The ABCs of Observing: Basic Observing Terms

(*This article is based partly on material compiled and published by* ***Bill Warren*** *in the* Observer *in Feb., 2001, and partly on material added by him since then***.)**

Alt-azimuth (mount). A type of telescope mount that must be moved manually upward (altitude) and laterally (azimuth).

Antoniadi scale. The Antoniadi scale measures the effects of air movement on what we see.

If you find a bright star and move it out of focus, a black ball with spikes will appear. The Antoniadi scale indicates how much air movement is occurring at any given time. On that scale, 1=no movement of the spikes; 2=occasional, slight quivering of the spikes; 3=occasional, major quivering; 4=constant quivering; and 5=severe quivering in which images fairly dance across the field of view.

Aperture. The diameter of the **primary mirror** of a reflector or **objective lens** of a refractor. Generally, the larger the aperture, the fainter the objects that can be seen and the greater the *resolution.* (While "resolution" normally refers to the telescope's ability to split close double stars into separate components, it can also refer to the ability to show greater detail (e.g., revealing individual stars in globular clusters).

Averted Vision. In the dark, the outer edges of the retina are more sensitive to light than the center. When observing objects such as faint galaxies, nebulae or unresolved clusters, looking slightly to one side of the object allows that object's light to fall on the more sensitive outer part of the retina, revealing detail that might otherwise escape notice when looking directly at that object.

That's why the "Blinking Planetary (NGC 6826 in Cygnus) appears to blink on and off like a turn signal when viewed at low power: when you look straight at it, the faint central star cannot be seen and the star's halo is too dim to be revealed. But when you look away slightly – say, half an inch in any direction – the outer portion of the retina collects the light and the central star and its gaseous halo "blink" back on. (This effect does not occur at high magnification.)

Barlow lens. Named for its creator, Peter Barlow, the Barlow lens is a lens that, when inserted into a telescope's focuser, doubles or triples the magnification of any eyepiece that is fitted into the Barlow's tube.

Collimation. The alignment of the optical elements of binoculars, a telescope or a **Telrad** at the correct angles to the light path. A poorly collimated instrument will distort images, esp. away from the center of the field of view, into elongated stars, hazy planetary images and unresolved close double stars.

With a reflector, both the large **primary mirror** located at the bottom of the tube and the flat **secondary (diagonal) mirror** near the light-gathering, open end require periodic recollimation; the former is easy, the latter more difficult.

Refractors, on the other hand, seldom if ever require such adjustments.

Diagonal (mirror). In a refractor, a mirror on the **focuser** that bends, or *refracts,* incoming light to make it easier to see through the eyepiece. In a reflector, the **secondary mirror** is also known as the diagonal mirror.

Direct vision. Looking straight at an object.

Dobsonian mounts. Alt-azimuth mounts consisting of a free-swiveling, "lazy susan"-type base upon which the **optical tube assembly (ota,** usually a reflecting telescope) rests. Named for the California ex-Jesuit priest John Dobson who invented them, Dobsonian mounts are responsible for the array of relatively inexpensive, large-**aperture** telescopes on the market today. Unless specifically adapted for such purposes, Dobs cannot track objects across the sky or be used for astrophotography.

Equatorial (mount). A type of telescopic mount that, when the altitude is locked in place, will track objects across the sky, either manually or by motor drive. Astrophotography requires some kind of equatorial tracking system.

Eye relief. The distance your eye must be from the eyepiece to see the entire field of view. The greater an eyepiece's magnifying power, the smaller its viewing aperture will be – and the closer your eye must be for you to see the whole field of view. That's why people who wear glasses sometimes have trouble observing with their glasses on. The expensive exception is eyepieces such as Naglers and Pentaxes, which offer adjustable eye relief.

Field of view (fov). The portion of the sky seen through an eyepiece.

The greater an eyepiece's magnifying power, the smaller its field of view will be, and the less time it will take for an object to drift out of view.

To determine the size of the fov of a given eyepiece, select a star near the celestial equator – say, Altair, in Aquila the Eagle – and place it at the E edge of your fov. Then time how long in seconds it takes for the star to drift across the center of the field to the W edge. That time, divided by 4, gives the diameter of the field in arc-minutes.

60' (arc-minutes)=1^o; 30'=$1/2^o$; 15'=$1/4^o$, etc. If your fov is $1/2^o$ or 30', the **Moon** will fit nicely inside it. 720 Moons placed side-by-side would stretch all the way around the celestial sphere.

Finderscopes. Basically, a finderscope is a small telescope mounted on a larger 'scope as an aid to finding celestial objects. Most new telescopes come with a finderscope attached, the better ones on small- to medium-sized 'scopes offering 6x-8x magnification.

Fields of view are inverted by finderscopes, so if an object you're looking for lies west of a given star, you'll have to move the 'scope in the opposite direction.

Finderscopes normally require re-collimation prior to observing – and it should be done in the daytime, since alignment involves using distant terrestrial objects such as treetops, utility poles or the like.

First Light. When you purchase a new telescope, "first light" refers to the first object you observe in that telescope.

Focal ratio. The "f/number" of a telescope, referring to its speed. The smaller (i.e., the faster) the f/number, the lower the magnification, the wider the field and the brighter the image. "Fast" (f/4 to f/6) focal ratios are preferable for wide field and deep-sky observing and photography; "slower" (f/11 to f/15) ratios are better for lunar, planetary an double star observing and high magnification photography.

Focal length (f.l.). The distance (in millimeters) from the primary mirror or lens where the light is gathered to the point where the image is focused.

Focuser. A knob on the telescope that brings the image into focus. It works by moving the eyepiece in and out a slight amount.

Guide Star. Any star or stars used in finding other stars or objects in the night sky.

Laser Pointer. A hand-held device that projects a single laser beam – usually green – into the night sky as an aid in showing the location of a given star or object to other observers.

Limiting magnitude. The magnitude (brightness) of the faintest star you can see naked-eye.

Magnification. To determine the magnifying power of an eyepiece, divide the eyepiece's focal length into the focal length of the telescope you're using. (Both figures are expressed in millimeters, and eyepiece focal lengths are usually listed on the side of the eyepiece.)

For example, if you're using an 8-in. reflector with a focal length of 1200mm and your eyepiece is 10mm, the magnification for that eyepiece is 120x.

There are broad limits beyond which high magnifications tend to cause images to lose contrast with the sky around them, spreading and dimming the light that affords clear images at lower magnifications. Those limits are roughly 50x for a 2.5-in. 'scope, 100x for a 4.5-in. 'scope, 150x for a 6-in. or 8-in.'scope, 175x-200x for a 10-in. 'scope, 210x-240x for a 12-in. 'scope, and 245x-280x for a 14-in. 'scope. To get clear images beyond those broad limits, you need exceptionally good seeing conditions and a Pentax or Nagler eyepiece.

Magnitudes (of brightness). A number indicating the relative brightness of a star or other celestial object. The brighter the object, the higher its negative number or lower its positive number will be. For example, Sirius, at mag. -1.46, is brighter than Arcturus (mag. 0), which in turn is brighter than Pollux (mag. 1.1).

A difference of one full magnitude of brightness between two objects means that one is 2.5 times brighter than the other; a 2-mag. difference indicates that one is 6.25

times (i.e., 2.5 x 2.5) brighter than the other; and 3 mags. of difference = 15 times brighter (2.5 x 2.5 x 2.5), etc. The full Moon is mag. -12.6, and the Sun is -26.7.

With deep-sky objects, the stated magnitude refers to the brightness an object would have if all of its light were concentrated into an area the size of a single star. For example, the face-on galaxy M33 (the Pinwheel Galaxy) is listed as mag. 6, but due to its large size – about twice the size of the full Moon – it can be difficult to see under less than ideal conditions. Such faint objects with relatively high stated magnitudes are said to have *low surface brightness.*

The faintest stars that can be seen visually (as opposed to photographically) in amateur telescopes of any size range somewhere between mag. 19 and mag. 22 in brightness.

Optical Tube Assembly (OTA). The telescope body with the lenses and focuser (but not the mount, tripod, etc., upon which the telescope body rests).

Parfocal. Eyepieces in a series – say, Meade’s Series 4000 Super Plossls – should be parfocal – that is, when you switch eyepieces, the image remains in focus or nearly so. Otherwise, you’ll have to re-focus every time you change eyepieces.

Primary mirror. On a reflecting telescope, the large mirror at the base of the **OTA** that magnifies the light coming in through the other, open end. The larger the primary mirror is, the more light it receives. (In refractors, light is gathered through an *objective lens,* not a mirror.

Scanning. Locating celestial objects systematically by moving the eyepiece – usually, at low-power – up, down, back and forth through the target’s suspected location. Everyone develops his or her own scanning technique, and there is no one “right” way to do it, as long as you cover the entire area. (Best advice: *scan slowly.*)

Secondary mirror. On a reflecting telescope, the small, flat mirror at the open end of the tube that collects light reflected from the primary mirror and directs it toward the focuser and eyepiece.

Seeing. The relative stillness of the atmosphere through which light is passing. Poor seeing conditions negatively affect the resolving power of any telescope, limiting the amount of magnification that can be applied under those conditions.

Seeing is measured by using the **Antoniadi scale.**

Star-Hopping. Locating celestial objects by moving to them in a series of small steps, or “hops,” from known stars or other objects – say, by using portions of the 4^o **fov** of a **Telrad** to move ever closer to your target.

Telrad. A zero-magnification alternative to a finderscope. When mounted on the **OTA** and aligned properly, the Telrad uses three concentric red circles of ½ ^{o}, 2^o, and 4^o to point your telescope toward where you want to look for an object.

An upright variation of the Telrad (called a *Rigel Quikfinder)* is easier to see through but uses just two red circles of 1^o and 2^o.

An even simpler variation is the *red-dot finder*, that uses a single red dot to point you toward your target. Red-dot finderscopes have been used on BB guns for many years.

In buying any zero-magnification finder, be sure that the device includes a dimmer switch that reduces the brightness of the red circles or dot, or else you won't be able to see the stars around the point you're aiming at.

Like primary mirrors, Telrads and Rigel Quikfinders normally require re-collimation every time you observe, but the process is incredibly easy.

Transparency. The clarity of the sky, as evidenced by the brightest star that can be seen naked-eye. *Seasonal Star Charts* will help you here.

Any constellation or portion of the sky will do, but it's easiest with one that has a broad range of star brightnesses in a small area. I use Corona Borealis in the Summer, the Great Square of Pegasus in the Fall, Orion and his shield in the Winter, and the backward question mark that forms the head and face of Leo in the Spring.

Triangulation. Locating celestial objects by using two known stars or other objects to form a triangle with the suspected location of the target, and starting the scanning process at that point.