An Annotated Glossary of Amateur Astronomy Acronyms and Terms

This is not intended to be a comprehensive dictionary, but a selected list of the common acronyms and terms used by amateur observers; many of these terms prove difficult for beginning observers to track down.

Note: A word/acronym in **bold** within a description below, indicates that it is itself defined explicitly within this glossary.

AAVSO The American Association of Variable Star Observers. A clearing house for variable star observation data by amateur astronomers, that is used by professional astronomers in their research.

AFOV Apparent Field of View. The true Field of View (**FOV**) provided by a particular eyepiece depends on what optical system (scope) it's used on, so eyepiece manufacturers use the term "Apparent Field of View" to indicate the "wide-angleness" of the eyepiece design irrespective of the scope itself. Knowing the Apparent Field of View of an eyepiece together with the characteristics of your scope, you can compute the true Field of View of an eyepiece - the true FOV is the Apparent FOV divided by the magnification of the eyepiece, which depends on the focal length of your scope. (The magnification of an eyepiece is equal to the telescope focal length divided by the eyepiece focal length, being careful to keep both in the same units, typically in millimeters.)

Alt-Az Altitude-Azimuth mount. A telescope's **OTA** must be mounted with two perpendicular rotational axes so that you can aim it at various areas of the sky. An Alt-Az mount has one rotational axis (the azimuth axis) perpendicular to the ground and the other axis (the altitude axis) perpendicular to the first; this is the simplest and least expensive type of mount. However the Earth rotates around an axis that points to the celestial pole, which is only perpendicular to the ground if the scope is located at the Earth's north or south geographic poles (which is rarely the case <grin>). Thus Alt-Az mounts had in the past been unable to readily track stars as the Earth rotates, since both the altitude and azimuth axes need to be moved at different varying rates, so good scopes were always mounted on equatorial mounts. However, the advent of inexpensive computers changed this situation because they could perform the rectilinear-to-polar-coordinate conversion calculations in real time. So now, good amateur and virtually all modern professional telescopes use Alt-Az mounts. However, Alt-Az mounts are not suitable for long-exposure photography (see **Equatorial Mount**).

Aperture Fever The disease caught by amateur observers who look at a **DSO** through a scope much larger than their own, and immediately become unhappy with the heretofore acceptable view provided by their own scope. The only cure for aperture fever is a large injection of money for a new, larger scope, although it can be avoided by following amateur astronomer Steve Coe's advice, which is to never observe through a telescope larger than you can afford.

Apo An apochromatic refractor telescope. See **Refractors**.

Asterism A group of stars that has an interesting shape but is not a star cluster. I.e. the shape is an artifact of our viewpoint from Earth, rather than a true association of a group of stars in interstellar space.

AU Astronomical Unit: The mean distance between the Earth and the Sun - 149,597,870.691 kilometers. A useful unit of measure within planetary systems but not for interstellar distances (see **Light Year**).

Averted Vision A method to better observe faint objects in a telescope. The retina of your eye has two sets of light-sensitive cells, called rods and cones. The cones are used for normal (well-lit) vision, and the rods are far more light-sensitive (and motion-sensitive) and are used for night vision. (Although, rods do not detect color - only cones do. Note also that the rods are stimulated by secretion of a hormone - rhodopsin - and this takes a while to occur which is why night vision takes a while to establish.) The cones are concentrated at the center of your retina, and the rods are distributed outward of the center. This means that when you concentrate on the part of your vision that sees straight ahead you are concentrating on your cone cells, while your rod cells are providing your peripheral vision. In a normally lit situation the cone cells transmit so much information to your brain that you don't even notice the peripheral vision information your rod cells are transmitting, unless there is motion there.

Now, at night your cone cells can't see much while your rod cells are actually detecting a lot. You've probably never been asked to pay particular attention to your peripheral vision but at night that's where your vision is strongest. What this means is when you want to observe a faint deep-sky object through a telescope eyepiece you will see it best if you direct your eye towards the edge of the eyepiece but concentrate your mind on the center. This feels very unnatural or even unsatisfying and at first you will likely feel that you aren't seeing objects very well in the center of the eyepiece when you direct your eye toward the edge. But keep at it - with practice you will find that you can absorb the view in the center of the eyepiece while using this averted vision, and you will find that you can see dim objects much better this way.

B## A Bernard number. The Bernard numbers refer to the list of 349 dark nebulae published by astronomer Edward Emerson Barnard in 1927. (E.g. B86 is one of many dark nebulae in Sagittarius.) There are actually a lot more than 349 dark nebulae in our galaxy - for example, B.T. Lynds published a list of 1802 dark nebulae in 1962. But observing any but the most obvious dark nebulae requires very dark skies and larger apertures so the Bernard list is the one commonly pursued by amateur observers.

Bayer When Johann Bayer in 1603 published *Uranometria*, the first modern star atlas, he assigned Greek letters to the stars in each constellation, generally in order of decreasing magnitude (so the brightest star in the Centaur became Alpha Centauri, although curiously the brightest star in Capricorn became Delta Capricornus). Bayer's work was very significant because prior to that time there was no agreed-upon nomenclature for astronomers in different countries to refer to particular stars. However, Bayer's work was done six years before Galileo began using a telescope to observe the heavens, so the Bayer letters only refer to the brightest stars in each constellation. As fainter stars began to be observed, a more detailed nomenclature was needed. In the late 1600s John Flamsteed, Britain's first Royal Astronomer, assigned numbers to the stars in each constellation.

Centuries later, we still use Bayer's Greek letters for the brightest stars, and Flamsteed's numbers for the less-bright stars, in each constellation.

Binary Star A double star wherein the stars actually are orbiting each other. (As opposed to an "optical double" - see **Double Star**.)

C## A designation of a **DSO** in the Caldwell list. (See **Caldwell**.)

Caldwell A list of **DSO**s compiled in 1995 by the noted British amateur astronomy observer and author Sir Charles Moore at the request of *Sky & Telescope Magazine.* To avoid confusion with the Messier objects (which are referred to by M-numbers) he called this new list the Caldwell Catalog. Despite this lofty pedigree, the Caldwell object list is basically silly. It neglects many of the best non-Messier NGC objects and includes objects that would only be on a list of faint objects for owners of very large aperture scopes. Also, it claims to include important objects for southern-hemisphere observers (who are unfortunately neglected in most observing lists) but doesn't include most of the wonderful objects only visible from the southern hemisphere. Nevertheless, the Caldwell list has appeared in the databases of modern GoTo scopes, presumably because of *Sky & Telescope Magazine*'s otherwise well-deserved strong reputation.

Cassegrain A type of telescope design wherein the light is reflected from a parabolic primary mirror at the rear of the scope to another small hyperbolic mirror at the front, and this front mirror reflects the light back through a hole in the center of the primary so that the image is viewed at the rear of the scope. The hyperbolic secondary magnifies the image, which allows the scope to be physically much shorter than its true focal length and thereby makes the scope lighter than it would otherwise be. These combine to make transporting the scope easier and allow for a less massive (i.e. expensive) mount, including a fork mount (q.v.). A Cassegrain scope can also be, but is not necessarily a Catadioptric (**CAT**) scope. (See **SCT** and **Mak**.)

CAT A common term for a Catadioptric scope, which is a type of telescope design that uses both a mirror at the rear of the scope for primary light gathering, and a corrector lens at the front of the scope to improve or correct the optics of the system. A corrector lens can be added to a **Newtonian** design but Catadioptric scopes most commonly use a **Cassegrain** design. (See **SCT** and **Mak**.)

Clock Drive The motor that turns the polar axis in an **equatorially-mounted** scope, to counteract the Earth's rotation and thereby keep a celestial object within the field of view of the scope's eyepiece. Prior to the early 20th century, such a motor was literally a clockwork mechanism. Long after these were replaced with electric motors the term is still commonly used, because it is good to retain a certain amount of tradition <grin>.

Collimation The process of tweaking the orientation of the secondary mirror in a reflecting scope, to achieve maximum clarity in the optical image the scope delivers. The collimation process is feared by new scope owners, who then find that with a little practice it can be done quickly and well, manifesting in much improved views of the planets (collimation is less critical for **DSO**s).

CPM Common Proper Motion. The term is used to indicate that two or more objects are moving through space together, and are probably gravitationally bound although that fact has not been established. So for example a pair of stars can be a CPM pair; but if they had actually been observed to orbit each other they would be called a **binary star**.

Culmination Refers to that time during the year when a particular celestial object (or constellation) is highest in the sky and thus most favorably positioned for observation. For example the constellation Scorpius culminates on July 20.

Dec Declination. Think of declination as "celestial lattitude" - it is the angle between the celestial equator and a particular celestial object (measured in positive degrees for an object north of the celestial equator, and negative degrees for an object south of it). Together with **RA** (Right Ascension), the declination of an object determines its position in the celestial sphere and allows an astronomer to aim a telescope at it.

Dob A telescope with a **Newtonian** optical design, that uses a Dobsonian mount. Invented by John Dobson, the Dobsonian mount is a relatively inexpensive **Alt-Az** mount, which allows the primary investment in a telescope to be vested in its optics. Dobsonian mounts have their greatest value at the two ends of the spectrum of telescope mounts: they allow beginners to enter amateur astronomy with less of a financial investment, and also are the only affordable mount for amateur astronomers who want a scope with a very large aperture (say, 14" and larger). Being non-computerized Alt-Az mounts, Dobs do not track celestial objects and must be moved by hand to keep an object in the field of view of the eyepiece, which can be somewhat difficult with a big Dob and a high-power eyepiece especially if the scope is aimed at the zenith (tracking can be added to a Dob but this tends to get expensive). On the other hand the view of a **DSO** such as a nebula through a large Dob can be breathtaking, which can lead to the expensive amateur astronomer's disease called **aperture fever**.

Double Star A pair of stars that appear close together visually. This may be a true **binary star**, or just an "optical double" wherein the stars are actually very far apart but appear close together from our viewpoint on Earth.

DSO Deep Sky Object. Refers to celestial objects outside of our solar system, including star clusters, nebulae, and galaxies. As commonly used, the term DSO does not include stars or double stars even though many of these are a lot of fun to observe.

Dwarf A main-sequence (normal luminosity) star on the Hertzsprung-Russell diagram, as opposed to a giant star. In this terminology of star classifications, our sun is a yellow dwarf.

EP Acronym for Eyepiece, commonly used on Internet discussion groups.

Erfle An early 20th-century, 5-element eyepiece design that performs reasonably well at low-power focal lengths. Although **Pan**optics and **Naglers** are more highly regarded, an Erfle can provide a decent wide-field view at a much lower price.

Equatorial Mount

As noted in the **Alt-Az** description above, a telescope's **OTA** must be mounted with two perpendicular rotational axes so that you can aim it at various areas of the sky. Whereas an Alt-Az mount has one of these axes perpendicular to the ground, an equatorial mount has one of these axes parallel to the Earth's rotational axis and so this axis (called the polar axis) is tilted relative to the ground. (And this tilt angle is equal to the latitude of the observing site.) This is a bit more mechanically complicated but it allows the scope to be rotated opposite to the rotation of the Earth very easily. With a telescope this rotation is necessary in order to keep the celestial object being viewed, from drifting out of the view in the eyepiece - because a scope magnifies distance it also magnifies the apparent speed of rotation of our planet. Typically, equatorial mounts also have a **clock drive**, so that the observer need not rotate the polar axis manually.

Equatorial Wedge

Used to convert a **fork-mounted**, **Alt-Az** scope to an **equatorially-mounted** scope. An equatorial wedge consists of a plate that is fastened to the top of the scope's tripod or pier, and a second plate (which holds the scope) that can be tilted relative to the first, so that the scope's azimuth axis becomes a polar axis. Modern computerized Alt-Az scopes don't need an equatorial wedge for visual observing, but a wedge is necessary for long-exposure astro-photography because in the Alt-Az configuration the star field will rotate during the exposure. This rotation is not apparent to a visual observer because our human optical system doesn't store light, but the rotation does manifest as star streaks in a long-exposure photograph.

Fork Mount

A mount that holds a scope's **OTA** between two arms (like a tuning fork) that connect to a base. The OTA can rotate within the forks and the base also rotates; together these provide the two perpendicular axes of rotation needed to aim the scope at various areas of the sky. A fork mount is only practical for **Cassegrain** scopes, whose OTAs are short enough to swing through the base of the mount. They are easy to operate and do not suffer from some of the problems of a **GEM** but with a fork mount the OTA is permanently attached to the mount. This can be a problem for large OTAs (say, 14" or larger) because the combined weight of the OTA and the mount is heavier than one (average) person can lift onto a tripod or pier, so large fork-mounted scopes tend to be permanently mounted in an observatory.

FOV

Field of View. As normally used, this term refers to the true field of view shown by an eyepiece when used on a particular scope. But since this depends on the scope as well as the eyepiece, eyepiece manufacturers publish the **AFOV** of their eyepieces, so that a scope owner can compute the true field of view that eyepiece will provide when used on their particular scope.

GEM

German Equatorial Mount; named after its inventor, the German astronomer Joseph von Fraunhofer (early 17th century). A common type of **equatorial mount** for amateur scopes, the GEM has the scope's **OTA** offset on one side of the polar axis and a long shaft with a counterweight on the other side, to keep the scope balanced and thereby reduce strain and wear on the bearings and clock drive. A disadvantage to a GEM is that as the scope turns across the sky the counterweight can move down enough to strike the scope's tripod or pier, at which point the scope must be "flipped"; continuous tracking through large angles across the zenith can't be done. Also, a GEM is somewhat more time-consuming to set up. However, a major advantage to a GEM over a **fork mount** for a large OTA, is that the OTA and the components of a GEM can be carried separately. This is the only way that one person alone can set up a very large and heavy GoTo scope.

GPS Global Positioning System. A series of satellites orbited by the U.S. military, that broadcast signals which allow a receiver to accurately determine its position on the Earth's surface. Celestron, and then Meade, added a GPS receiver to its GoTo scopes to simplify the process of aligning the scope with the celestial coordinate system after the scope's computer is booted up.

GRS The Great Red Spot. One of the more obvious and interesting features to observe on the planet Jupiter.

HC Hand Controller. A common abbreviation for the hand-held unit that controls the operation of a GoTo scope.

HST The Hubble Space Telescope.

IAU International Astronomical Union. It is an organization whose members comprise leading astronomy researchers, and whose mission is to be the international body that officially recognizes and records astronomical data including the names of celestial objects. So if, for example, you discover a new asteroid and decide to give it a name, it is the IAU that must recognize that name. (And they will actually do so, provided your name meets certain parameters, including the requirement that it actually is an asteroid not previously discovered <grin>.)

IC Index Catalog. After publishing the **NGC** in 1888, in 1895 astronomer J. L. E. Dreyer subsequently published a follow-on Index Catalog of even more **DSO**s, followed by a second Index Catalog in 1908; taken together these are commonly referred to as the IC catalog. These DSOs were, like the NGC objects, originally discovered visually (rather than on photographic plates taken with very large professional telescopes) and so you have a good chance of seeing them with an amateur scope. But, they were discovered with newer, larger professional scopes than were the NGC objects, so they are generally fainter than the NGC objects and tend to be more difficult to observe in amateur scopes.

ISS The International Space Station.

JMI Jim's Mobile, Inc. A common acronym for the company that makes a variety of widely-used accessories for telescopes, particularly electric motor-driven focusers that are useful for astrophotography.

Kellner A 3-element eyepiece design that can perform reasonably well at low-power (wide-view) focal lengths. Although this is a very old eyepiece design it is often sold at reasonable prices, under the “modernized” name Super Modified Achromat (SMA).

Light Year The distance light travels in one year, moving at 300,000 km/sec (186,400 miles/sec). This distance is 9.26×10^{12} km or 5.88×10^{12} miles. A long distance, but even the very closest star is about 4 ly away; most are orders of magnitude farther - the universe is a very, very big place. So a light year is a useful measurement of interstellar or intergalactic distances. One way to help your brain understand these distances is to imagine at what time in the past the light from a star left that star to arrive at Earth: the light from a star only 100 ly away (which is relatively close) left that star at the beginning of the 20th century, before automobiles were commonly produced. (See **Quasar**.)

LPR Light Pollution Reduction filter. A broadband filter intended to mitigate the effect of common light pollution sources such as street lights. The jury is out as to whether an LPR filter is effective. (See **Nebula Filter**.)

Lucida The brightest star in a cluster.

Luminosity Intrinsic light output (brightness) of a star. A star's luminosity is completely unrelated to its apparent brightness as seen from Earth (i.e. its apparent **magnitude**). A star may have an enormous intrinsic luminosity but may appear dim because it is very far away. For example, Rho Cassiopeiae has a visual magnitude of 4.5, but assuming that its known distance (as calculated by astronomers) is accurate it actually has a luminosity of 500,000 times that of the Sun. Luminosity is typically quoted as a multiple of the Sun's light output in amateur astronomy literature, or by professional astronomers as Absolute Magnitude, which is the brightness the star would have if it were 10 **parsecs** (32.6 ly) from Earth.

M## A designation of a **DSO** in a catalog originated by Charles Messier in 1781. For example, M31 is the Andromeda Galaxy. (See **Messier**.)

Magnitude (Apparent) The term magnitude is usually used to mean Apparent Magnitude, which is the apparent brightness of a star as viewed from Earth. Because stellar distances cover an enormous range, a star's magnitude is typically completely unrelated to the star's true luminosity. I.e. the brightness you see can be from a relatively dim star close to us, or a very luminous star very far away.

Mak A Maksutov-Cassegrain scope. This optical design, invented by Dmitri Maksutov in 1941, is similar to an **SCT**. The major difference is that the correcting lens has a meniscus shape whose rear surface is ground to the hyperbolic curvature required for a **Cassegrain** design, so the secondary reflector mirror is simply an aluminized reflective spot on the rear of the corrector lens. The advantage of this design is that this secondary mirrored spot is smaller than the equivalent size of the secondary mirror in an SCT so this smaller obstruction impedes contrast less, an advantage for planetary observing. Also, provided that the optical system is manufactured properly, the secondary mirror in a Mak does not require collimation (and indeed, adjusting the collimation isn't really practical in this design). So it would appear that Maks would be more popular than SCTs. However Maks have a significant disadvantage in that the corrector lens is difficult to manufacture, so a larger-aperture Mak becomes very, very expensive. To mitigate this problem, manufacturers tend to make them with larger focal ratios than equivalent SCTs, which allows them to grind the corrector with spherical surfaces which are much easier to configure. So Maks tend to be optically slower which is a disadvantage especially for photographing DSOs. Nervertheless, Maks are popular with amateur astronomers who favor planetary observing since they are less expensive than equivalent-aperture refracting scopes while still providing high contrast.

MAPUG The Meade Advanced Products Users Group. An Internet discussion group among owners of the Meade "LX" line of scopes. Much of the MAPUG discussions (www.mapug.com) contain information specific to those Meade telescopes, but much of the information (such as discussions about accessories) is relevant to **SCT**s regardless of the manufacturer.

Masayuma A 5-element eyepiece design that provides a wider **FOV** than **ortho**scopic eyepieces, without sacrificing very much contrast. The highly regarded Takahashi and Celestron Ultima eyepieces use this design.

Messier Charles Messier (1730 - 1817) was a comet-hunter in Paris in the late 1700's (and thus in the relatively early years of telescope technology). He was a comet-hunter because comets had deep astrological and social significance at that time (astrology and astronomy were not segregated as separate endeavors until the late 1800's - astronomers prior to that time were also astrologers). Messier kept finding fuzzy objects with his telescope that looked like they might have been comets, but when he tracked them he found they didn't move in the sky so they couldn't be comets. He compiled a list of them in 1781 to help other comet-hunters; only later when telescopes became more powerful did astronomers realize that his "objects to avoid" list was actually a compilation of wonderful star clusters, nebulae, and galaxies. They represent a collection of objects that is a favorite of amateur astronomers because they tend to be the brightest deep-sky objects in the sky (due to the optical limitations of scopes like the ones Messier used in the late 1700s).

Metal The term "metal" is used by professional astronomers to refer to elements other than hydrogen or helium, that may be present in stellar compositions (I'm not making this up). Thus, a "metal-rich" star might show substantial carbon or oxygen in its spectrum. If you have a background in the sciences, you are allowed to be astonished by this vernacular.

Nagler A premium eyepiece invented by Al Nagler (an extremely well-regarded optical designer formerly with NASA) and sold by his company TeleVue. Nagler eyepieces deliver the widest **FOV** of any eyepiece sold, and provide a wonderful field of view of **DSO**s (at a high price). However, at high-power focal lengths the 6 lens elements of this eyepiece design will tend to reduce contrast, so other designs with fewer lens elements tend to be preferred by planetary observers.

Navi The name jokingly given to the star Gamma Cassiopeiae by U.S. astronaut Gus Grissom; it is his middle name - Ivan - spelled backwards. The staid and very conservative IAU would disband itself before it would recognize a star name with such an origin. Nevertheless the name has come into common use, at least among U.S. amateur observers.

Nebula Filter

Nebula filters are formulated to enhance the contrast of many nebulae and can enable you to see nebulae that are otherwise not very visible in light-polluted locations (and in fact they can enhance the visibility of some nebulae even at very dark observing sites). They are manufactured with vacuum-deposition technology to create coatings that transmit very specific wavelength regions and block the rest of the visible spectrum to increase contrast for certain nebulae. Narrowband nebula filters, commonly called Ultra High Contrast (UHC) filters, pass the Hydrogen-alpha, Hydrogen-beta, and Oxygen-3 spectral wavelengths (although note that the Orion UHC filters do not include the H-alpha bandpass) and block the rest of the visible spectrum; O-III filters pass only the Oxygen-3 spectral wavelength. Since stars are broadband emitters these filters will not help you view stars, star clusters, or galaxies - they will in fact just make those objects more dim (a common misunderstanding). Reflection nebulae are merely reflecting starlight so they are not helped by UHC filters either. But the atoms in emission nebulae and many planetary nebulae have excitation characteristics that cause them to emit light strongly in the H-alpha, H-beta, and/or O-III wavelengths so a UHC or OIII filter can increase the contrast of these objects; they won't get brighter - only a larger-aperture scope will do that - but they become easier to detect. A UHC filter boosts contrast for more of the nebulae out there than does an O-III filter, but for those nebulae whose emission is concentrated in the O-III wavelength an O-III filter works better than a UHC. So most experienced observers recommend that you get both a UHC and an O-III filter but get the UHC filter first.

A third type of filter called an H-Beta blocks all light but the Hydrogen-beta wavelength and is only useful for a few very specific nebulae that strongly emit in the the H-beta wavelength. The Horsehead nebula is one of these few; since the Horsehead nebula (**B**33) is both a very desirable object to see and one notoriously difficult to see without an H-beta filter, many observers do purchase an H-beta filter to see the Horsehead. (It is also helpful for the California Nebula, the Cocoon Nebula, and a few others.)

Finally, there is a type of filter called an LPR (light pollution reduction) filter, which is a broadband filter intended to mitigate the effect of common light pollution sources such as street lights. Amateur observers typically have not found these filters to be beneficial although in fairness, most of us do not observe in severely light-polluted urban environments and it is possible that they may be helpful there.

Newtonian

A type of telescope design wherein the light is reflected from a parabolic primary mirror at the rear of the scope to a small flat secondary mirror at the front, and this front mirror is set at a 45° angle to reflect the light out through a hole in the side of the front of the scope. Invented by Sir Isaac Newton in 1668 and perhaps the most common type of amateur telescope until the late 20th century, this design is the easiest for an amateur telescope maker to create, and the secondary mirror is smaller and thus causes less of an obstruction than for a **CAT**. This design's disadvantage is that in larger primary mirror sizes, the **OTA** is large and heavy so mounting it **equatorially** (so that it can be driven with a clock drive) requires a more robust (i.e. more expensive) mount than would be necessary if the scope were a CAT. Also, because the OTA is physically much longer than an equivalent CAT, as you move the scope from one object to other nearby objects in the sky the eyepiece moves to a much more displaced location - which requires you to move and re-adjust your observing chair a lot more - than would be necessary with an equivalent CAT.

NGC The *New General Catalog of Nebulae and Clusters of Stars*, originally published by astronomer J. L. E. Dreyer in 1888. The NGC objects were originally discovered visually (rather than photographically) so you have a good chance of seeing them with an amateur scope. Therefore amateur astronomers observing **DSO**s, tend to pursue NGC objects as the next step after they have observed the **Messier** objects.

OIII An Oxygen-3 nebula filter. See **Nebula Filter**.

Ocular A fancy term for an eyepiece; its usage is declining.

Opposition One of the more confusing terms used in astronomy. Formally speaking, opposition of an outer planet is defined to mean that the planet is "opposite to the Sun". This actually means that the outer planet is at the same side of the Sun as is the Earth. The important thing to remember here is that when a planet is in opposition, it is actually as close to the Earth as it can be (yes, trying to understand this can make your brain explode). So when the date of a planet's opposition is published for a given year, that is the best time to observe the planet. (This makes more sense when you look at drawings of planetary motion.)

Optical Double See Double Stars.

Ortho Orthoscopic. A 4-element eyepiece design, sometimes referred to as an Abbe design after its inventor, the great German optical designer Ernst Abbe who created the design in 1880 (and subsequently became a partner in the Carl Zeiss Optical Works). In high-power focal lengths an ortho provides an excellent view for planetary observing, at a reasonable price.

OTA Optical Tube Assembly. The telescope tube that contains its primary optics (whether a lens system, mirror, or both) along with a rear cell that allows adding an eyepiece and other accessories. The OTA is fastened to one of various types of mount to create an operable telescope.

Pan Panoptic. An eyepiece design invented by the extremely well-regarded optical designer Al Nagler and sold by his company TeleVue. Panoptics have a somewhat lesser **FOV** than do **Nagler** eyepieces, but still provide a very wide FOV. They provide a terrific view of **DSO**s, at a lower price than comparable Naglers and are regarded as eyepieces that have a very high value to price ratio for wide-field observing. But they still are expensive eyepieces – fortunately you don't need very many of them to enjoy observing DSOs.

Parsec A useful measure of distance to nearby stars, equal to 3.26 light years. Formally, it is the distance at which an object would exhibit a parallax of one arc-second.

Pentax A manufacturer of very high quality (and expensive) eyepieces whose design works particularly well for medium-power to medium-high-power views. In that range, personally I absolutely love these eyepieces, but note that eyepiece preference is a personal thing that varies depending on the idiosyncrasies of any particular person's eyesight.

Plössl A 4-element eyepiece design invented by the Austrian optician Simon Plössl in the 19th century, that provides a somewhat wider **FOV** than does an **ortho**. Unlike orthos, the design of Plössls has been modified and improved by manufacturers to the point that it now provides excellent views at both long and short focal lengths. The design provides good value for its price and has thus become the most popular general-eyepiece design among folks new to observing, or observers on a more limited budget. Nevertheless at any specific short, medium, or long focal length there are better specific eyepiece designs available (albeit at generally higher prices) so in the long run experienced observers usually end up not using many Plössls (in much the same way that experienced mechanics have acquired specific wrenches for specific purposes and end up tending not to use adjustable wrenches very often.

Precession The Earth's rotational axis itself rotates (like the wobble of a spinning top as it slows down). This precession of the Earth's axis takes about 26,000 years to complete a circle, and during that time the Pole stars continually change. Currently Polaris is close to the north celestial pole, but Thuban (Alpha Draconis) was the pole star during the late part of the ancient Egyptian civilization (2800 BC). Around 130 BC, the great Greek astronomer Hipparchus detected the precession of the Earth's rotational axis by comparing the then-current position of Regulus to its position as recorded on Babylonian clay tablets 2000 years earlier.

Pulsar Believed to be a neutron star transmitting a regular, pulsed radio signal. After a very massive star has used up most of its fuel it may erupt in a supernova. The collapsed core becomes dense enough that the protons and electrons fuse to become neutrons, resulting in an incredibly dense neutron star (on Earth, a cubic inch of a neutron star would weigh a million tons). This neutron star rotates rapidly and sends a rotating beam of radio waves sweeping across the universe. Depending upon the neutron star's orientation relative to the Earth, we can receive this beam as a regularly pulsating radio signal, with a period ranging from a few milliseconds to about 5 seconds depending on the pulsar. The neutron star at the center of the Crab Nebula (**M**1) is one of the most famous pulsars.

Quasar Quasi-Stellar object (QSO). An incredibly bright light source (quasars are the most luminous objects in the universe), believed to be caused by a super-massive black hole at the center of a galaxy, that is accreting (absorbing) stars into itself at a rate of perhaps one star per year. The brightest Quasar visible from Earth is Quasar 3C 273 (object #273 in the 3rd Cambridge catalog of radio sources, 1962), which at magnitude 13 is one of the few that are visible in amateur telescopes. It has a spectral red shift that indicates it is 2 billion light years away, which would mean that it has a luminosity 100 times greater than the entire Milky Way galaxy. Although it looks like a faint blue star in an amateur scope, observing it becomes more interesting if you consider that at 2 billion light years away (about the most distant object you can see in an amateur scope), when the light from Quasar 3C273 left it on its journey here, the first abundant fossils of living organisms, mostly bacteria, had just appeared on Earth.

RA or R.A. Right Ascension. Roughly speaking (and with apologies to professional astronomers), it is the "celestial longitude" of a celestial object. Because the Earth turns 360° in one day, right ascension is most conveniently used, and is commonly given, in hours/minutes/seconds eastward from the vernal equinox. If you know the **declination** ("celestial latitude") and right ascension ("celestial longitude") of a celestial object you can aim a telescope at it, just as you can locate a position on the Earth's surface by knowing its terrestrial latitude and longitude.

R/C Reducer/Corrector. An accessory lens system designed to be attached to the rear cell of a scope, to increase its field of view. For example, an f/10 scope (especially one with a large aperture), will have a fairly narrow field of view. An f/6.3 Reducer-Corrector (the most common R/C sold) converts an f/10 scope to an f/6.3 instrument which provides a wider field of view, useful for viewing larger **DSO**s. With **Cassegrain** scopes, reducing the focal ratio tends to increase a type of optical aberration called coma. So the R/C lens system is designed to correct coma (reducing coma is also called "field-flattening") along with reducing the scope's focal ratio, which is why the term "corrector" is included in the name of this accessory.

Reflector A telescope whose primary light-gathering component is a mirror rather than a lens. A mirror has the advantage that it reflects all visible frequencies of light at the same angle, so it does not inherently introduce chromatic aberration (which manifests in severe cases as an inability to achieve a good focus, and in mild cases as color fringes around objects). A mirror also has the advantage that even when it is very large it can be mechanically supported across its rear surface, so it can be prevented from sagging under its own weight. At the extremely short wavelengths of visible light, even a miniscule sagging (bending) of the mirror introduces optical aberrations that destroy the quality of the image produced by the scope.

The disadvantage of a reflecting scope is that it requires a secondary mirror to reflect the image out of the scope’s light path so that humans or instruments can see it, and this secondary mirror obstruction causes a reduction in the contrast of the image. Nevertheless, all larger scopes are reflectors because **refractors** are much more expensive to produce and in any event they cannot overcome the problem of sagging caused by gravity when they reach larger diameters. (Several very large refractor lenses were created in years past, that could not be made to support themselves well enough to provide good images; the largest useable refractor ever made is the 40” Alvan Clarke refractor, built in 1897 and still operational at the Yerkes Observatory in Williams Bay, Wisconsin.)

Refractor A telescope whose primary light-gathering component is a lens rather than a mirror. This was the first type of telescope, when Galileo turned a refractor to the heavens in 1609. Lenses refract (bend) light at different angles depending upon the wavelength of the light, so a single-lens refractor introduces so much chromatic aberration that a celestial object cannot be focused well enough to see very clearly. Opticians discovered that a second, convex lens cemented to the concave primary lens can offset much of this chromatic aberration and this type of doublet primary lens could yield a useable telescope; a scope with a doublet primary lens assembly is called an achromatic refractor. However, a doublet lens system still cannot bring the wavelengths of light at the far ends of the visible spectrum to a common focus - to accomplish this a third lens element is required. Triplet lens systems can eliminate chromatic aberration especially if the lens elements are manufactured from specialized glass compounds; scopes with triplet lens systems are called apochromatic refractors.

Apochromatic refractor scopes, lacking any secondary obstruction in the light path, provide the theoretically highest contrast. They are especially favored by planetary observers particularly since those planets that have details (e.g. Jupiter and Saturn) tend to be bright enough that very large apertures are not required to see those details. This is fortunate because producing a high-quality triplet lens system in a large diameter is extraordinarily expensive, and solidly mounting the resulting very long **OTA** up high enough for comfortable viewing is also challenging. So amateur astronomers who favor observing **DSO**s, for which light-gathering ability is of paramount importance, find that **reflector** telescope designs, in the larger diameters than are affordable in refractor designs, are preferable for DSO observing.

SCT — A Schmidt-Cassegrain Telescope. This optical design was invented by Bernard Schmidt in 1930, when he determined that the primary mirror of a **Cassegrain** scope could be made with a spherical shape (which unlike the more difficult to grind parabolic primary mirror, introduces optical aberrations), if those aberrations were corrected with a specially-designed corrector lens at the front of the scope. A spherical primary is much easier (and thus less expensive) to grind, but the special corrector lens has a complex shape that would be difficult to create without the invention of particular manufacturing techniques. In the mid 20th century a mass-production manufacturing technique for the corrector lens was invented by Tim Johnson (who ultimately founded the Celestron company), allowing creation of a scope that, being both a **Cassegrain** and a **Catadioptric** design, has the advantages of both.

An SCT's front corrector lens has a flat rear surface and a complex front surface, although the front appears to the naked eye to be flat. The SCT's hyperbolic Cassegrain secondary mirror is mounted in a mechanical assembly within a hole in the center of the corrector lens. This leads to the minor disadvantage of the SCT design, in that its optical performance is sensitive to the alignment of this secondary mirror (see **Collimation**). The SCT's other disadvantage is that the secondary mirror is larger than in other **reflector** designs, and the size of this secondary obstruction is regarded to reduce contrast by observers who concentrate on planetary observing. Nevertheless, the SCT can be manufactured with large apertures at affordable prices, and this larger light-gathering ability tends to overwhelm the problem of reduced contrast and provides an affordable scope that can make very faint **DSO**s visible. Thus the SCT has become the most popular larger-aperture amateur telescope.

SMA — Super Modified Achromat - a fancy term for an eyepiece using the **Kellner** optical design.

Spectroscopic Binary — A **binary star** whose components cannot be resolved with telescopes, but whose spectrum reveals a pair of stars orbiting each other.

ST-80 — A short-tube (wide-field) achromatic **refractor** with an 80mm primary objective. These are often mounted atop a large scope because larger scopes typically are not designed to be able to provide a wide field of view regardless of the eyepiece used. Many beautiful celestial objects are too large to fit in the field of view of a large scope but are too small to be appreciated with the naked eye, so amateur astronomers find that a rich-field scope like an ST-80 is a useful accessory for a larger scope.

S### — An earlier notation for a Struve double star (See **STF###**) Because the Greek S is not part of the lower ASCII character set for computer keyboards, this notation was gradually replaced by the "STF" notation as computers became widely used.

Star Party An opportunity to meet famous actors. Just kidding - a star party is a meeting of amateur astronomers who bring their scopes to an open field with dark skies, camp out for a weekend and share views through their scopes and their knowledge about observing, telescope operation and accessories. It can be an ideal opportunity, for example, to borrow and try an expensive eyepiece or filter on your own scope before you make the decision to purchase it. But you need to be careful at star parties because it is a common occasion to catch the disease **aperture fever**.

STF### Struve The Father. A star with the catalog designation STF### is a double star, with the number relating to a set of lists of double stars published by F. G. Wilhelm Struve in the early 1800s. Because these were discovered visually with the less optically-sophisticated scopes of that time, the angular separations of these doubles are large enough to be readily resolved in amateur scopes. Thus, F. G. W. Struve's double stars are among the first double stars pursued by amateur observers interested in double stars. (See also **S###**.)

Telrad TELescope Reticle Aiming Device. A "zero-power" finder that serves to help aim a telescope. Because it does not magnify the image, many scope users find it much more convenient to use than the finder scopes commonly provided with telescopes by their manufacturers. A similar device is the QuikFinder produced by Rigel Systems; neither of these are very attractive physically but the convenience they provide, makes them very popular.

Terminator A series of science-fiction movies in which…ooops, just kidding again. The boundary between the illuminated and dark hemispheres of a planet. This term is most commonly used for lunar observing, because it is along the terminator that the Moon's mountains and craters create the most striking shadows and thus have their most three-dimensional appearance in an eyepiece.

UHC An Ultra High Contrast nebula filter, also called a narrowband filter. (See **Nebula Filter**).

UO University Optics. A vendor of telescope accessories, particularly a line of relatively inexpensive but very good **ortho**scopic eyepieces useful for planetary observing.

Urano A prefix meaning "the heavens" (not the planet Uranus). Thus the term uranometry means star charts (or atlases), and one of the first star charts was *Uranometria*, published by Johann Bayer in 1603. (See **Bayer**.)

Created by Ted Kurkowski
An SCT Site for Beginners
http://SctScopes.net/index.html