Astronomy From Å to ZZ — Howard L. Cohen

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 ended with z so we are now in the second cycle of twenty-six terms. See the February 2001 issue for a cumulative index.)

Note: This is my thirty-seventh and last regular "Å to ZZ" column. Other duties now need my attention so this column will appear only occasionally.

Word of the Month for January 2002

Keplerian Telescope A basic *refracting* (lens) telescope employing a simple convex lens for both its front, light collecting objective and its rear eyepiece. This design gives a larger field of view with higher magnification and better eye relief than the *Galilean telescope* but produces an inverted view. (The Galilean telescope, used by Galileo, uses a single, concave lens for the eyepiece but produces an erect image.)

Devised by the German astronomer, Johannes Kepler (1571–1630) in 1615, it suffers severely from both *chromatic*[1] and *spherical aberration*.[2] Long focal ratios[3] help reduce these optical defects so early refracting telescopes were often made with very long focal ratios, sometimes exceeding 100:1. Thus, telescope tubes were often more than one hundred times longer than their diameters! In fact, many of these telescopes could not employ a tube so the objective lens was "hung" from a pole or tower with ropes running from the objective to the eyepiece of these "aerial" telescopes. Poor quality images and fields of view often only a few *arc minutes*[4] across made these early refractors extraordinarily difficult to use.

Consequently, most "practical" telescopes of the 17th and 18th centuries did not use lenses but employed (metal) mirrors for their objectives since mirrors do not suffer from chromatic aberration. These early "reflector" telescopes took on various forms including the *Newtonian* (well known to amateur astronomers), the *Cassegrain* (common today in many large observatory instruments), and the *Gregorian* (a once popular terrestrial design since it produces an erect image).

In 1729 Chester M. Hall invented the *achromat*, a lens consisting of two different glass elements (usually of crown and flint). This allowed light of two different wavelengths to focus at the same point. These *achromatic refractors* produced acceptable images with focal ratios of about 15:1 and made this telescope popular from the late 18th through the 19th centuries. (The largest operating refractor, the Yerkes 40-inch, opened in 1897, has a focal ratio of 19:1.)

However, residual chromatic aberration remains in achromatic lenses. Today, more complex optical systems, sometimes using special types of glass, have virtually eliminated chromatic aberration in small, high-end refractors. Such telescopes often have focal ratios of only 8:1 or smaller. ☼

Note: The author will show a *Keplerian telescope* at the 2002 January 8 meeting of the AAC.

References. J. Mitton 1991, *Concise Dictionary of Astronomy* (Oxford Univ. Press); I. Ridpath 1997, *A Dictionary of Astronomy* (Oxford Univ. Press).

[1] *Chromatic aberration* produces "false colors" from the failure to focus light of different wavelengths (colors) to the same point. Colored fringes appear around images. It occurs in lens but not mirror optical systems.

[2] *Spherical aberration* produces images that cannot be sharply focused because light far and near to the optical axis cannot both be focused to the same point. Thus, images appear blurred. It occurs in both lens and mirror optics.

[3] The focal ratio (f-ratio or f-stop) is the ratio of focal length to diameter. Example: A 60 mm diameter objective with a 900-mm focal length has a focal ratio of 15:1 (written f/15).

[4] An arc minute is 1/60 of a degree or about 1/30 of the Moon's apparent diameter.