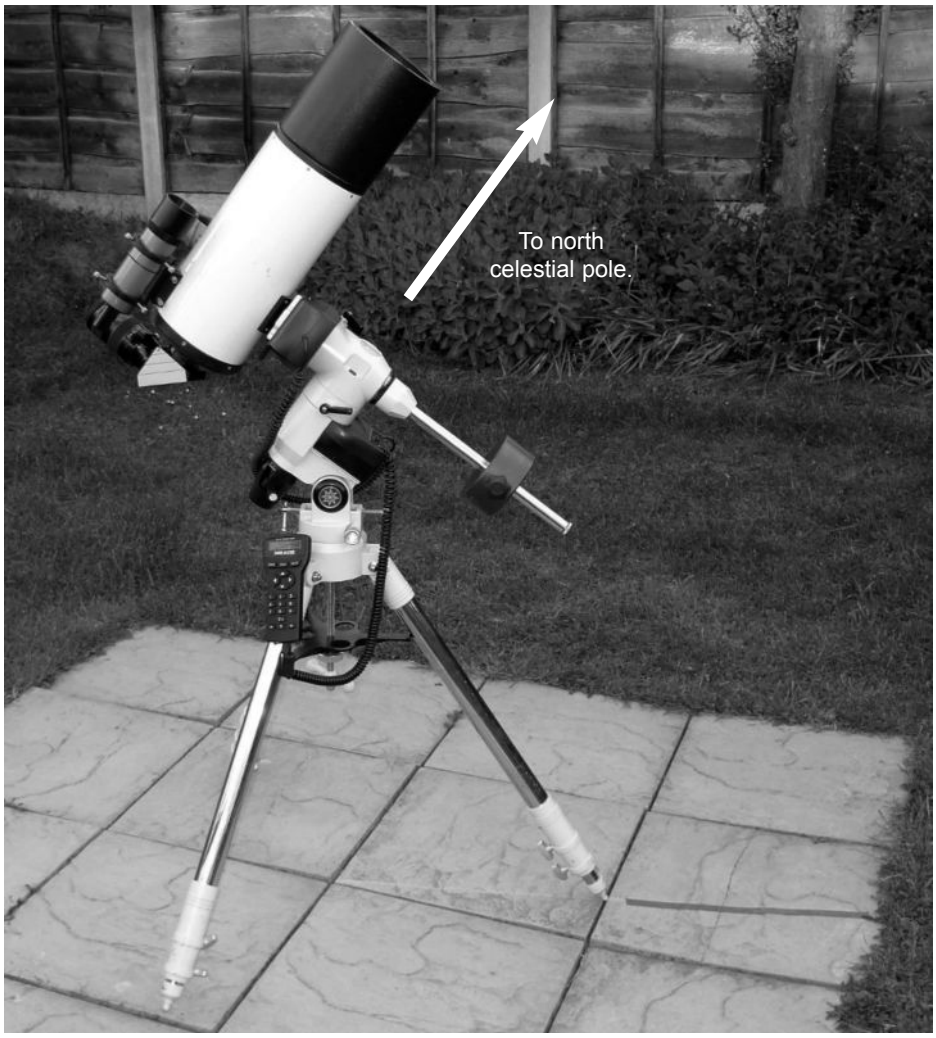
How to align an equatorial mount



Above: An equatorially-mounted Maksutov telescope points to the north celestial pole (the mark on ground to right of tripod leg is aligned north-south). All images by Ian Morison.

FEW things cause more problems to amateur astronomers than the setting up of an equatorial mount! But taken slowly and gently it is not really so bad. But first, how does it work? Imagine that you are at the North Pole. The Sun, planets and stars will appear to rotate round at a constant elevation, so that if you had a vertical pole (which would point to the North Celestial Pole (NCP) above your head) and mounted a telescope on the side so that you could change the elevation, you could adjust the elevation and rotate the pole to observe any object in the sky. Having centred it in the field of view it would remain there simply by rotating the pole once per sidereal day.

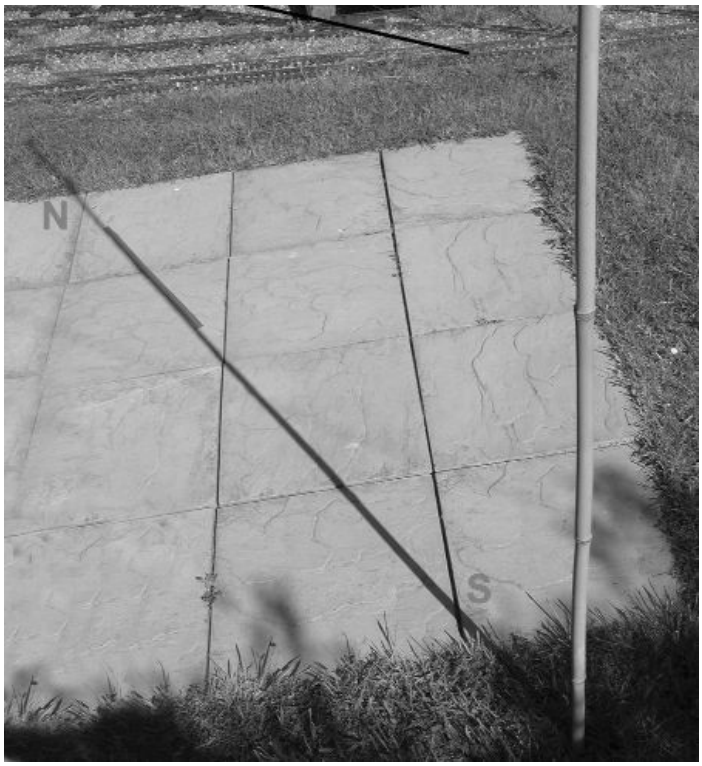
Providing that you have a pole pointing at the NCP, you do not have to be at the North Pole for this to work. In equatorial mounts this is a short stubby tube called the polar axis and, in driven mounts, a motor and gears drive this round at the 'sidereal rate'. In many mounts, a small telescope — the polar scope — is mounted in this tube, aligned along the polar axis, to enable precise alignment on the NCP, but more of that later. Good features of an equatorial mount are that the orientation of a star field remains fixed, so allowing long exposure photography and also only one motor has to be running to track an object across the sky so giving somewhat smoother following.

So the whole exercise is to align the polar axis to the NCP. This can be largely done in daylight so maximising your valuable observing time. There are two steps to this process. The first is to set up the correct elevation for the polar axis which will depend on your latitude. This information can be found from a map or you can use a new website www.threelittlemaids.co.uk/magdec/. Move the map to include your town and place the mouse over it when the lat and long are given. On the side of the mount are a pointer and scale with adjusting screws to set the polar axis to the correct elevation — just set the pointer to your latitude. Of course, the elevation will not be right unless the equatorial head is level, so adjust the tripod legs using a spirit level (in two directions at right angles) to make the base of the head horizontal.

Now the harder bit — setting the equatorial axis true North. This obviously involves knowing where true north is and this is not trivial! An obvious way is to use a compass, but this involves knowing the Magnetic Variation which depends where you live in the UK. The same website that gave your lat and long also gives you the difference between magnetic north and true north from your location. For me, it is 2 degrees 47 minutes west, so true north is just under 3 degrees to the east (right) of the compass needle. Simples!

Above: The observer's latitude is matched to a basic elevation scale on the equatorial mount's polar axis.

There is a second way; using the Sun to cast a shadow which will lie on the north-south axis when the Sun is due south. But when is that? It depends on your longitude and also on the equation of time. The time that the Sun is due south can be found if you have a program like *Stellarium* (free to download). Set it to observe from your location in lat and long, and then to 12 noon on a day when the Sun is shining. Remove the atmosphere, put on the azimuthal grid to show the meridian and look due south — you should see the Sun somewhere in the south, now adjust the time until the Sun straddles the meridian line and that's it! I used a bamboo pole to cast a shadow over my observing platform and laid down an accurate north south line along which



Above: The tripod, level and aligned, ready for the equatorial head.

Left: An accurate north-south line can be determined by using the shadow cast by a pole when the Sun is due south.

Below: The north celestial pole is located a little more than one Moon's width from Polaris in the direction of Kochab.

to align the equatorial axis. Having done these two alignments in daylight, it was very pleasing to look through the polar scope that night and immediately see Polaris in the field of view!

What if you just bring out your scope in the evening? Set the head horizontal and the polar axis to the appropriate elevation as described above, and adjust the azimuth to point the polar axis up towards Polaris. I have made an adapter so that I can mount a laser pointer in the polar axis tube and simply move the mount so that it points up at Polaris — but not quite. The NCP is a little way — 42 arc minutes or 0.7 degrees — from Polaris towards the star Kochab, the second brightest star in Ursa Minor. If you have done this, then your alignment is pretty good and fine for visual observing when small adjustments to the pointing can be made as you track an object. If, however, you are going to do astrophotography, then you will need to be more accurate and would then use the polar telescope to offset Polaris the right distance and direction away from the NCP. This scope must be rotated so that Polaris is in the right position. Put the graticule (often a circle) where Polaris is to be placed so that it is directly opposite Kochab. (A planisphere or *Stellarium* can be used to find the relative orientation of Kochab to Polaris if you cannot see it at the time of observation.) Then, when you adjust the mount slightly so that Polaris is within the graticule, the equatorial axis will be the correct distance away from Polaris towards Kochab, just as required.

One final trick can be used with a computerised mount which has been set so the equatorial head is horizontal (important) and roughly right in azimuth and elevation so the equatorial axis points reasonably close to the NCP. Having put the scope in the 'home' position, the computer will drive the scope to the first alignment star which may well not even be in the field of view! Instead of using the slow motion drives to centre it in the field of view as you are told to do, adjust the azimuth and elevation of the polar axis to get it approximately right. Then start the alignment process over again. It should be a lot better. After, perhaps, a third try you should be pretty well aligned and can begin to enjoy your observing!

Next Issue: Observing with binoculars.