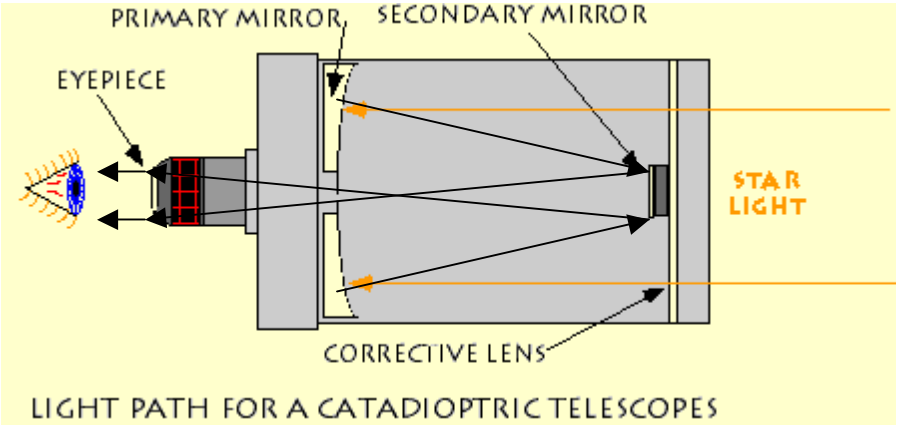
Aperture:	Diameter of the lens or main mirror.
Catadioptric:	One of the three common types of telescopes – uses lenses and mirrors.
Dobsonians:	A simply constructed and very useful mount invented by John Dobson.
Equatorial:	A mount that allows your telescope to rotate around Earth's axis.
Eyepiece:	A special kind of magnifying glass located at the end of a telescope's light path.
Eye Relief:	The maximum distance between your eye and eyepiece where the full field of view can still be seen. Of most use for people who wear glasses.
Field of View:	What the eye can see through the eyepiece. Can be actual or apparent. Usually measured in degrees.
Focal Length:	The distance from objective to the focal point. Usually given in millimeters.
Fork mount:	A common type of computerized telescope mount.
Limiting Magnitude:	The faintest star a person with normal eyesight can see on a dark night.
Magnification:	Calculated by dividing the focal length of the eyepiece into the focal length of the telescope. Maximum useful magnification is 50 power for every inch of aperture.
Maksutov:	A common type of Catadioptric telescope
Newtonian:	The most popular type of reflecting telescope - invented by Sir Isaac Newton
Objective:	The main light gathering device for a telescope. Either a lens or a mirror.
Reflector:	One of the three common types of telescopes – uses mirrors.
Refractor:	One of the three common types of telescopes – uses lenses.
Resolution:	Calculated as the minimum distance two sixth magnitude stars can be apart and still be seen as separate. Usually given in seconds of an arc. Not the same as magnification.
Schmidt-Cassegrain:	A common type of Catadioptric telescope



Refracting Telescopes



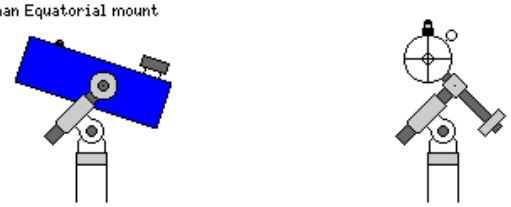
Reflecting Telescopes



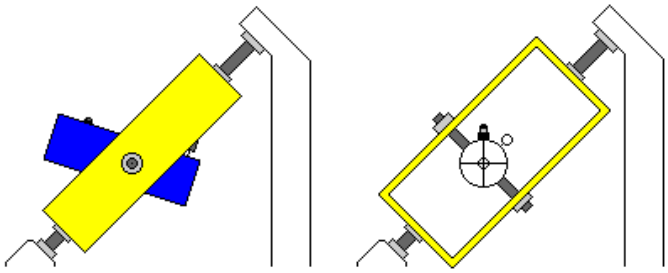
Catadioptric Telescopes

Fork mount

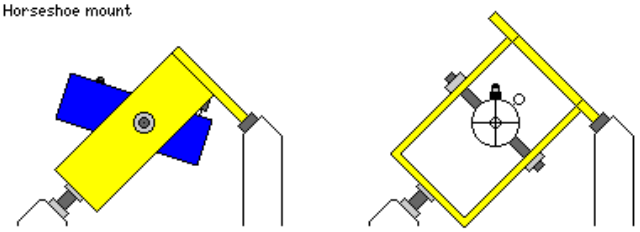
German Equatorial mount



Yoke mount

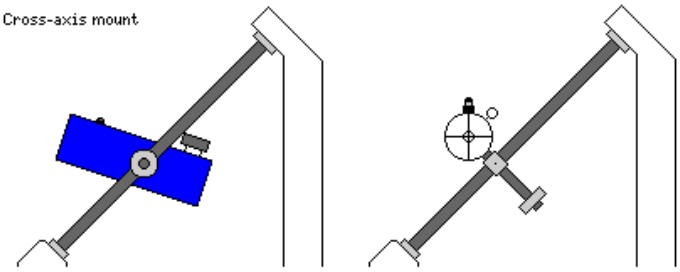


Horseshoe mount



Astrographic mount

Cross-axis mount



Inverterted-fork mount

Siderostat