Quick & Easy Polar Alignment

NIGHT SKY: LAUREN DARBY

IT TAKES ONLY A FEW MINUTES AT THE BEGINNING OF YOUR OBSERVING SESSION TO GET THE MOST OUT OF YOUR EQUATORIAL MOUNT.

Whether your scope is brand new, gleaming and fresh out of the box, or one that you've had for a while, you may find using it outdoors a little intimidating. Just getting the finderscope aligned correctly can be a puzzling chore if you're doing it for the first time. Then you have to get familiar with different eyepieces and other accessories. And no matter how well you understand your telescope's optics, finding and tracking some dim, distant object can be frustrating in the dark.

But using a telescope, as with lots of other things in everyday life, just requires a little familiarity and patience to succeed. For example, take a good look at your scope's mount. You're probably wondering exactly what those dials, knobs, and adjustments do.

The world of backyard stargazing is populated with two varieties of telescope mounts. One type, called an *alt-azimuth* or *alt-az* mount, allows you to move your instrument up and down (in altitude), left and right (in azimuth). A popular version of this, called a *Dobsonian*, is used with reflecting telescopes. The alt-az approach is also typical on computer-controlled "Go To" telescopes.

If your scope came with an *equatorial* mount, as many entry-level instruments do, it'll have extra dials and knobs and various parts canted at seemingly mysterious angles. That's because this design moves your scope according to directions in the sky: north and south, east and west. Why is this distinction important? When properly set up, an "EQ" mount allows you to track objects with a single east-to-west motion, following their paths across the sky. Not only does this make it easier to keep the Moon in view at 200×, but it also makes it much simpler to equip your scope with a motor for automatic, hands-free tracking.

Equatorial mounts come in two flavors. Most common is the *German equatorial mount*. If your scope has a heavy counterweight, chances are it's riding on a "GEM." The other type is the *equatorial fork mount*, so called because the optical tube attaches to it with one or two sturdy tines (fork arms). Although the two types look quite different, they do essentially the same thing the same way. Go To telescopes also typically come on fork mounts — many of these can be angled upward to work in an equatorial mode, but the scope's computer-driven motors will track your target even if you leave the mount in its standard alt-az configuration.

EQ-mounted scopes have capabilities that give them some pretty compelling advantages over their alt-azimuth cousins, but you probably noticed a few lines ago that I slipped in the caveat "when properly set up." As the scope's

manual will (hopefully!) explain, most of the knobs and adjustments are for aiming the scope at your desired target. But a few are there specifically for a procedure called polar alignment. "Polar what?" you're thinking to yourself. "Uh, maybe I'll skip that for now." No, wait! Polar alignment is not as bad as it sounds — and learning how to do it will really make using your scope more rewarding.

Getting Ready

Before you can polar align your scope, you'll need to set its mount to the latitude of your observing site, something you can do indoors or in daylight outside. This involves adjusting the scope's polar axis, which should have a scale reading 0° to 90° and a pointer. (Don't confuse this with the declination scale, which is marked from –90° to +90°.)

On German equatorial mounts, the polar axis is typically locked at an upward-pointing angle by a single large bolt. Carefully loosen this bolt and pivot the polar axis up or down until the pointer on the scale reads to within 1° or 2° of your latitude — you don't have to be ultraprecise here. So, for example, if you're at a latitude of 40°, adjust the mount until the pointer indicates 40° on the scale. (It's easier to do this step before you attach the scope and counterweight; otherwise their added weight might cause everything to flop over when the bolt is loosened.) Once done, tighten the bolt to lock the axis in place.

Equatorial fork mounts typically incorporate some kind of wedge-shaped assembly that also has a latitude adjustment. Once again, the idea is to match the wedge's latitude scale with the latitude of your observing site. Some mounts also have a fine-motion adjustment, which makes this little job easier.

Doing the Alignment Dance

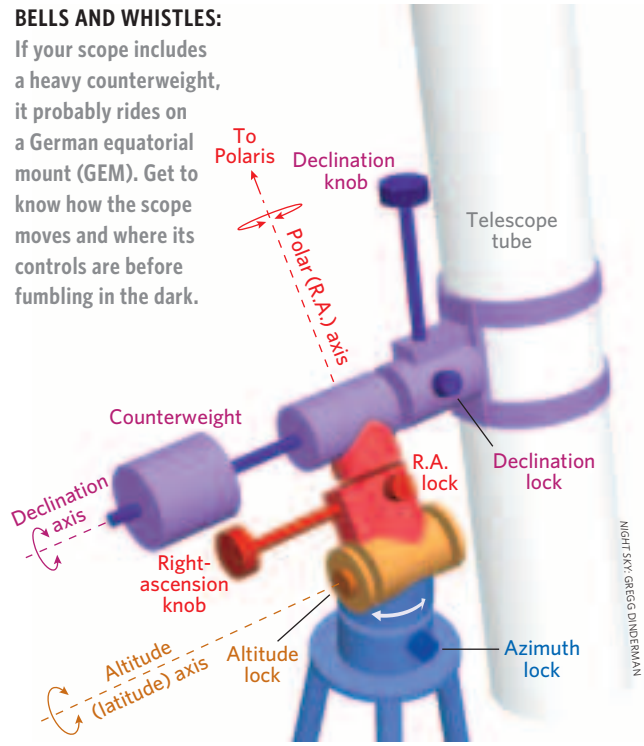
Polar alignment good enough for most kinds of viewing adds only a few seconds to an observing session. If you plan on doing long-exposure astrophotography, the alignment must be more accurate and consequently the setup is more involved. But for most situations the quick-and-easy methods described here will be good enough.

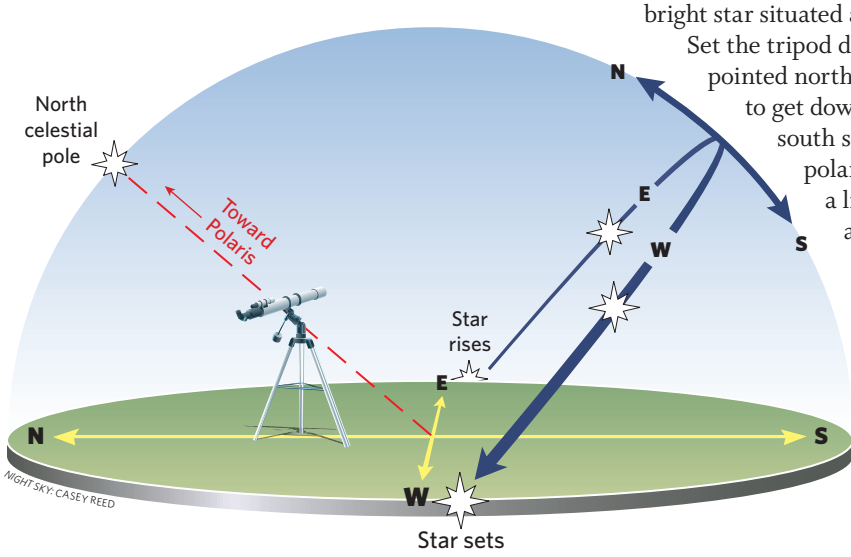
To begin, take your telescope out to a spot that has a clear view of the sky and is roughly level. For an equatorial mount to work its magic, its polar axis has to be aimed at the *north celestial pole* — an imaginary point in the sky around which all the stars appear to circle as Earth rotates. (If you live south of the equator, the stars seem to move about the south celestial pole.) Polar alignment is simply aiming your mount's polar axis at that point in the sky. So how do you aim at an imaginary point? As luck would have it, there's a reasonably bright star very close to the north celestial pole: Polaris, also known, appropriately enough, as the North Star.

Contrary to what you might have heard, Polaris is not the brightest star in the sky. But it is easy to find. Use the all-sky maps on pages 12–13 and 16–17 to help locate it. Or you can simply note where the Sun sets and pivot a quarter turn to your right: the direction you're now facing is north, more or less. Polaris is the lone medium-bright star situated about halfway to overhead.

Set the tripod down so that the mount's polar axis is pointed northward. For the next step you'll have to get down on your hands and knees on the south side of the tripod. Now, sight along the polar axis of the mount and try to imagine a line extending from it out into space and passing through Polaris. (If you're using a fork mount, sight along one of the forks.) This can be tricky to judge, but do your best. Chances

BELLS AND WHISTLES: If your scope includes a heavy counterweight, it probably rides on a German equatorial mount (GEM). Get to know how the scope moves and where its controls are before fumbling in the dark.





FRAME OF REFERENCE: The essence of polar alignment is simply ensuring that your mount's polar axis (also known as the *right-ascension* axis) is aimed at the north celestial pole, located near the star Polaris.

POLAR ALIGNMENT WITHOUT A POLE STAR

So what do you do if you can't see Polaris from your backyard, or if you want to set up before it gets dark? You can still polar align your mount — you'll just need a couple of extra tools: a decent magnetic compass and a bubble level. Actually, this is my favorite method, because I find it provides the most accurate alignment in the least time.

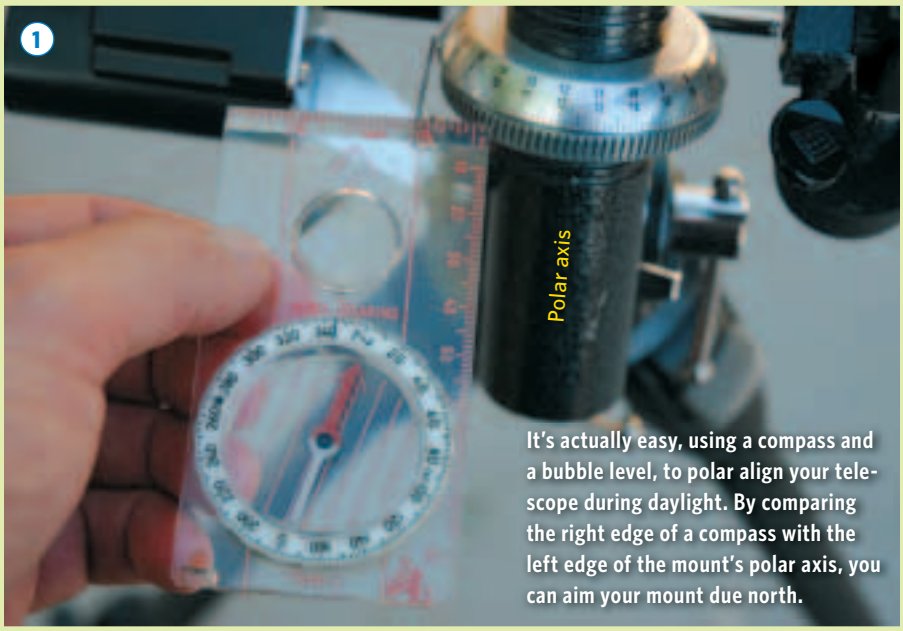
Make sure your compass is set to the correct magnetic declination, the adjustment that compensates for the difference between magnetic north and true north. (Instructions for doing so, along with the magnetic declination for your location, can be found at: http://www.geolab.nrcan.gc.ca/geomag/apps/mdcal_e.php.)

Place your scope outside where you plan to observe later, and check that the mount is adjusted for your latitude and aimed as close to north as you can guess. To polar align your mount with this method, you need to make two adjustments — one sets the polar axis to the correct azimuth, the other to the correct alititude.

1. Let's start with the azimuth setting. All you have to do is aim your compass toward due north, and then turn the tripod or mount so that the polar axis is pointing in the same direction. Because the compass can be thrown off if it's close to metallic objects, you'll probably have to keep it several inches away from your mount. I find the best way to check alignment is to compare one edge of the compass to one edge of the polar axis, as shown in the picture below. You can get a surprisingly accurate position this way.

To set the altitude of the polar axis, you should:

2. Aim your scope until it's pointed straight up, more or less.
3. Pivot the mount around its declination axis so that the reading on the declination scale corresponds to your latitude. (The more accurately you're able to do this, the better your polar alignment will be.) Tighten the bolt that locks the declination axis in place.
4. Place the bubble level in the middle of your scope's dust cover. If you don't have one, or if it's not rigid, gently lay a CD or some other thin, flat object over the front of the scope. Adjust the scope's latitude setting and right ascension until the bubble reads level.



It's actually easy, using a compass and a bubble level, to polar align your telescope during daylight. By comparing the right edge of a compass with the left edge of the mount's polar axis, you can aim your mount due north.

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In most cases, your polar alignment will be good enough if you simply look to make sure that the mount's polar axis is pointing toward Polaris.

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are your initial positioning of the mount was a bit off, so you'll have to tweak things.

To adjust the aim point of the polar axis in an up-and-down direction, you can raise or lower the tripod leg closest to the north-south line. Or use the mount's built-in latitude adjustment — don't worry if this means the scale no longer matches your latitude, as the initial setting was just to get you close.

If you need to move the polar axis left or right, grab two of the tripod legs and lift them off the ground a little — just enough to allow the whole assembly to pivot on the third leg as you move the mount into position. Alternately, some mounts have an additional adjustment that allows the equatorial head to rotate on the plate at the top of the tripod. Look for a bolt under the mount, where it attaches to the tripod, or for one that screws in horizontally just above the tripod legs. Loosen this and turn the mount sideways as needed.

You'll probably have to repeat these steps once or twice until you're satisfied that the alignment is close enough. Don't fret about achieving perfection — after all, Polaris is not exactly at the north celestial pole (as described at right).

That's it! Now you're all set for a night of observing utilizing all the capabilities of your equatorial mount. You should be able to track a star or planet for many minutes, moving the scope only in right

Left: **The mount's altitude setting should match your latitude.** ***Right:*** **Adjust your mount side to side (in azimuth) by loosening the azimuth lock and swiveling the entire assembly.**

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ascension either with its fine-motion control or motor drive. At some point you might inadvertently kick one of the tripod legs and ruin your polar alignment, but that's okay — practice makes perfect.

For more tips on using an equatorial mount, see Alan Dyer's excellent guide in the May/June 2005 issue, page 64.

Contributing writer Gary Seronik recently returned to Victoria in his native Canada, where the latitude is 48° north. Read more about his lifelong fascination with telescopes on page 77.

Polaris and the Pole

Ursa Minor's leading light, Polaris, provides a handy way to locate the north celestial pole. However, the North Star isn't exactly in the right spot — that's about ¾° away in the direction of Alkaid, the last star in the Big Dipper's handle. For most observing situations, aiming your mount's polar axis at Polaris will be good enough for casual tracking of stars and other objects. However, for long-exposure astrophotography, you'll want to align the polar axis as accurately as you can.

One method is to position the telescope so the declination scale reads precisely +90°, then use a low-power eyepiece to view the area near Polaris and adjust the mount's azimuth and polar axis until the north celestial pole is centered in the field.

Some larger telescopes come with a small finderscope that threads directly into a hole in the mount. Such "polar-axis scopes" superimpose a circular scale in the view that makes it very easy to gauge the correct offset from Polaris.