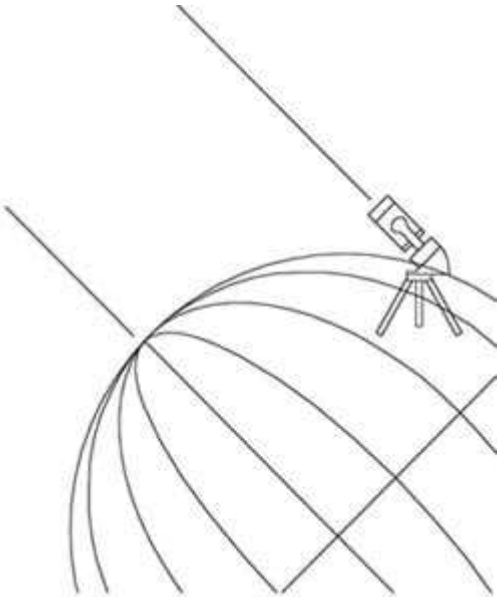
Polar Alignment

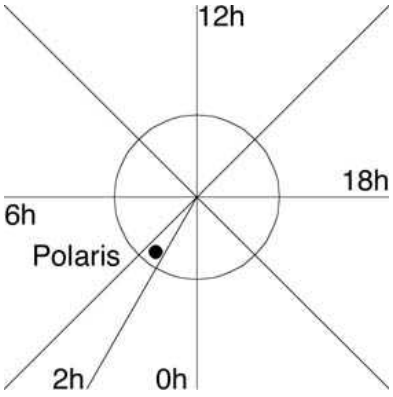


Polar alignment is simply setting up your telescope so that you may easily follow a star (or other object) across the sky. This is done by aligning one of the telescopes axis with the rotational axis of the earth. OK, that sounds like a complicated idea, but the reality is actually quite simple.

For this method to work you must have a telescope with some sort of equatorial mounting. An equatorial fork mount, or a german equatorial, an english yoke mount, or any of the many variations, the procedure is the same. This mounting allows the telescope to be mounted at an angle. This angle can be adjusted to align the telescope with the earth's axis. What angle do you use? This depends on your latitude. For an observer standing at the north (or south) pole this angle would be straight up, or 90 degrees. For an observer at the equator this angle would be level with the ground, or zero degrees. For an observer somewhere in between this angle is also in between. Actually the angle is equal to your latitude. Before attempting to polar align your scope simply look on a map that has latitude marks and find your latitude. Set your telescopes latitude adjustment to this angle. Don't worry about getting it perfect, close is good enough, as we will be fine adjusting it later.

Those with the newer computer controlled, altitude-azimuth telescopes (such as the Meade LX200 or Celestron Ultima 2000) need not perform polar alignment as described here. The Alt-Az mounted scopes follow their own alignment routine and take care of tracking using the computer to track with both the altitude and azimuth motors simultaneously. If you plan to do photography with one of these scopes the addition of a wedge tilting the scope to the correct angle is a useful, and polar alignment is again necessary, though the computer simplifies this a bit.

Alignment Using Polaris



For observers in the northern hemisphere there is a convenient marker in the sky that makes polar alignment very simple. There is a nice bright 2nd magnitude star marking the spot. Called the North Star, or more properly Polaris, this star is very close to the spot in the sky where the axis of the earth is pointing. Simply aligning your telescope on this star is sufficient for a quick and dirty polar alignment.

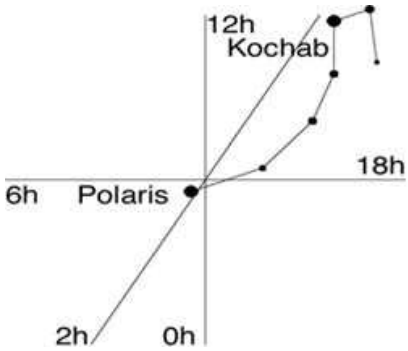
Aligning on Polaris is sufficient for visual observing, and in fact, this is all many amateurs do when setting up in the evening. Using a telescope equipped with an equatorial mount, but without a clock drive it is only necessary to slew the telescope in one axis, or with one motion to follow the target. With a clock drive the object should stay centered for many minutes, but will slowly drift out of the field to the north or south over time since the telescope is not perfectly aligned with true north.

The diagram to the left shows the north celestial pole where all of the lines cross in the middle. The circle marks the distance of one degree from the pole. As you can see Polaris is about 3/4 of a degree off true north. This is the error you encounter when aligning to Polaris.

When making corrections, remember to move the mount, not just the telescope tube. You are aligning right ascension axis of rotation. I hesitate to add how to make adjustments to your particular scope here as there are so many variations, it is up to you to figure out how to adjust your specific scope. That's what the manual is for anyway.

Improved Alignment Using Polaris

As noted above Polaris a just a little off true north, actually about 3/4 of a degree. To correct for this it is necessary to align the telescope a little off Polaris.



But 3/4 of a degree in which direction do you correct? As the earth spins so does Polaris about the north celestial pole. Another stroke of good luck aids us here. There is a second star in the constellation of Ursa Minor, also second magnitude, Kochab. This star is almost exactly the other direction of true north. Kochab is the star at the other end of the Little Dipper (Ursa Minor). Correction then becomes simple, align the telescope on Polaris then correct 3/4 of a degree towards Kochab.

Many finderscopes and other pointing devices have methods of measuring this offset. Some have a circle added to the crosshairs that is the appropriate distance, provided for just this purpose. The common Telrad has markings at 1/4 and 1 degrees in radius. So a bit inside the second circle is 3/4 degree.

If you do not have a measuring device use the one nature has given us, the Moon. Our moon is almost exactly 1/2 degree across. Turn your telescope finder to the moon and learn what 1/2 degree looks like in your finderscope. This is a skill that you will find invaluable while you observe. While finding deep sky objects you will need to be able to estimate degrees away from a star or some other object. So when the book says the object is 1 degree south of the bright star you will have a good idea where to look.

Polaris: mag: 2.02 r.a.: 2h 31' 50" dec: 89d 15' 51"

Kochab: mag: 2.08 r.a.: 14h 50' 42" dec: 74d 09' 19"

As you can see from the coordinates Polaris is 44 arcminutes (0.75degrees) away from the pole. The difference in right ascension is about 12 hours, or almost exactly the other way. It is also convenient that both magnitudes are nearly the same, if you can see one, you can see both stars.

Drift Star Polar Alignment

For fine polar alignment the drift star method is used by amateur and professional alike. To use drift star you usually must have a telescope with a clock drive. The basic idea with drift star alignment is to let the telescope run and observe which way the star drifts. Note the direction of the error and correct by moving the mount of the telescope.

Step 1: Perform a rough alignment by using the improved Polaris alignment shown above.

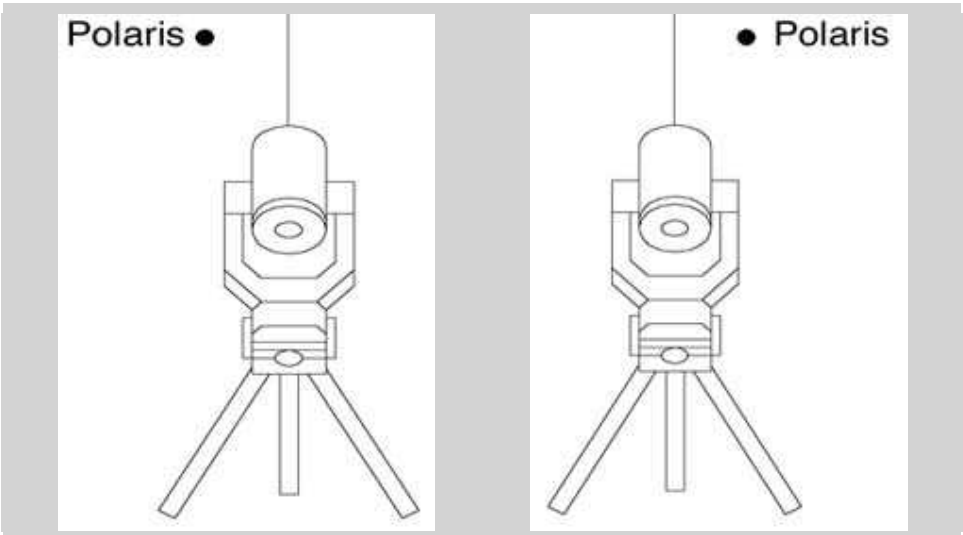
Step 2: Choose a reasonably bright star near the meridian (the imaginary line running from the zenith to due south, or north for southern hemisphere observers) and near the celestial equator (zero degrees declination or 90 degrees down from the pole). It is best to choose a star within 5 degrees of this position. Aim the telescope exactly at this star using a reticle eyepiece. If you do not have a reticle eyepiece use your highest power eyepiece to allow you to see which way the star drifts. The finderscope does not generally have enough magnification for this task.

Step 3: Allow the telescope clock drive to run for a while, at least five minutes. The star will begin to drift north or south, any east/west error you see is probably the speed of your clock drive. It is up to you to figure out which way is north and south in the eyepiece, just move it up and down and observe the motion. Once you figure this out the rules below work for any telescope.

- If the star drifts **north** the telescope mount is pointing too far to the **west**.
- If the star drifts **south** the telescope mount is pointing too far to the **east**.

Step 4: Determine which way the star drifted and make the appropriate correction. This is done by rotating the entire mount east or west as needed. Make small corrections, many scopes have adjustment screws to allow this correction to be made with some precision.

East-West Correction



Telescope mount pointing too far east. Telescope mount pointing too far west

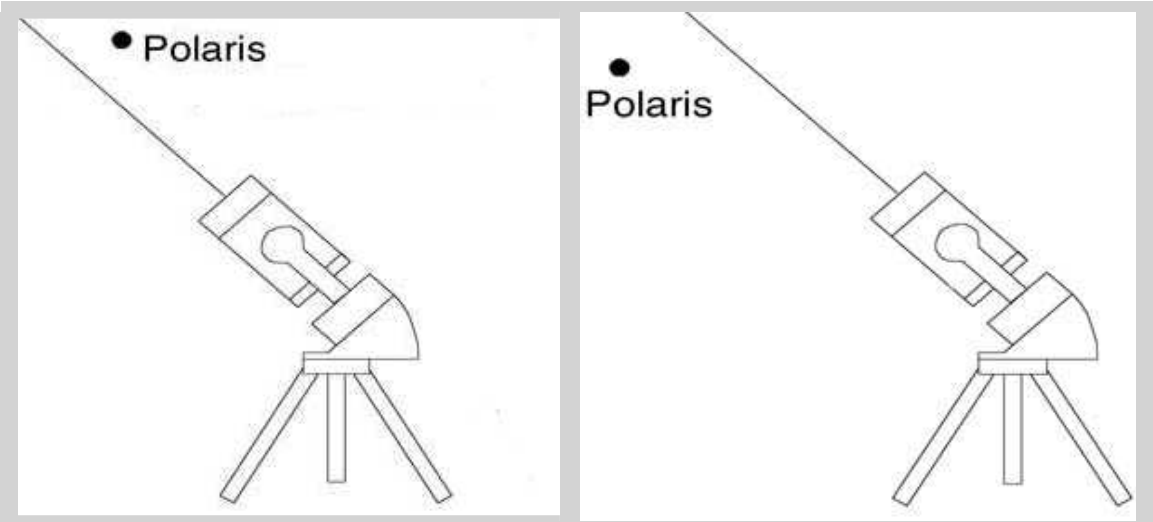
Step 5: Point the telescope at a reasonably bright star near the eastern horizon and still near the celestial equator.

Step 6: Allow the telescope to run for at least five minutes possibly longer, the star will begin to drift north or south.

- If the star drifts **south** the telescope mount is pointed too **low**.
- If the star drifts **north** the telescope mount is pointed too **high**.

Step 7: Observe the drift and make the appropriate correction to the telescopes latitude adjustment.

High/Low Correction



Telescope mount pointing too low | Telescope mount pointing too high

Step 8: Go back and repeat from step 2 as necessary to get the needed precision.

Summary

Polar alignment is easy! It takes a little practice and the only way to do this is to get out, set up your telescope and try it. If you are observing visually a quick and dirty alignment to Polaris will probably serve your purposes.

If you have a few moments, correcting the proper distance and direction from Polaris will serve your needs most of the time.

For astrophotography you will need to perform the drift star alignment as described above. This procedure is also used for site mounted telescopes from modest amateur scopes to the largest of professional telescopes.

This page was compiled and produced by Andrew Cooper

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