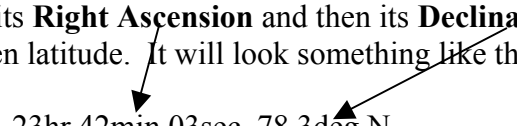
The World's Easiest Equatorial Mount Instruction Manual for Refractor Telescopes

Before you get started, you'll need to know that your telescope is a **Refractor** telescope. All telescopes turn the image they receive upside down and backwards. Refractor telescopes have the ability to turn (erect) or turn the image right side up. Also, some refractor telescopes can correct the right to left viewing with a special eyepiece. All of this is especially helpful if what you are looking at is on land as opposed to outer space.

Without getting fancy or technical, equatorial mounts are star finders. Most all of the visible stars in the sky have an address in a book called a Star Atlas (roadmap of stars) that is expressed in terms of its **Right Ascension** and then its **Declination**. Basically it's outer space longitude and then latitude. It will look something like this:



When using an equatorial mount, you can move your telescope to these settings and find the star that corresponds to that address. You can purchase a Star Atlas at just about any bookstore on earth

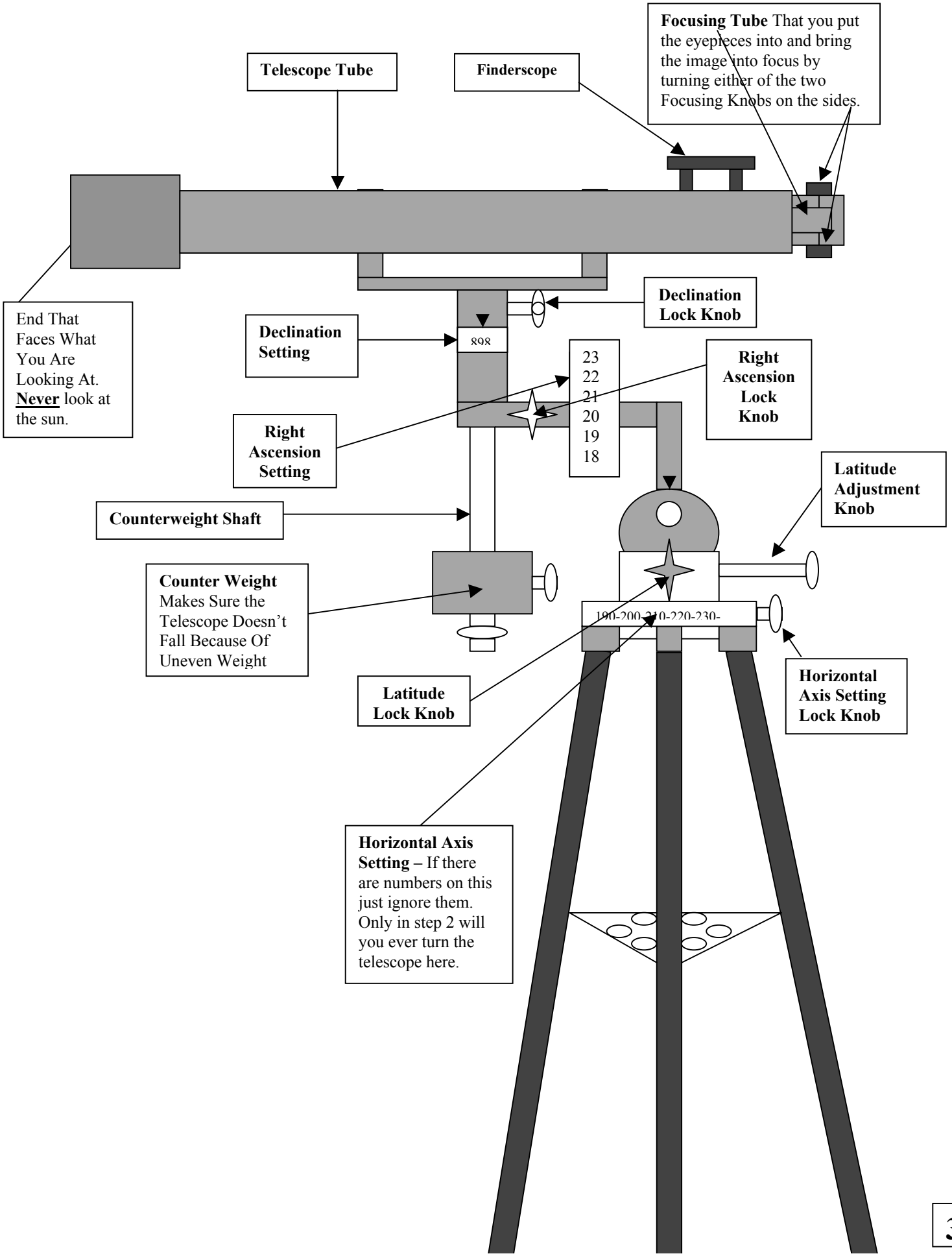
As well, you will need to be able to locate and identify 2 stars in the sky. The first star will be the North Star. Coincidentally this star is perfectly north **EVERY** night you go out. It is **generally** around 25 to 45 degrees up from the horizon in North America.

The second star you will need to be able to identify in the sky is a little bit harder. The second star can really be any star in the sky other than our sun and the North Star. You can pick a star from a constellation that is in the sky and use a particular star in it. You will not only have to be able to identify it, but in Step 5 you will need to be able to center it in the telescope. Unfortunately, there is no other alternative. If you want to use your equatorial mount, you'll need to be able to do this. We recommend using a star called Mizar, as it is visible all months of the year in North America.

In most Star Atlas books there is a section that gives suggestions on which stars to use for the second star, I recommend using it. Also, there is a section that has the latitude setting for the North Star in certain areas. You will need this when going through Step 4.

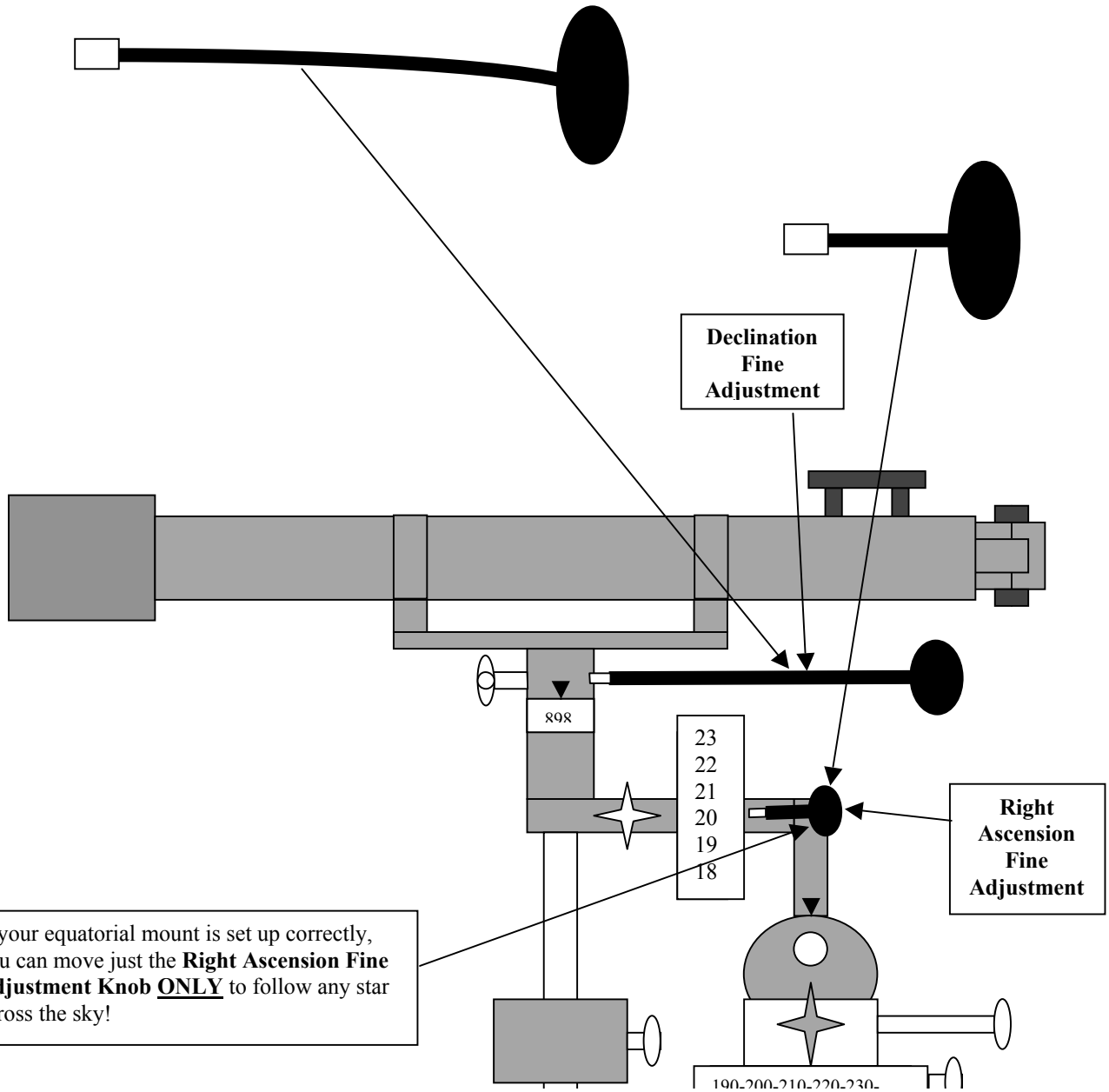
Finally, you will need to set your telescope up to be able to use a Star Atlas. The following instructions in steps 1-7 will show you how to do this. Good Luck and Have Fun!!!!!

Table of Contents

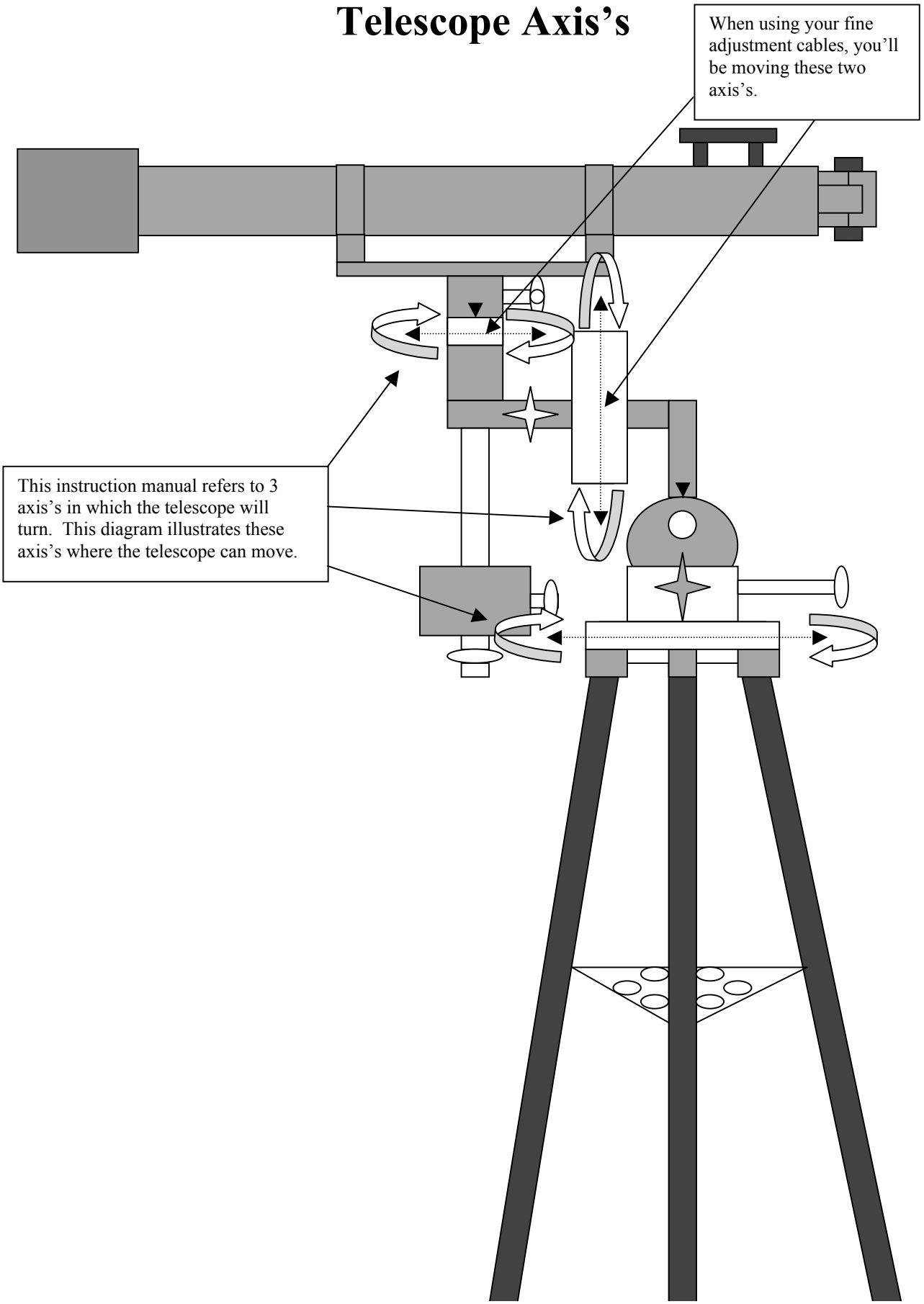

Telescope Tube
Finderscope
Focusing Tube That you put the eyepieces into and bring the image into focus by turning either of the two Focusing Knobs on the sides.
End That Faces What You Are Looking At. Never look at the sun.
Declination Lock Knob
Declination Setting
898
23
22
21
20
19
18
Right Ascension Lock Knob
Right Ascension Setting
Latitude Adjustment Knob
Counterweight Shaft
Counter Weight Makes Sure the Telescope Doesn't Fall Because Of Uneven Weight
190-200-210-220-230-
Latitude Lock Knob
Horizontal Axis Setting Lock Knob
Horizontal Axis Setting – If there are numbers on this just ignore them. Only in step 2 will you ever turn the telescope here.

Fine Adjustment Cables

The fine adjustment cables move the declination and right ascension settings in very small increments. When you are aligning the finderscope or centering a star or planet in the telescope there will be a time when only small adjustments will be necessary. That is when you'll use these knobs. They look like the diagram below. Notice one is long and the other is short. It really doesn't matter which one goes on the declination and which one goes on the right ascension. Generally though, they go on just like the below diagram. They connect to the telescope mount only one way so I won't cover their attachment procedure.



Telescope Axis's

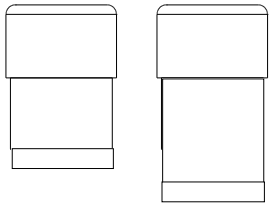


The Different Lenses

There are many different lenses to know about on a refractor telescope. Each has a specific function that also goes on in a specific order. Below covers these lenses. If you try different combinations other than what is listed in the next few pages, you will not be able to see out of your telescope clearly. I'll introduce you to each of the lenses and their functions.

The Eyepieces

4mm Eyepiece
This is the high-powered eyepiece. It is generally shorter than the 20mm eyepiece.



20mm Eyepiece
This is the low-powered eyepiece. It is generally taller than the 4mm eyepiece

The Barlow Lens
This piece multiplies the magnification by generally 2 to 3 times.

The Barlow Lens

Most of the time it will say 2X or 3X on the side of it. Every once in a while it will even have a different number.

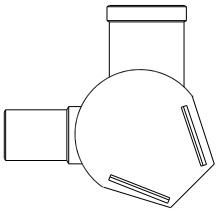
The Erector Lens
All telescopes turn the image upside down. This piece can "erect" the image.

The Erector Lens

Erecting the image is only available on Refractor telescopes. Erecting Lenses generally multiply the magnification by 1.5 times.

The Penta Mirror
All telescopes make the image appear to move in the opposite direction as you are turning it from right to left. The Penta Mirror corrects this and allows you to look down into the telescope instead of having to look from behind.

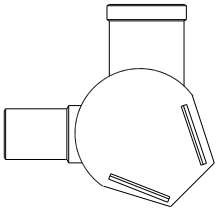
The Penta Mirror



It multiplies the magnification by 2 times.

The Diagonal Mirror
The Diagonal Mirror allows you to look down into the telescope instead of having to look from behind. It does not correct the right to left viewing.

The Diagonal Mirror



This piece offers no additional magnification. As well, most all Refractor telescopes come with either the Penta Mirror or the Diagonal Mirror but never with both.

Figuring the Magnification

Magnification is generally referred to as "power". Figuring the power on a Refractor telescope sometimes can be tricky because of all of the different combinations possible. Below I'll go into the different combinations and how to figure each magnification. To figure magnification you must first know the basic formula for determining it. It is:

Focal Length in mm ÷ Eyepiece in mm = Magnification (Power)

Example:

A telescope that has a 700mm focal length that has a 20mm eyepiece in it has 35 power or magnification.

700 (focal length) ÷ 20 (eyepiece in mm) = 35 (power)

If you have in a 3X Barlow lens **also** then multiply the answer by 3. In this case it would be 105 power or magnification.

700 (focal length) ÷ 20 (eyepiece in mm) = 35 (power)

35 (power) X 3 (Barlow Lens) = 105 (power)

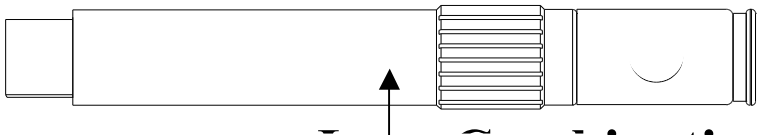
Since the Penta Mirror doubles the magnification, then you would further multiply the answer by 2 if you added to the lens example. In other words the magnification would be 210.

700 (focal length) ÷ 20 (eyepiece in mm) = 35 (power)

35 (power) X 3 (Barlow Lens) = 105 (power)

105 (power) X 2 (Penta Mirror) = 210 (power)

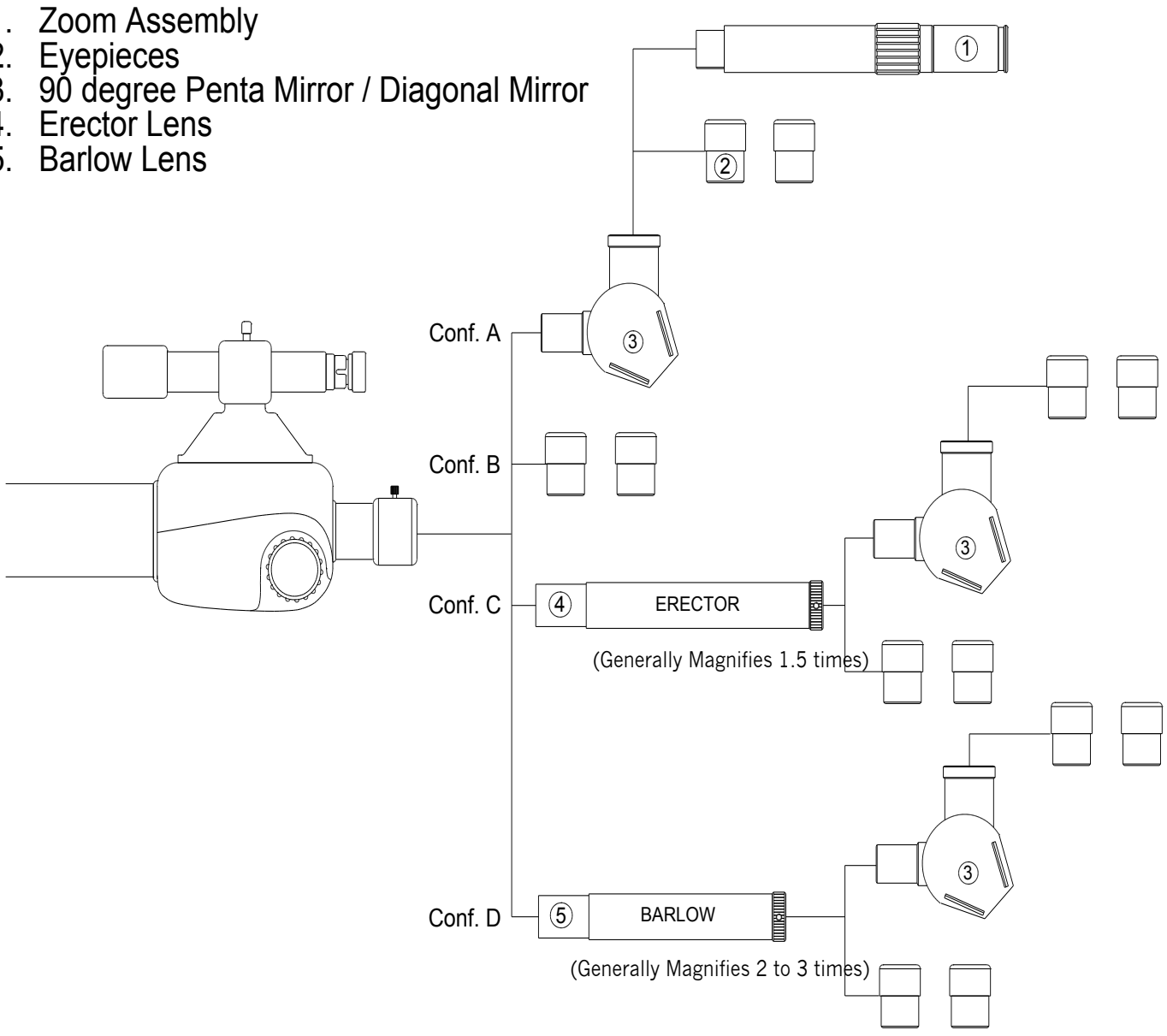
Finally, there is **one** Bushnell telescope (78-9470) that offers a Zoom Lens that magnifies from 25 – 75 times. It can ONLY be used in conjunction with the Penta Mirror and therefore offers actual magnifications of 50 – 150. (The Penta Mirror once again doubles the magnification.) It also erects the image so you need no other lenses with it.



binations

The different lenses offer many combinations. Using the previous definitions you should be able to determine the effect each lens will have on the viewing. Using the below diagram will help you understand the possible combinations your lenses can be put in with.

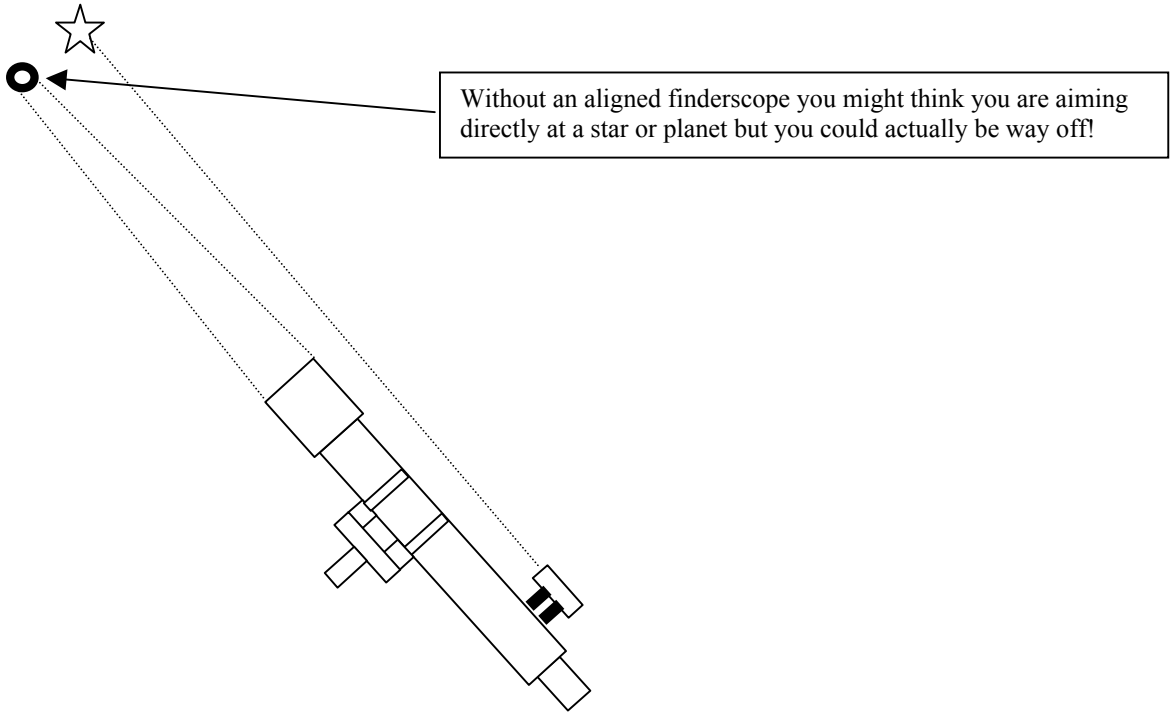
1. Zoom Assembly
2. Eyepieces
3. 90 degree Penta Mirror / Diagonal Mirror
4. Erector Lens
5. Barlow Lens

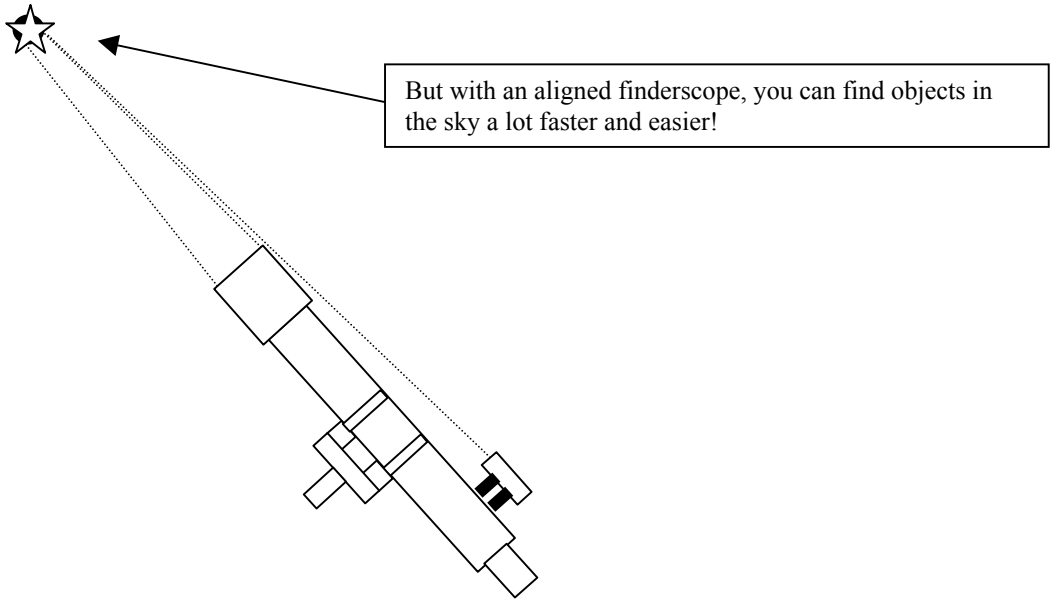


Once again, only use these combinations as they are the ONLY ones possible for good viewing through your telescope.

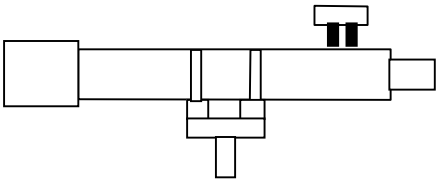
Aligning the Finderscope

You will need to line up the **Finderscope** with your telescope. A finderscope acts kind of like a riflescope in that it helps you aim. To get started you should always use the highest number eyepiece (lowest power) **without** the Barlow lens. If you use too powerful of an eyepiece (low number) then it may be very hard to find an object or it will be too dark to see anything as higher powers cause light loss. Below is an example of why aligning the finderscope is important.

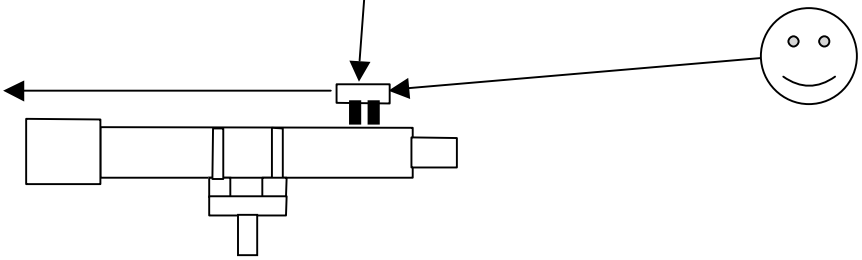


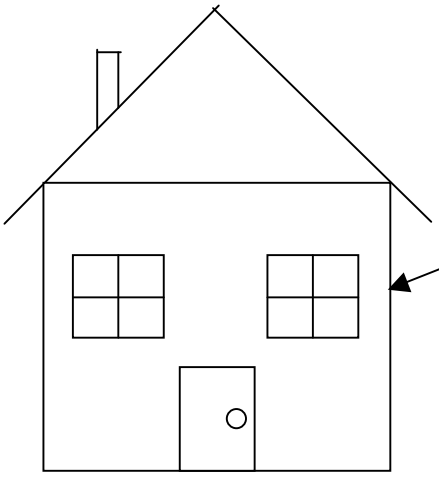


To get started, put the 20mm eyepiece in the focusing tube **without** the Barlow lens.



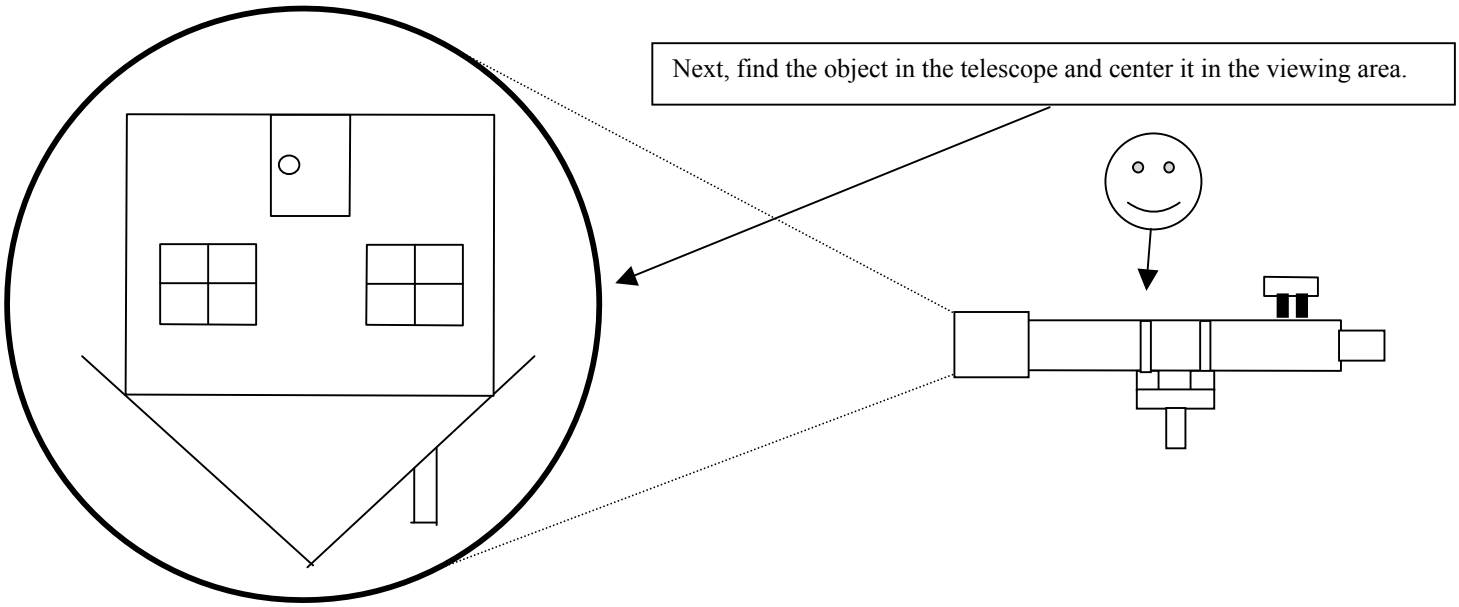
Since the finderscope has a slight magnification to it, put it on so that when viewing through it you see the magnification. If you put it in backwards, everything will appear small and far away.

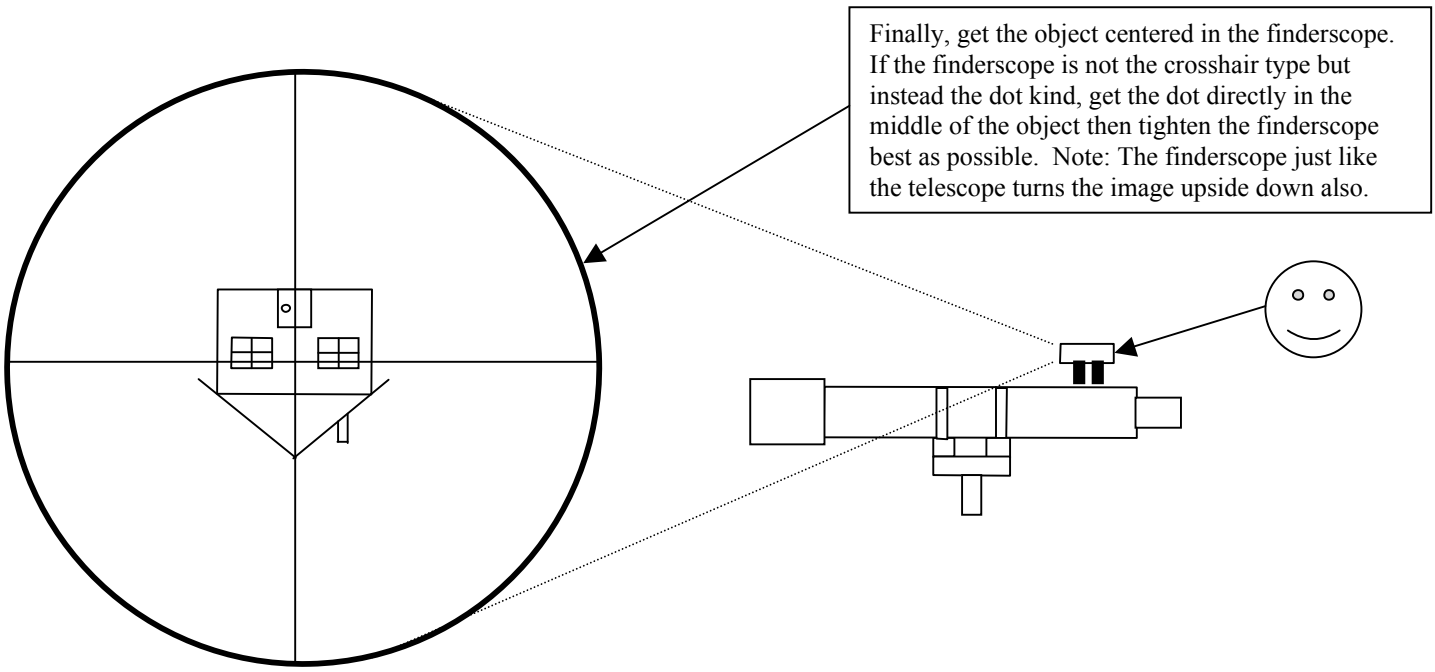




Start with a large object about 200 yards away. You do not have to be absolutely accurate with the distance as it will not help you or hinder you if you are not exact. In this example I'll use a house as the object

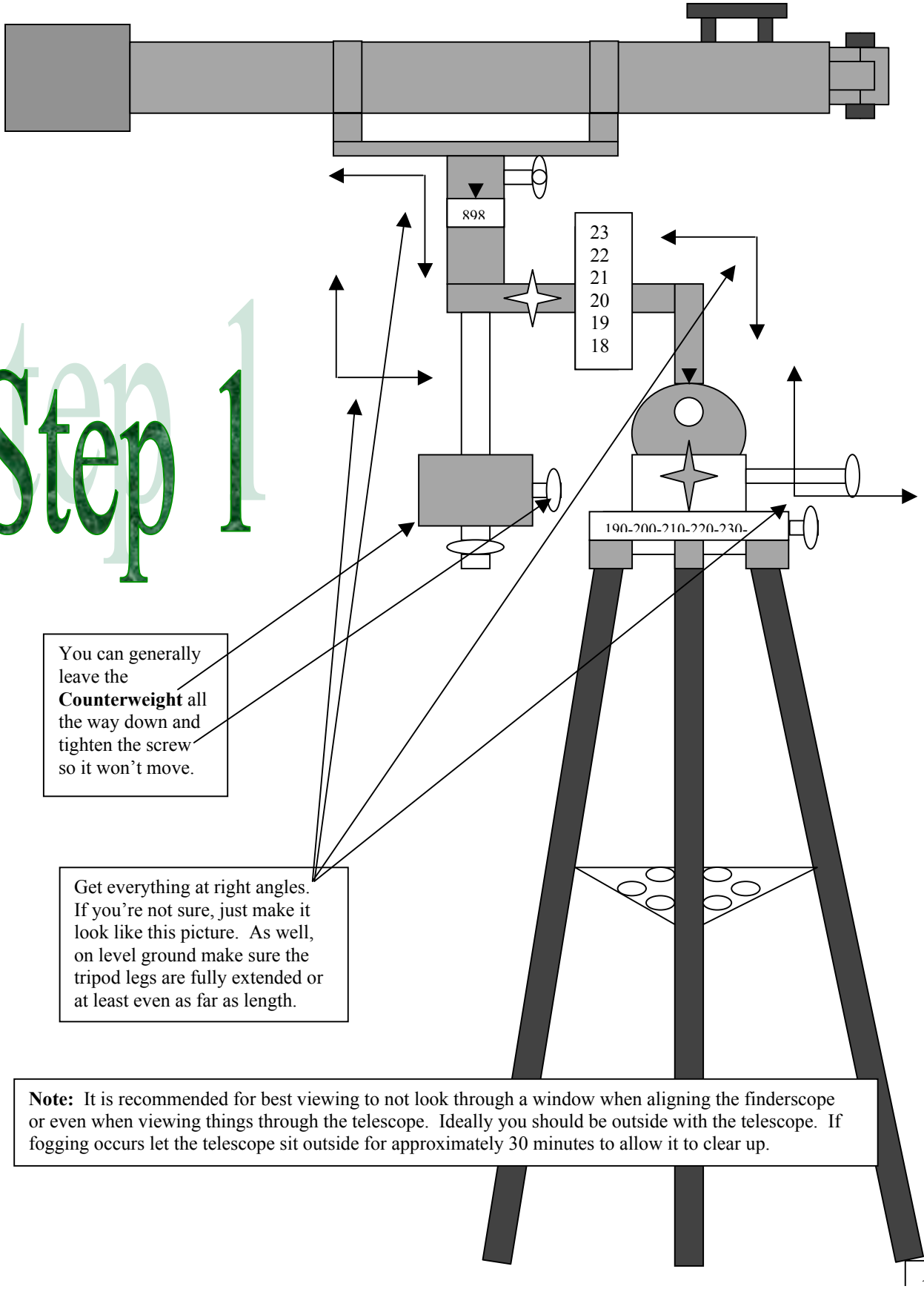
Note: It is recommended for best viewing to not look through a window when aligning the finderscope or even when viewing things through the telescope. Ideally you should be outside with the telescope. If fogging occurs let the telescope sit outside for approximately 30 minutes to allow it to clear up.





Know that finderscopes sometimes have a red dot in them as opposed to crosshairs. Sometimes they adjust with thumbscrews on the outside of the mounting bracket and sometimes they have actual fine adjustment knobs on the finderscope itself. Regardless, you will need to determine how to adjust them yourself using common sense and if you have it, the instruction manual.

Step 1

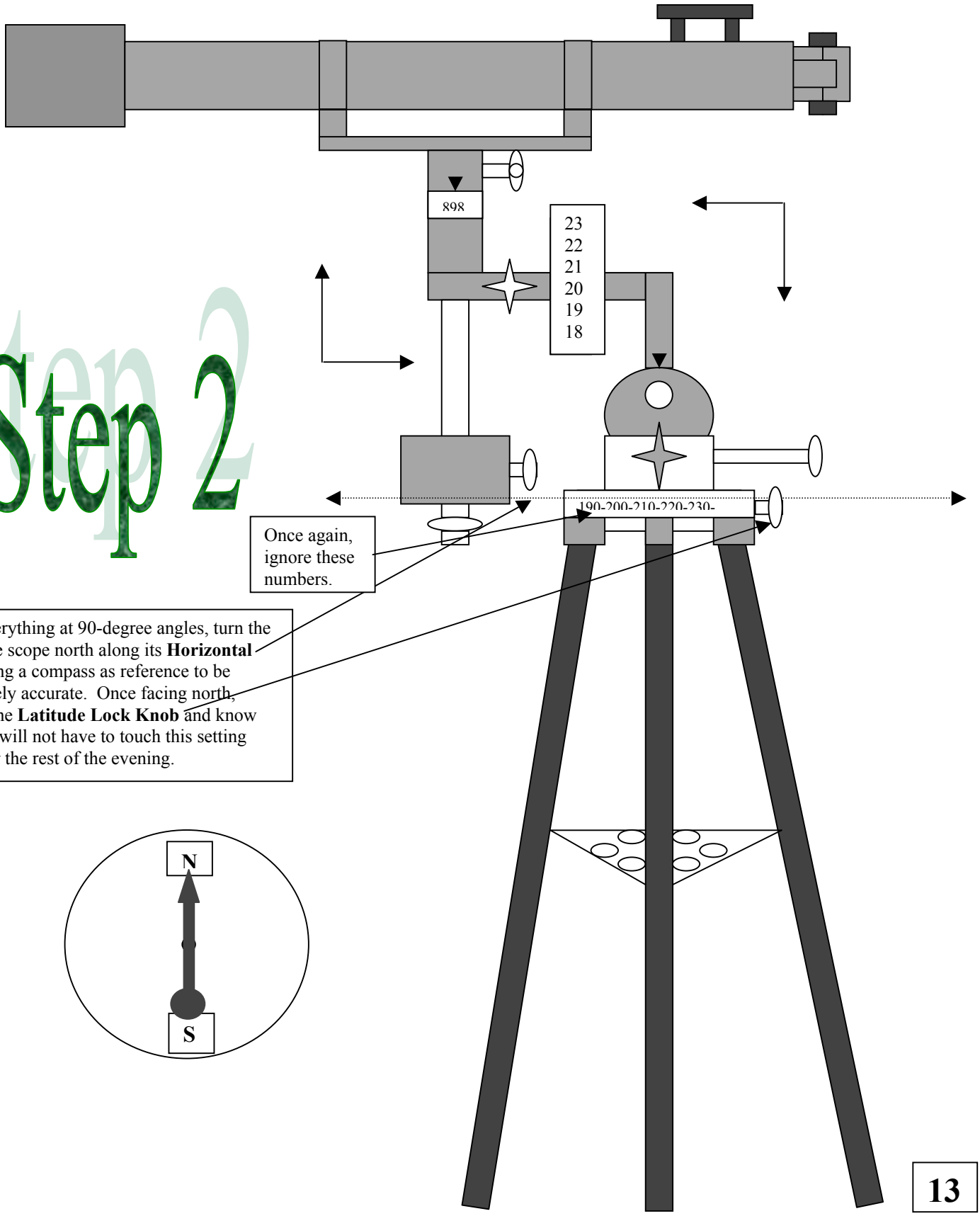


You can generally leave the **Counterweight** all the way down and tighten the screw so it won't move.

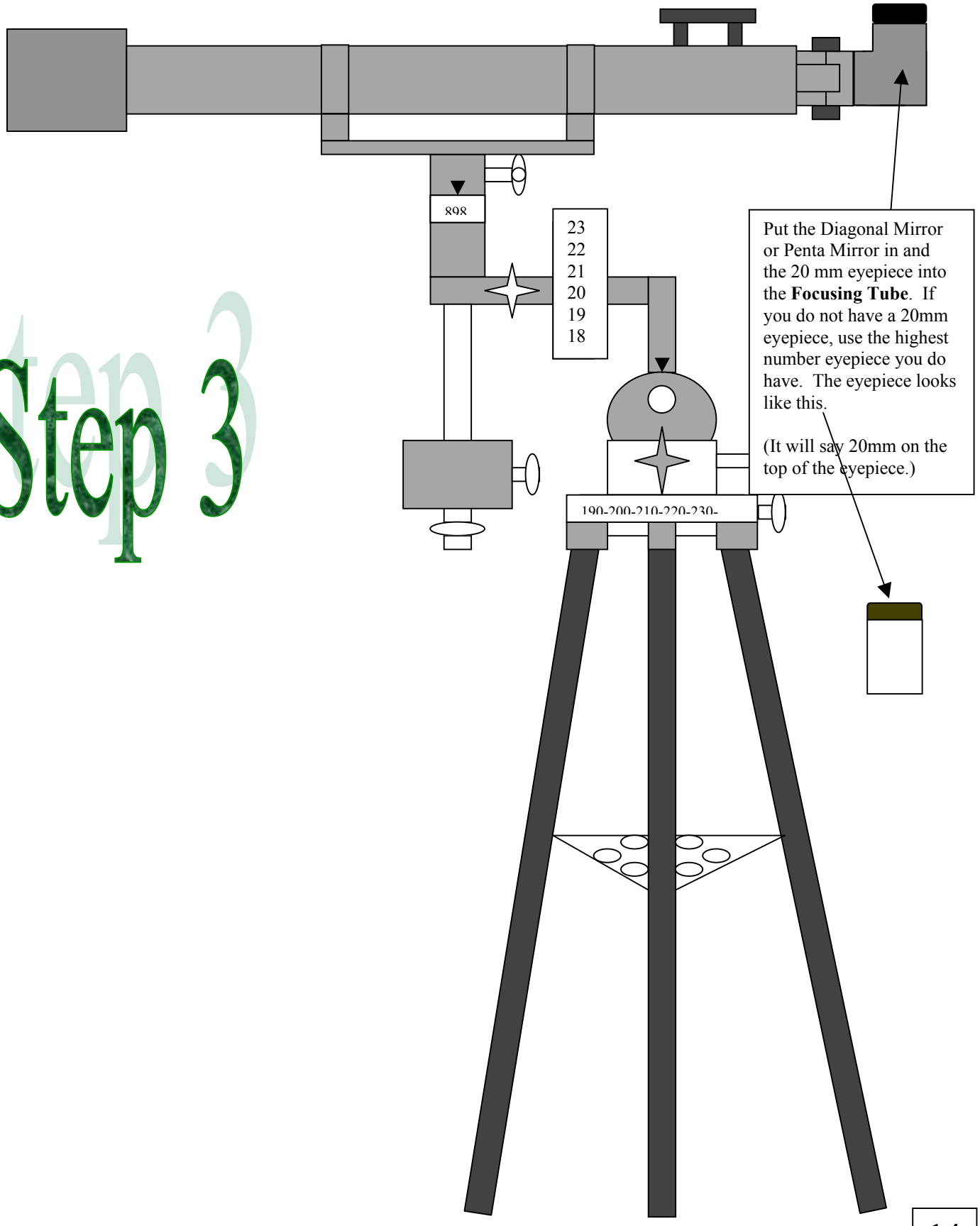
Get everything at right angles. If you're not sure, just make it look like this picture. As well, on level ground make sure the tripod legs are fully extended or at least even as far as length.

Note: It is recommended for best viewing to not look through a window when aligning the finderscope or even when viewing things through the telescope. Ideally you should be outside with the telescope. If fogging occurs let the telescope sit outside for approximately 30 minutes to allow it to clear up.

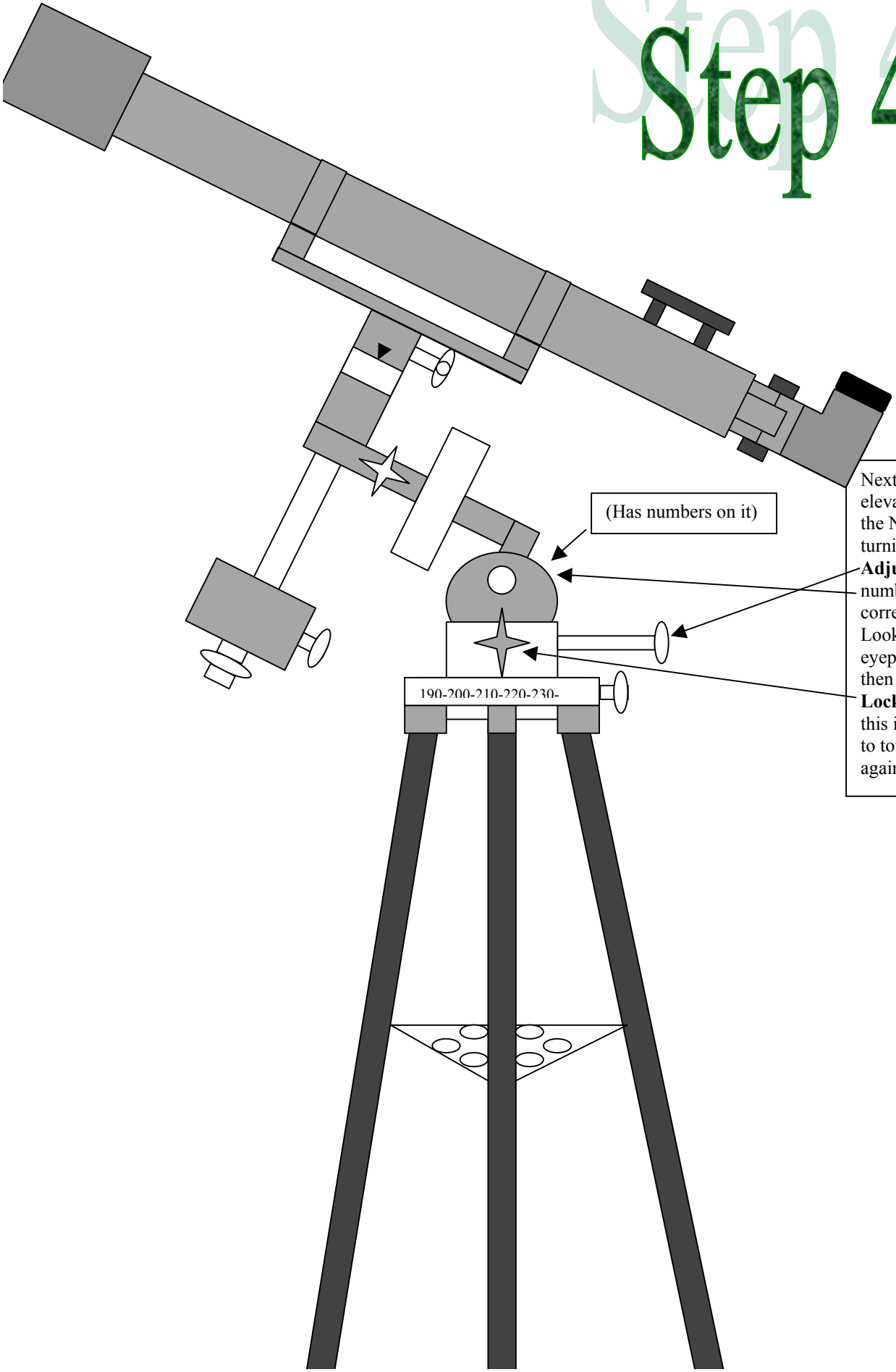
Step 2


898
23
22
21
20
19
18
90-200-210-220-230-
Once again, ignore these numbers.
With everything at 90-degree angles, turn the telescope scope north along its **Horizontal Axis** using a compass as reference to be completely accurate. Once facing north, tighten the **Latitude Lock Knob** and know that you will not have to touch this setting again for the rest of the evening.
N
S

Step 3

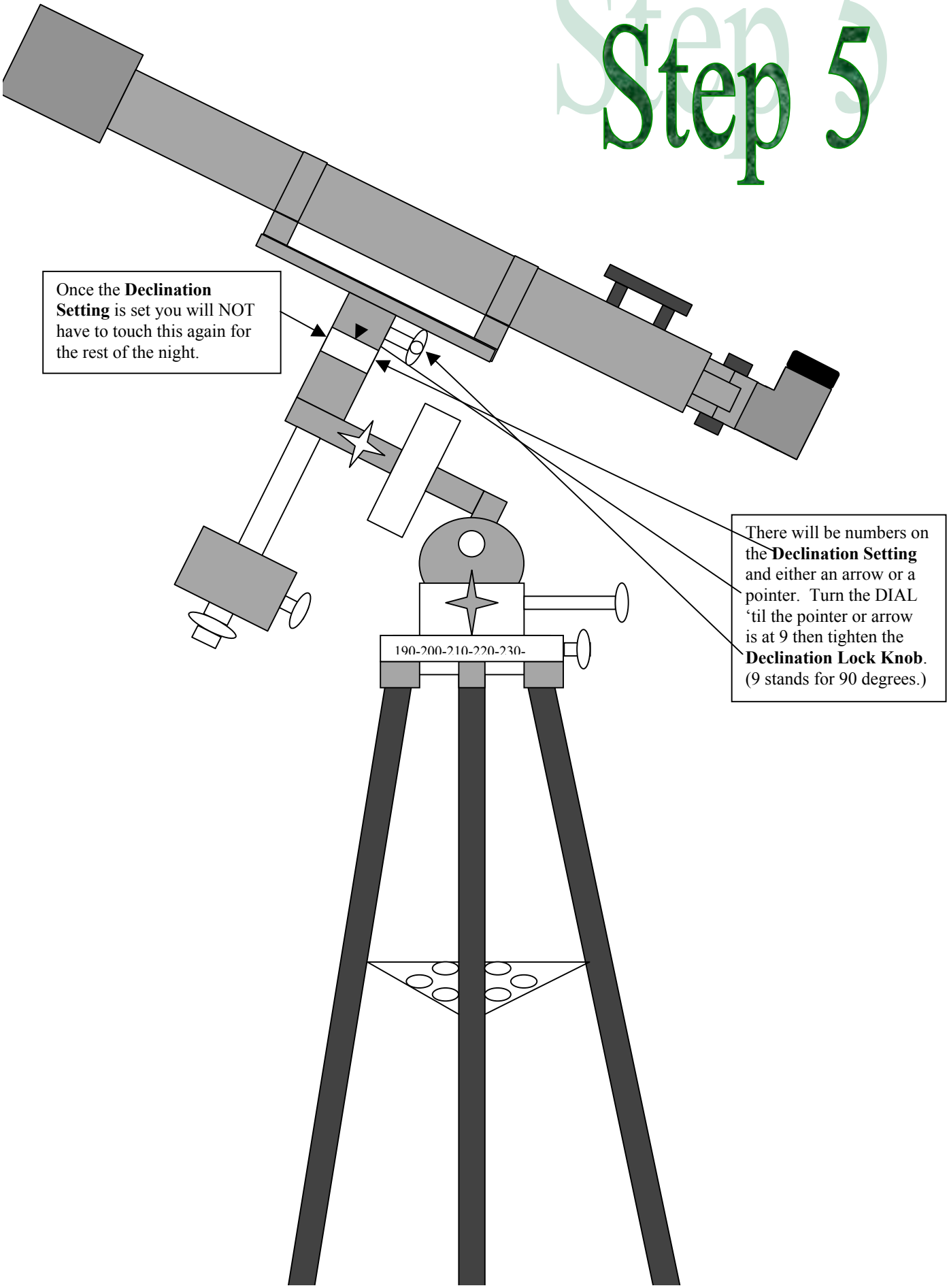

23
22
21
20
19
18
Put the Diagonal Mirror or Penta Mirror in and the 20 mm eyepiece into the **Focusing Tube**. If you do not have a 20mm eyepiece, use the highest number eyepiece you do have. The eyepiece looks like this.
(It will say 20mm on the top of the eyepiece.)

Step 4

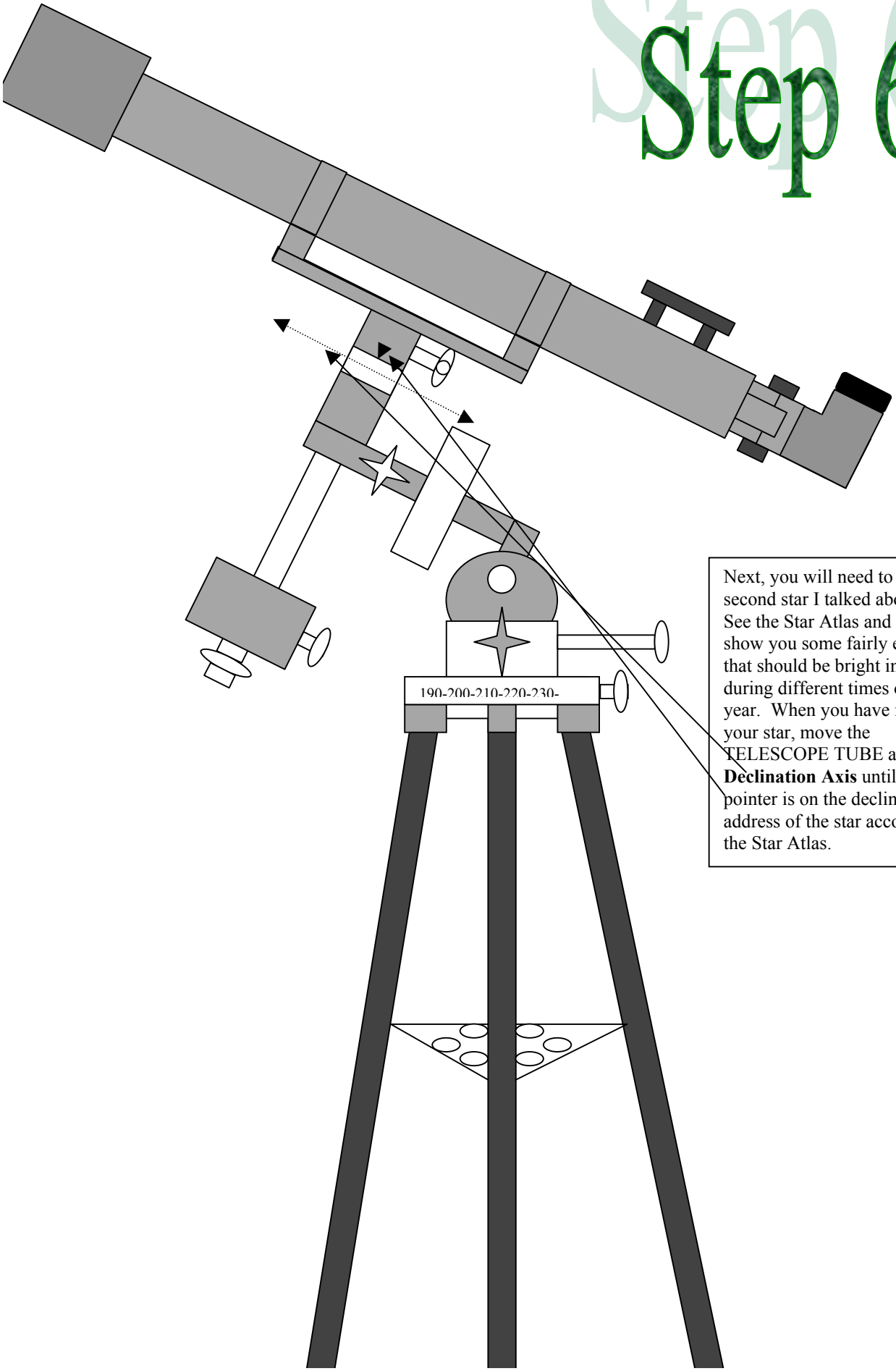


Next, you will need to elevate the telescope up to the North Star. Do this by turning the **Latitude Adjustment Knob** to the number on the Star Atlas that corresponds to your location. Looking through the eyepiece, find the North Star then tighten the **Latitude Lock Knob**. Note: when this is done you will not have to touch either of these knobs again for the rest of the night.

Step 5

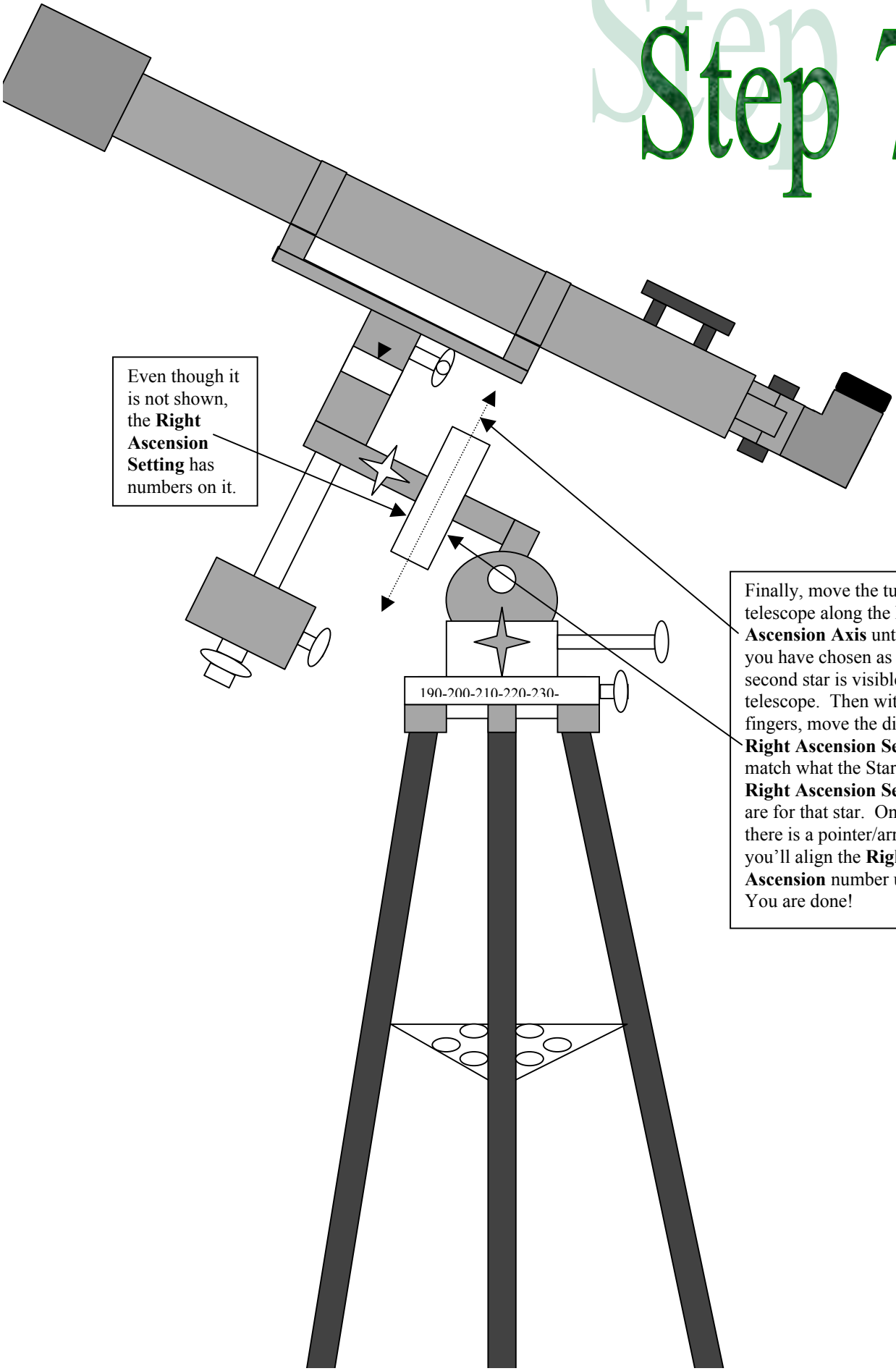

Once the **Declination Setting** is set you will NOT have to touch this again for the rest of the night.
There will be numbers on the **Declination Setting** and either an arrow or a pointer. Turn the DIAL 'til the pointer or arrow is at 9 then tighten the **Declination Lock Knob**. (9 stands for 90 degrees.)
190-200-210-220-230-

Step 6



Next, you will need to find the second star I talked about earlier. See the Star Atlas and it will show you some fairly easy stars that should be bright in the sky during different times of the year. When you have identified your star, move the TELESCOPE TUBE along the **Declination Axis** until the pointer is on the declination address of the star according to the Star Atlas.

Step 7



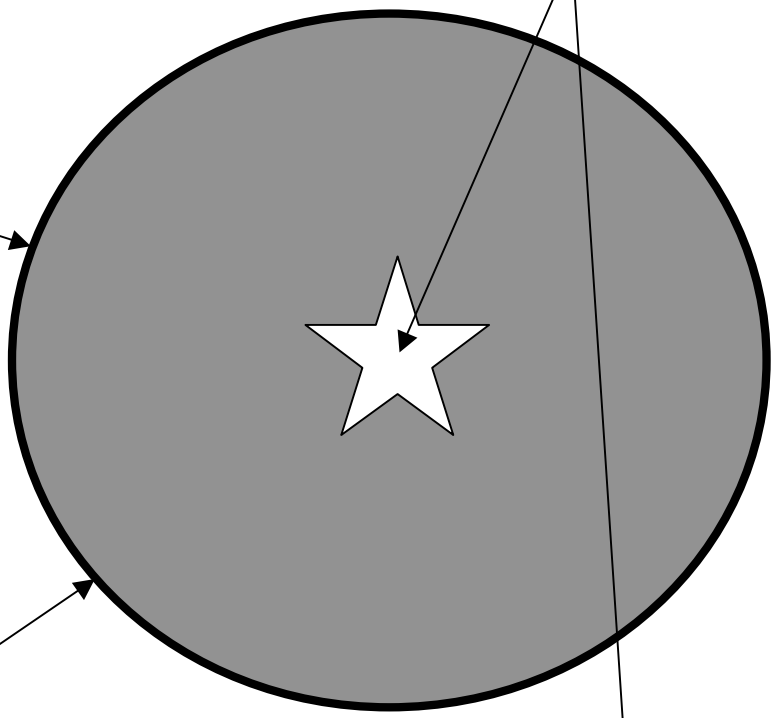
Even though it is not shown, the **Right Ascension Setting** has numbers on it.

Finally, move the tube of the telescope along the **Right Ascension Axis** until the star you have chosen as your second star is visible in the telescope. Then with your fingers, move the dial on the **Right Ascension Setting** to match what the Star Atlas's **Right Ascension Settings** are for that star. Once again, there is a pointer/arrow that you'll align the **Right Ascension** number up with. You are done!

Finally,

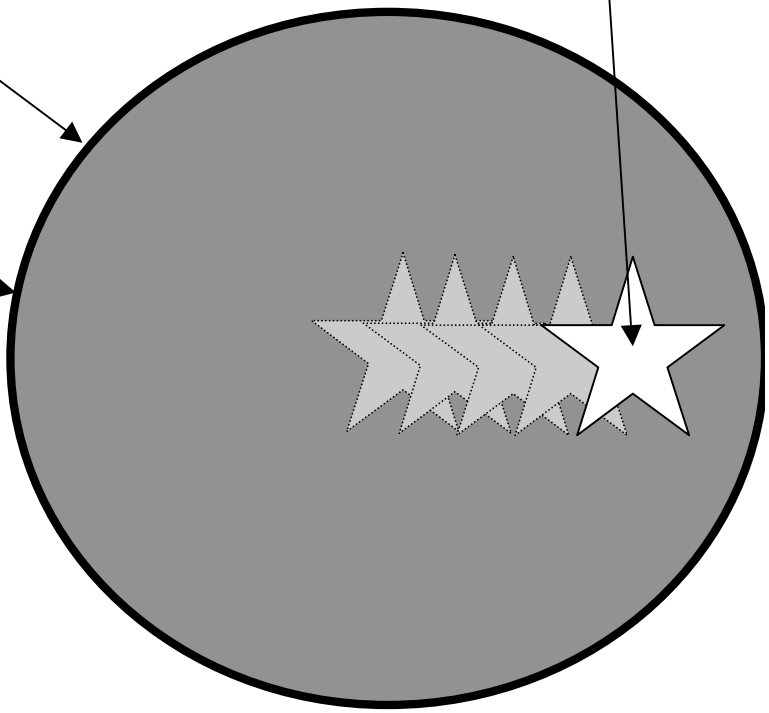
This is the 2nd star that you are aligning your telescope to. It is the same star as in **Step 7**.

When you have centered the 2nd star, it should look something like this.



(Simulated views through your telescope)

As the earth rotates, the star will appear to move like this.



Therefore, every few minutes while you are surfing the sky with your telescope you will need to repeat Step 7.