A Brief Column for the Beginning Stargazer Introducing a New Astronomical Term Each Month

Astronomy is rich with terminology. This column will help beginning stargazers ease into the world of astronomy by *briefly introducing* a new but *basic astronomical term* (word, acronym or abbreviation) each month. This list, which began January 1999 with the letter ***a***, is alphabetical but uses successive letters for each month's entry. (We will return to the letter ***a*** after twenty-six months.)

(The February 2001 column ends with z so this completes one cycle of twenty-six terms. An index of all entries covered in the last twenty-six columns appears at the end of this month's column.)

Word of the Month for February 2001

zenith (or **zenith point**) The overhead point of the sky. Hence, the point on the *celestial sphere* that is directly above the observer. A line from the observer to the zenith is at right angles to the plane of the *horizon*. (The point opposite the zenith is the *nadir*.) If used without qualification, zenith refers to the *astronomical zenith*. See Figure 1.

Other forms of zenith include the *geocentric zenith*, the direction indicated by a line from the center of the Earth through the observer. Another is the *geodetic zenith*, the direction indicated by a line at right angles to the Earth's *geoid* (or *geodetic ellipsoid*) at the observer's location.

All three forms of zenith result from the nonspherical shape of the Earth.

Note: The Earth's *geoid* is the hypothetical surface of the Earth that coincides everywhere with mean sea level. Thus, it represents the figure of the Earth if it were entirely covered by water at mean sea level.

zenith distance or **colatitude** (symbol *z* or **ZD**) The angular distance (usually in degrees) measured along a *vertical circle* (a *great circle*) from the zenith down toward to the object. See Figure 1.

Note: Besides denoting *zenith distance*, the symbol ***z*** is also used to indicate the *red shift* of an object, an increase in the measured wavelength of electromagnetic radiation (due to such effects as the *Doppler effect* or by the presence of a gravitational field).

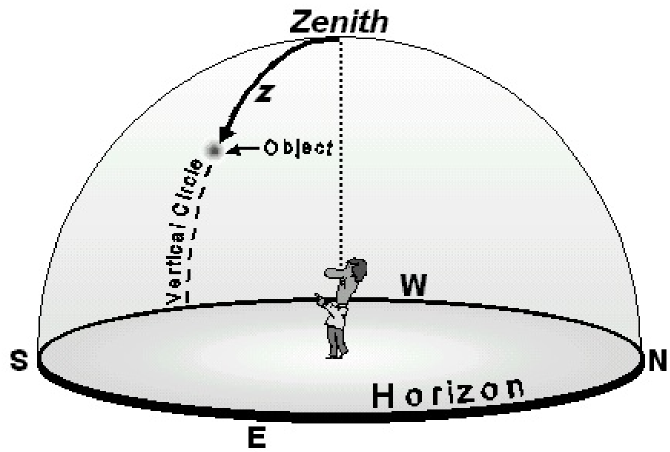

Figure 1. Zenith distance (*z*) is measured down from the *zenith* (overhead point) along a *vertical circle* to the object.

The zenith distance of an object is 90° minus the object's *altitude* above the horizon. (Altitude is the angular elevation of an object above the horizon.) Thus, the zenith distance is the *complement* of altitude so zenith distance is also called *colatitude*.

Zenith distance (or altitude) is one of the two celestial coordinates in the *horizon system*, one of several systems of astronomical coordinates. (The other coordinate of the horizon system is *azimuth*, measured along the horizon, usually from north toward east.)

Although altitude is usually used rather than zenith distance in the horizon system of coordiantes, some phenomena are more directly or simply expressed using zenith distance. For example, the apparent dimming of celestial objects as diurnal motion carries them toward the horizon depends on the zenith distance. This *extinction*, which increases with increasing zenith distance, is due to the loss of light as it passes through the Earth's atmosphere.

For bodies with small or moderate zenith distances, extinction (in magnitudes) is roughly proportional to the *secant* of the zenith distance. (The secant is a trigonometric function equal to the reciprocal of the *cosine function*, where, in a right triangle the cosine of an acute angle is the *ratio* of the *side adjacent* to the acute angle to the length of the *hypotenuse*).

For the Technically Minded If Δm is extinction (in magnitudes), then $\Delta m = k \sec z$ (approximately) where k is the *extinction coefficient* (extinction at the zenith, i.e., at z = 0°). More accurate expressions exist, especially for large values of z. The value of k depends on the wavelength of the radiation and atmospheric conditions. (The extinction coefficient increases with decreasing wavelength.) For yellow light, it may typically have a value of a few tenths of a magnitude.

For example, the following table shows roughly how much the eye would see a star dimmed for several zenith distances under clear skies. (A value of $k = 0.25$ magnitudes was used.)

z	0°	15°	30°	45°	60°	75°	80°
Δm	0.25	0.26	0.29	0.35	0.50	0.95	1.40

So, on a night where a star at $z = 0°$ is dimmed 0.25 magnitudes, the star will be dimmed by nearly one magnitude at $z = 75°$ (when it is 15° above the horizon). ☼

References. J. Mitton 1991, *Concise Dictionary of Astronomy* (Oxford Univ. Press); I. Ridpath 1997, *A Dictionary of Astronomy* (Oxford Univ. Press); *Astronomical Techniques*, 1962, ed. W.A. Hiltner.

Astronomy From Å to ZZ— Index (1999 January through 2001 February)

This Index Covers "One Cycle" of Twenty-Six Terms