ASTRONOMICAL LEAGUE

A FEDERATION OF ASTRONOMICAL SOCIETIES
A NON-PROFIT ORGANIZATION

- ★ *To promote the science of astronomy:*
- ★ *By fostering astronomical education;*
- ★ *By providing incentives for astronomical observation and research;*
- ★ *By assisting communication among amateur astronomical societies.*

ASTRO NOTES

Produced by the Astronomical League

Note 13: Using Setting Circles

This note presupposes an equatorial mounting, properly aligned with the Earth's axis of rotation. If you are using a portable mounting, the accuracy with which your setting circles can point your telescope is directly proportional to the accuracy with which you have aligned your mounting to the pole. A few extra minutes spent achieving proper alignment can pay big dividends if you plan to use setting circles.

Alt-azimuth mountings, such as a Dobsonian mount, can use altitude and azimuth circles, but a calculation must be done to convert the target's celestial, equatorial coordinates (as tabulated) into topocentric, alt-azimuth coordinates. Consult a reference such as the League's ***Math for Amateur Astronomers*** or one of the many available computer programs to accomplish the coordinate transformation.

Computerized, digital setting circles are now available on many commercial telescopes. Their use may differ from that described here for analog or dial-type setting circles. In that case, follow the directions that come with the computerized mountings.

Declination Circle Only

Many observers find it convenient to use only the declination circle and to "sweep" in right ascension to find an object once its declination has been set. First, point your telescope at a bright star of known coordinates. Then adjust your declination circle or declination pointer (depending on your particular telescope design) to the star's declination. Your declination circle is now "calibrated" until you move your mounting.

To find another object, turn your telescope until the target's declination reads on the declination circle. Lock the declination axis. Point your telescope in the general direction of the target and move the telescope back and forth about the polar axis until the target comes into the field of view. This back and forth movement about an axis is called *sweeping*. Use caution with this method while trying to find an object in the daytime sky. Do not sweep near the Sun or its image could enter the field of view and cause permanent eye damage.

You might be tempted to simply point your telescope at Polaris and set its declination of 89.1^{o} for your declination calibration. While this would work in theory, errors in polar alignment decrease your pointing accuracy as you move farther away from your calibration star. It is much better to calibrate your circle with a star near the zenith or at least near the declination of your zenith. That way you will never be more than 90^{o} away from your calibrated declination.

Guide Star Method

This method extends the "declination only" technique to include the right ascension or hour circle. In this case, you point your telescope at a guide star whose coordinates are known and then rotate your scope to read the target coordinates. However, this must be done with certain considerations.

After the guide star is centered in the field, set the declination circle to read the guide's declination. If the scope is not clock driven, re-center the object and set the hour circle to read the right ascension of the guide. If the scope is clock driven, check to be sure you did not de-center the guide while setting the declination and then set the hour circle to the guide's right ascension. Quickly rotate the telescope in both axes to the coordinates of the target.

Always set the declination circle first and then set the hour circle. Move to the target as soon as the hour circle has been set. Remember, the Earth continues to rotate -- one degree in four minutes -- while you are making your adjustments. Try to find a guide star close to your target, within a few degrees if possible. This will make the movements quicker and will lessen the effect of inaccuracies in polar alignment. Note that if your hour circle turns with your clock drive, it will remain accurate as the Earth rotates.

The Sidereal Method

This method requires that you know your local sidereal time at the time of observation. You must either keep a clock set to sidereal time or you must calculate the sidereal time for the time of the intended observation.

First, calibrate your declination circle according to the methods above. Next, determine the target's hour angle by subtracting its right ascension from your local sidereal time. A positive hour angle indicates the target is west of your meridian; a negative hour angle indicates the target is east of your meridian. Now, turn your telescope to read the target's declination and then use the hour circle to point the calculated hours (and minutes or fractional hours) east or west of you meridian.

Note that this is the usual method for finding bright planets in the daytime.