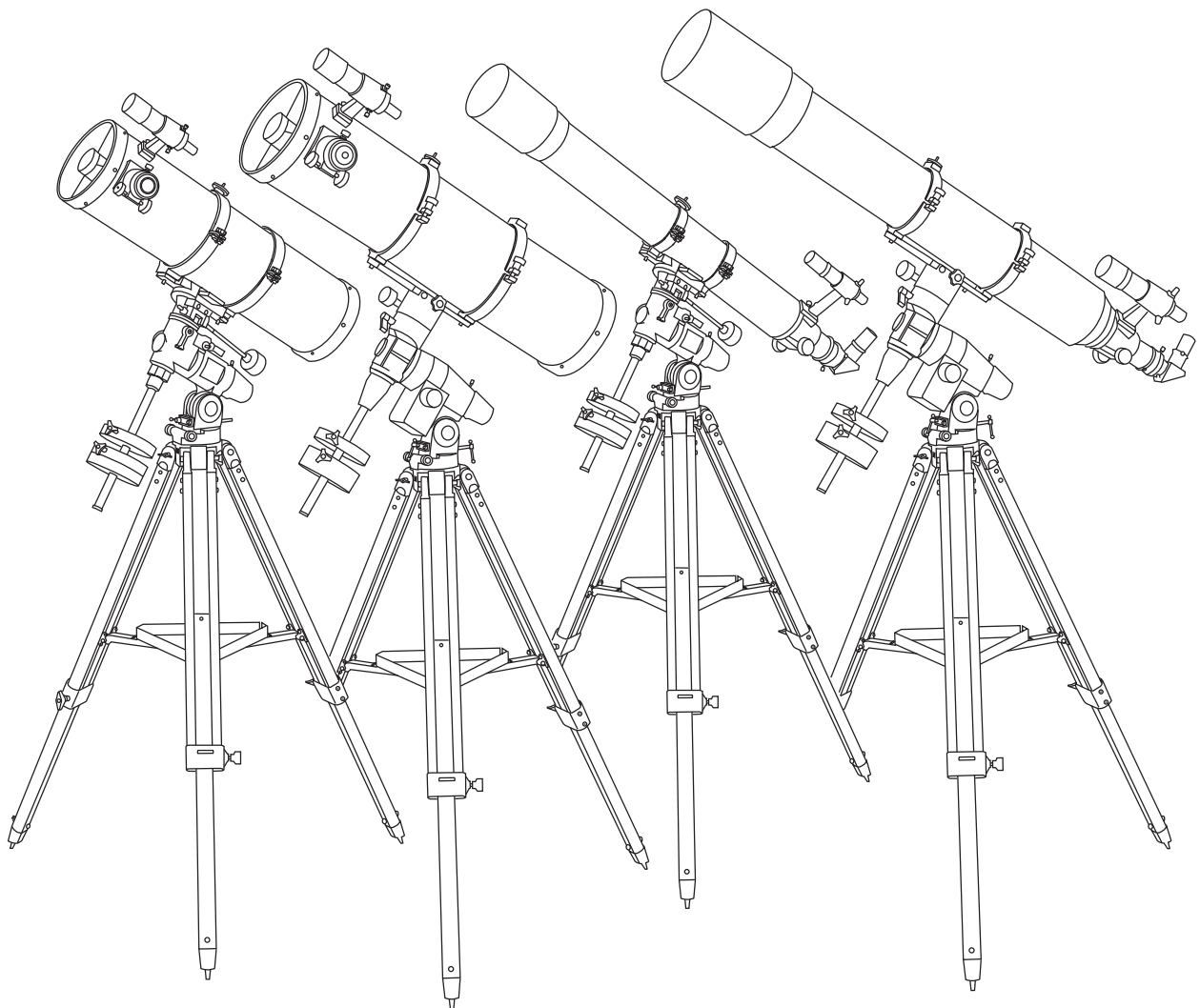


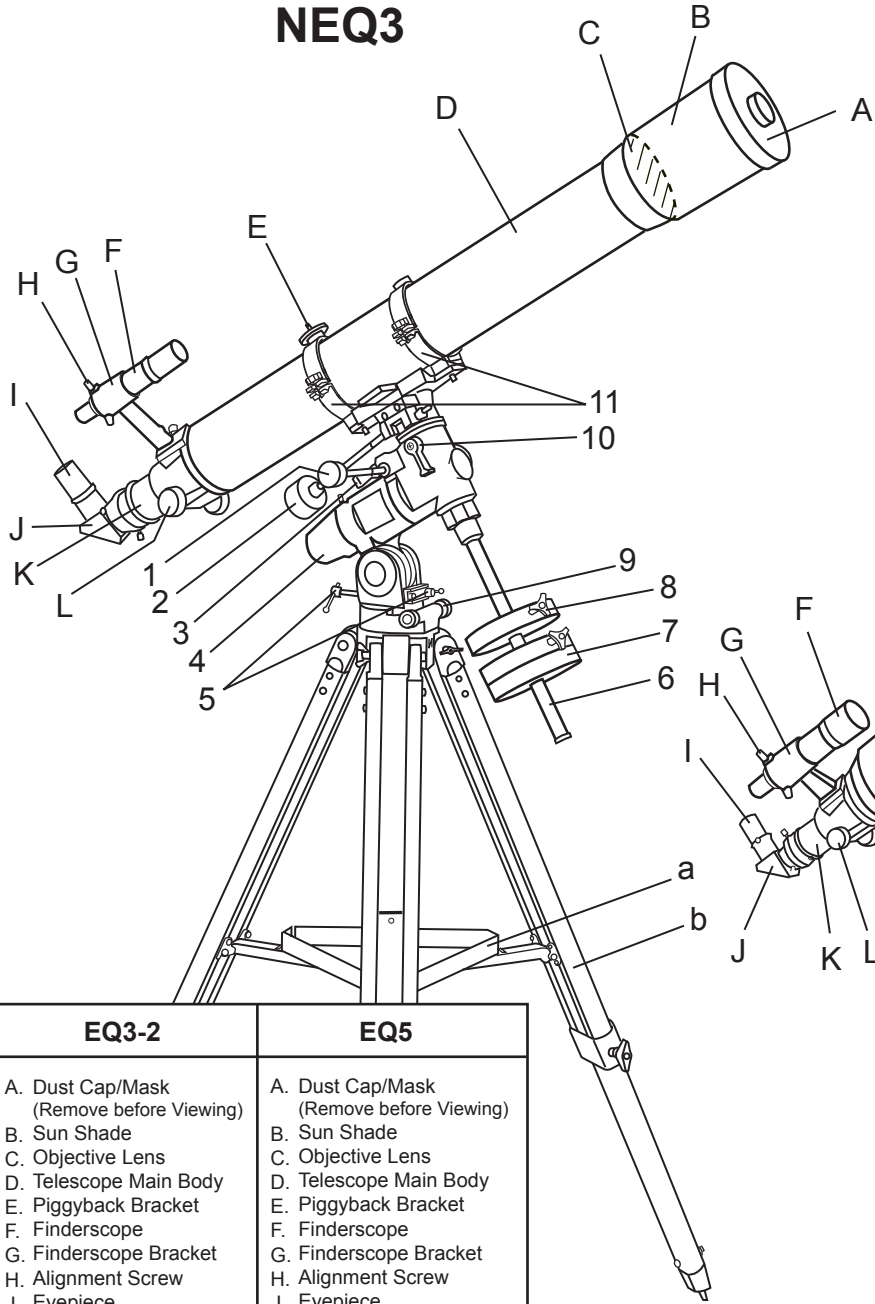
# INSTRUCTION MANUAL

## Telescopes with NEQ3 & EQ5 Mount

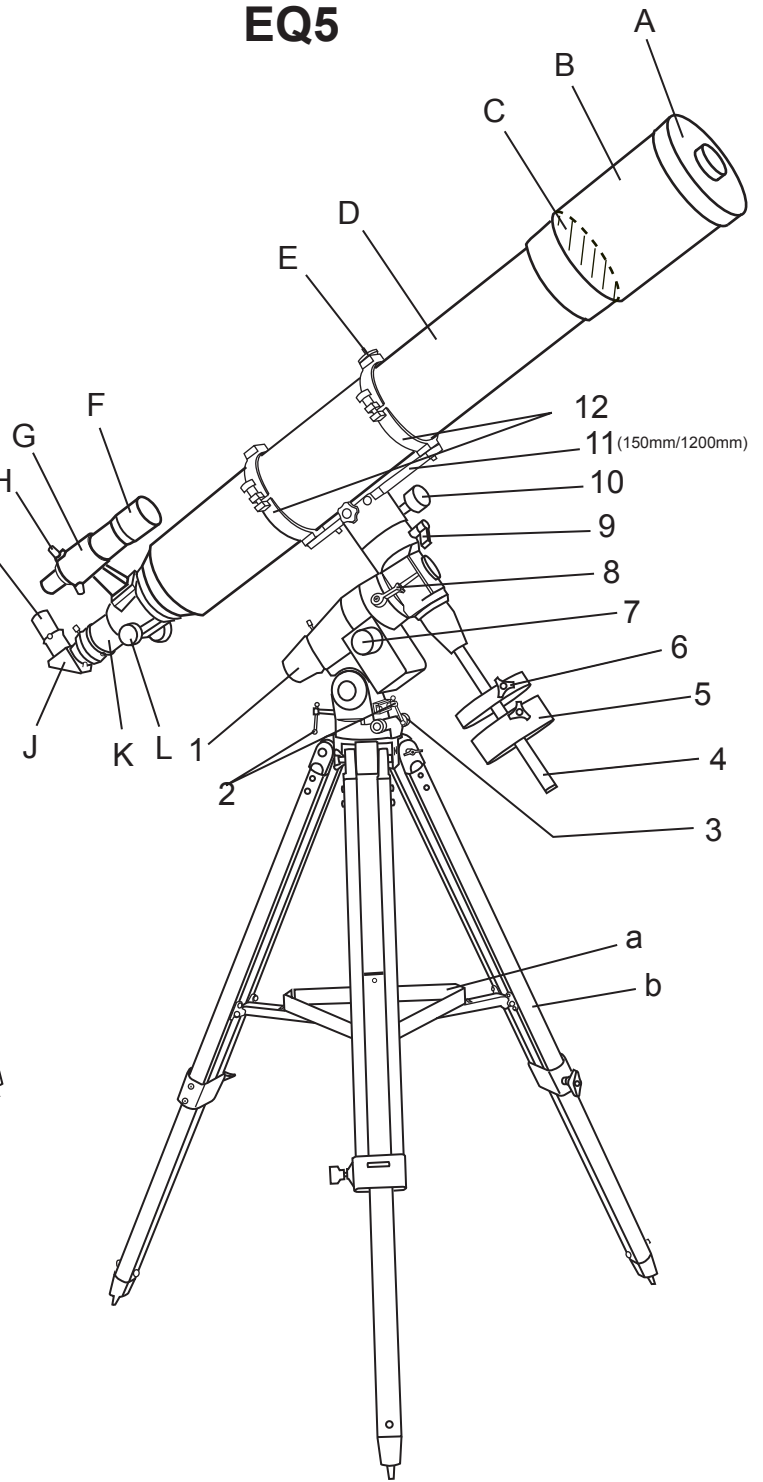


# REFRACTOR

## NEQ3



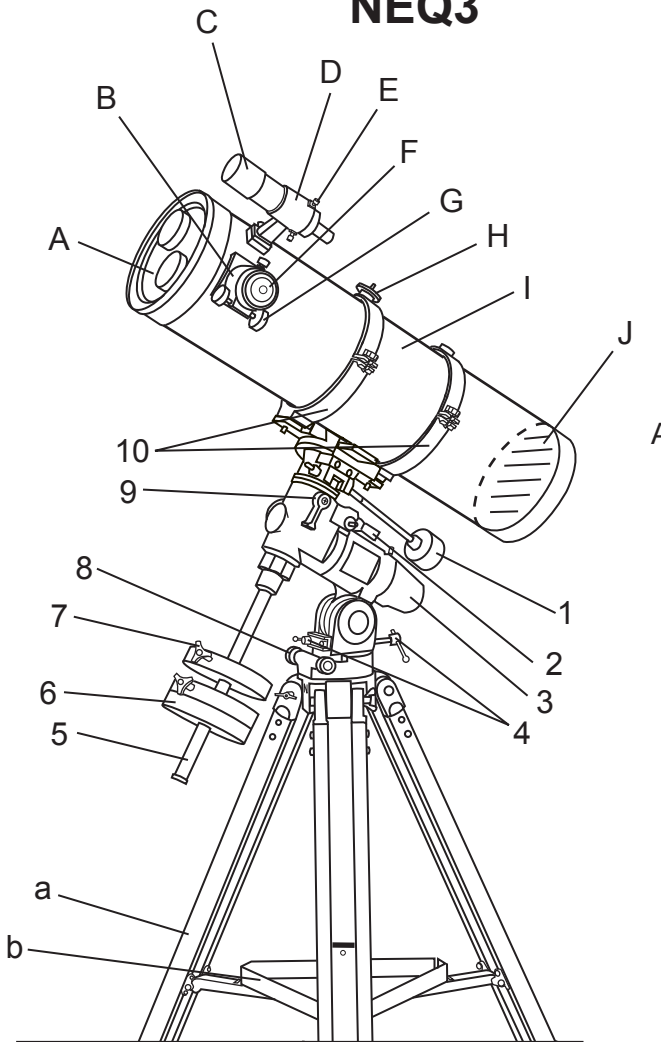
## EQ5



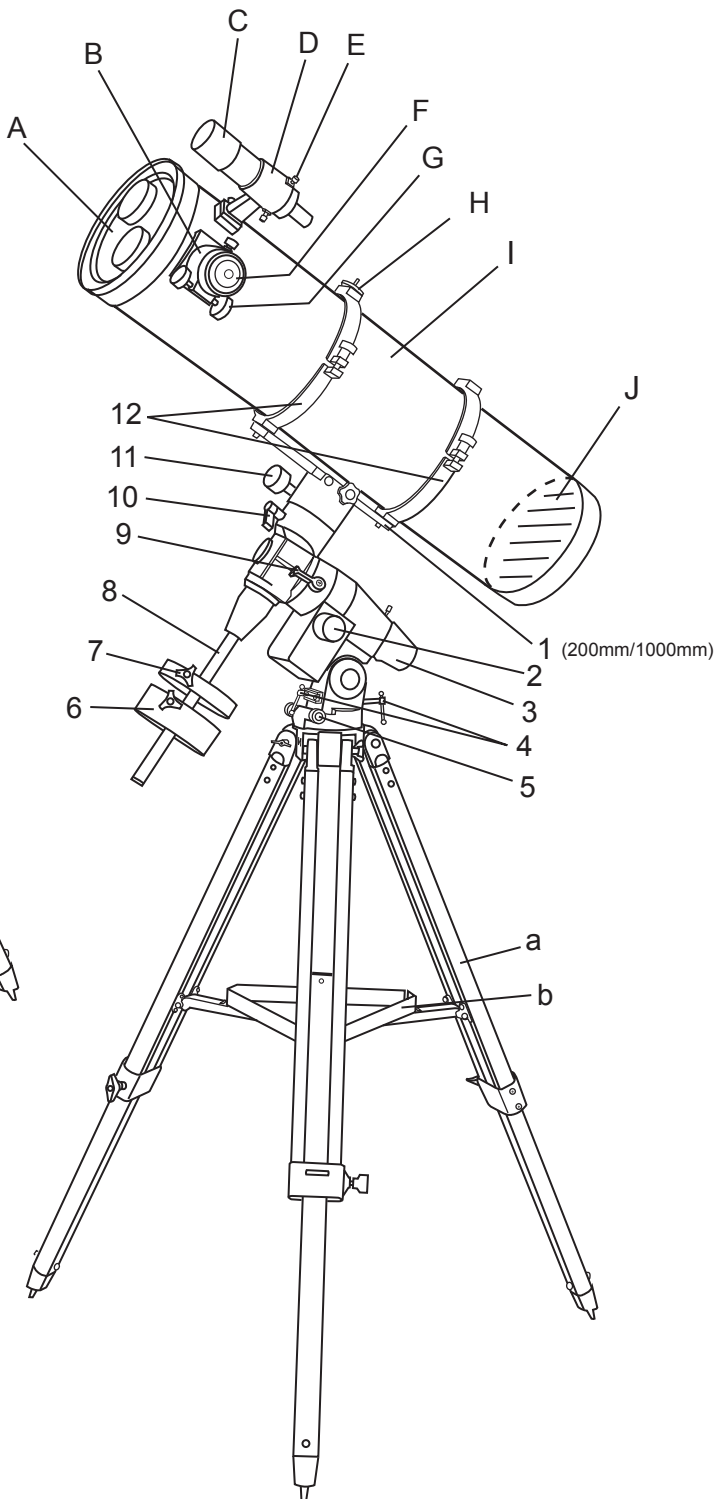
EQ3-2	EQ5
A. Dust Cap/Mask (Remove before Viewing)	A. Dust Cap/Mask (Remove before Viewing)
B. Sun Shade	B. Sun Shade
C. Objective Lens	C. Objective Lens
D. Telescope Main Body	D. Telescope Main Body
E. Piggyback Bracket	E. Piggyback Bracket
F. Finderscope	F. Finderscope
G. Finderscope Bracket	G. Finderscope Bracket
H. Alignment Screw	H. Alignment Screw
I. Eyepiece	I. Eyepiece
J. Diagonal	J. Diagonal
K. Focus Tube	K. Focus Tube
L. Focus Knob	L. Focus Knob
1. R.A. Flexible Control Cable	1. Polarscope Holder (not shown)
2. Dec. Flexible Control Cable	2. Altitude Adjustment T-bolts
3. R.A. Lock knob	3. Azimuth Adjustment Knob
4. Polarscope Holder (not shown)	4. Counterweight Rod
5. Altitude Adjustment T-bolts	5. Counterweight
6. Counterweight Rod	6. Counterweight Thumb Screw
7. Counterweight	7. R.A. Control Knob
8. Counterweight Thumb Screw	8. R.A. Lock Knob
9. Azimuth Adjustment Knob	9. Dec. Lock Knob
10. Dec. Lock Knob	10. Dec. Control Knob
11. Tube Rings	11. Mounting Plate (150mm/1200mm)
a. Accessory Tray	12. Tube Rings
b. Tripod Leg	a. Accessory Tray
	b. Tripod Leg

# REFLECTOR

## NEQ3



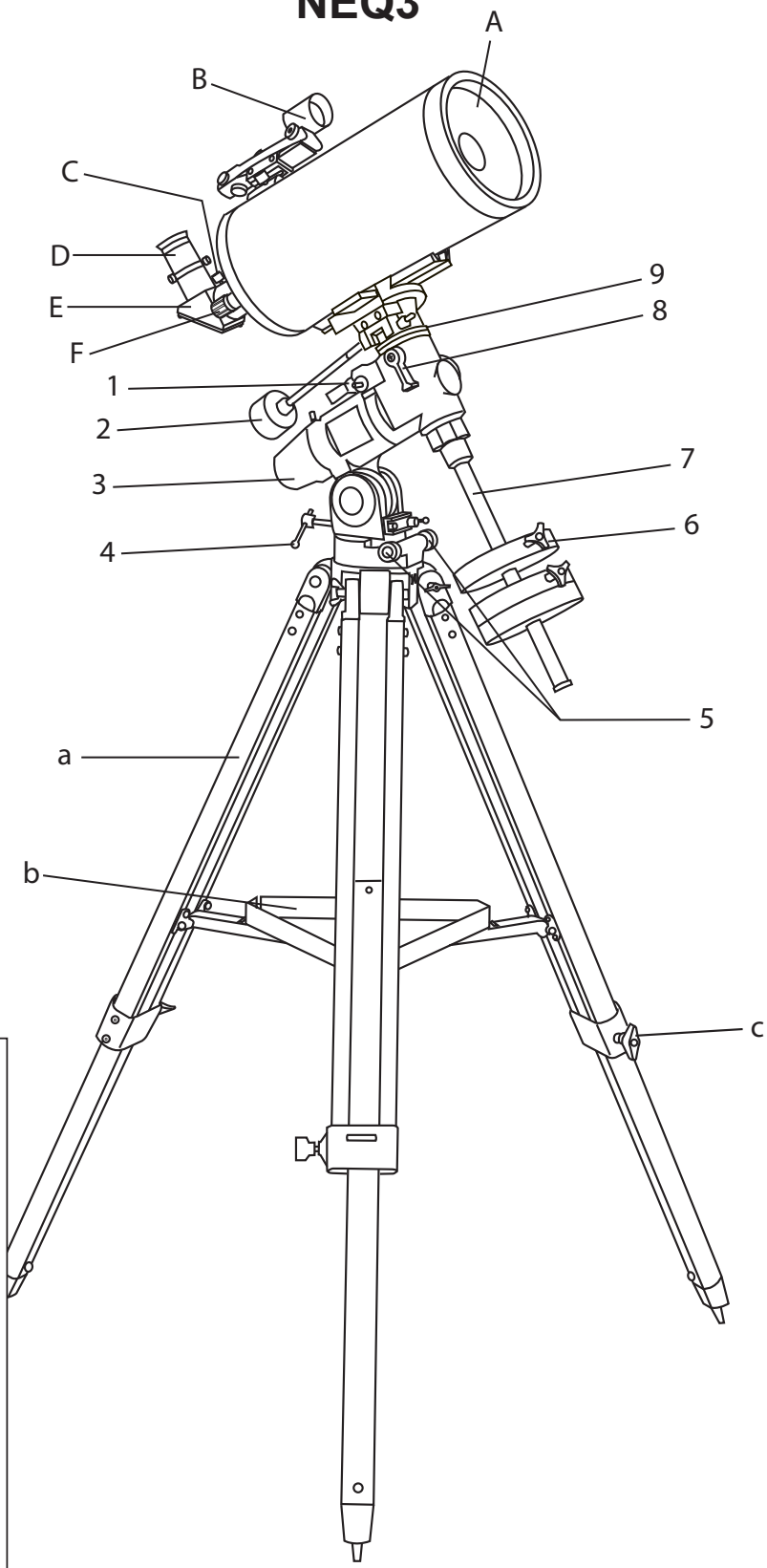
## EQ5



EQ3-2	EQ5
A. Dust Cap/Mask (Remove before Viewing)	A. Dust Cap/Mask (Remove before Viewing)
B. Focus Tube	B. Focus Tube
C. Finderscope	C. Finderscope
D. Finderscope Bracket	D. Finderscope Bracket
E. Finderscope Adjustment Screws	E. Finderscope Adjustment Screws
F. Eyepiece	F. Eyepiece
G. Focus Knob	G. Focus Knob
H. Piggyback Bracket	H. Piggyback Bracket
I. Telescope Main Body	I. Telescope Main Body
J. Primary Mirror Position	J. Primary Mirror Position
1. Dec. Flexible Control Cable	1. Mounting Plate (200mm/1000mm)
2. R.A. Lock Knob	2. R.A. Control Knob
3. Polarscope Holder (not shown)	3. Polarscope Holder (not shown)
4. Altitude Adjustment T-bolts	4. Altitude Adjustment T-bolts
5. Counterweight Rod	5. Azimuth Adjustment Knob
6. Counterweight	6. Counterweight
7. Counterweight Thumb Screw	7. Counterweight Thumb Screw
8. Azimuth Adjustment Knob	8. Counterweight Rod
9. Dec. Lock Knob	9. R.A. Lock Knob
10. Tube Rings	10. Dec. Lock Knob
a. Tripod Leg	11. Dec. Control Knob
b. Accessory Tray	12. Tube Rings
	a. Tripod Leg
	b. Accessory Tray

# MAKSUTOV

## NEQ3



- A. Dust Cap (not shown, remove before Viewing)
- B. Red Dot Finder
- C. Focus Locking Screw
- D. Eyepiece
- E. Diagonal
- F. Focusing Knob
  
- 1. R.A Lock Knob
- 2. Dec Flexible Control Cable
- 3. Polarscope Holder/ Polarscope (not shown, optional)
- 4. Altitude Adjustment T-bolt
- 5. Azimuth Adjustment Knobs
- 6. Counterweight Locking Thumb Screw
- 7. Counterweight Rod
- 8. Dec Lock Knob
- 9. Dec Setting Circle
  
- a. Tripod Leg
- b. Accessory Tray
- c. Height Adjustment Clamp

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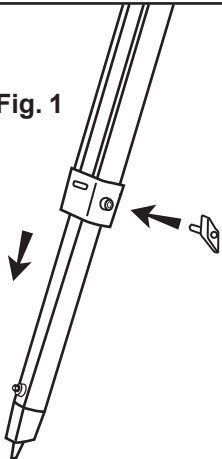
## Before you begin

This instruction manual is applicable to all the models with the EQ3-2 or EQ5 mount. Take a moment to find the model closest to your telescope on p.2 p.3, and p4. Follow the instructions for your specific model in the manual. Read the entire instructions carefully before beginning. Your telescope should be assembled during daylight hours. Choose a large, open area to work to allow room for all parts to be unpacked.

# FOR NEQ3 MOUNT

## TRIPOD SET UP

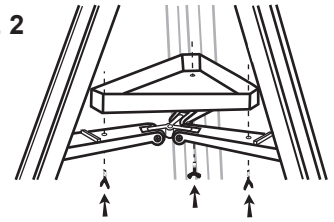
Fig. 1



### ADJUSTING THE TRIPOD LEGS (Fig.18)

- 1) Slowly loosen the height adjustment clamp and gently pull out the lower section of each tripod leg. Tighten the clamps to hold the legs in place.
- 2) Spread the legs apart to stand the tripod upright.
- 3) Adjust the height of each tripod leg until the tripod head is properly leveled. Note that the tripod legs may not be at same length when the equatorial mount is level. Do not over tighten the clamps.

Fig. 2



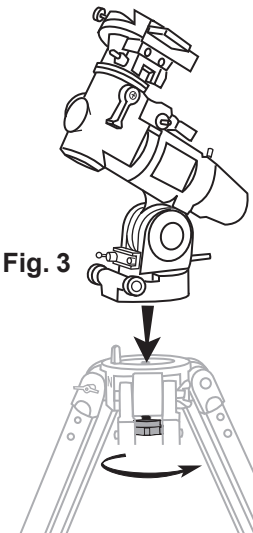
### ATTACHING THE ACCESSORY TRAY (Fig.2)

- 1) Place the accessory tray on top of the bracket, and secure with the locking thumb screws from underneath.

### ATTACHING THE MOUNT TO THE TRIPOD (Fig.3)

- 1) Align metal dowel on the tripod head with the gap between the azimuthal adjustment knobs underneath the mount. Tighten the knurled knob underneath the tripod head to secure mount to tripod.

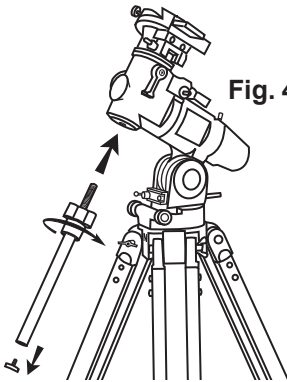
Fig. 3



Note: Loosen the azimuthal adjustment knobs if mount does not fit into tripod head completely. Retighten knobs to secure.

## TELESCOPE ASSEMBLY

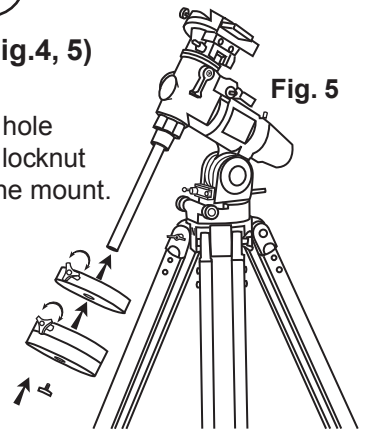
Fig. 4



### INSTALLING THE COUNTERWEIGHT(S) (Fig.4, 5)

- 1) Locate the counterweight rod.
- 2) Screw the counterweight rod into the threaded hole on the end of the declination shaft. Tighten the locknut on counterweight rod until it is locked against the mount.
- 3) Unscrew the threaded cap from the end of the counterweight rod.
- 4) Locate the counterweight(s) and slide them halfway along the counterweight rod. Tighten the counterweight thumbscrews to secure.
- 5) Replace the cap on the end of the counterweight rod.

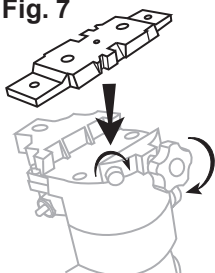
Fig. 5



### INSTALLING THE CONTROL CABLES (Fig.6)

- 1) Slide the sleeve end of the cable over the nipple on the end of the worm gear. Secure the cable by tightening the set screw against the flat surface of the nipple.

Fig. 7



### (short mounting plate) ATTACHING THE MOUNTING PLATE (Fig.7)

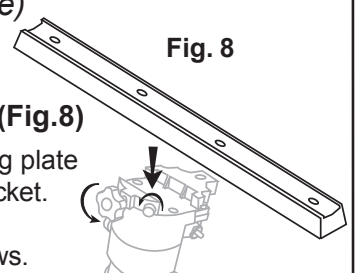
- 1) Align the screws with the grooves on the side of the mounting bar. Position the mounting plate on the mounting bracket.
- 2) Secure by tightening the two locking screws.

### (long mounting plate)

### ATTACHING THE MOUNTING PLATE (Fig.8)

- 1) Position the mounting plate on the mounting bracket.
- 2) Secure by tightening the two locking screws.

Fig. 8

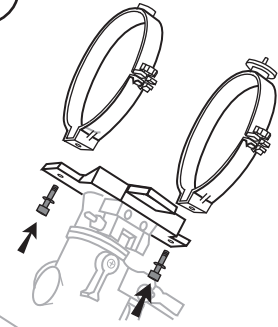


## TELESCOPE ASSEMBLY

### ATTACHING THE TUBE RINGS TO THE MOUNT (Fig.9)

- 1) Remove the telescope tube assembly from its plastic packaging.
- 2) Remove the tube rings from the telescope by releasing their thumb nuts and opening their hinges.
- 3) Using the bolts provided, fasten the tube rings to the mount with the 10mm wrench provided.

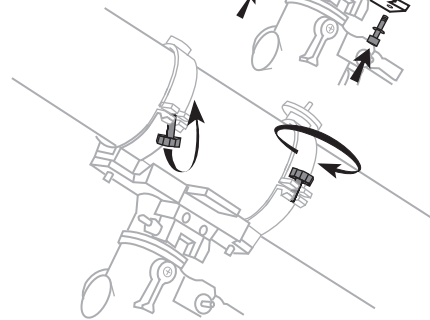
Fig.9



### ATTACHING THE TELESCOPE MAIN TUBE TO THE TUBE RINGS (Fig.10)

- 1) Remove the telescope tube from the paper covering.
- 2) Find the center of balance of the telescope tube. Place this in between the two tube rings. Close the hinges around the telescope and fasten securely by tightening the thumb nuts. Do not over tighten.

Fig.10



## FINDERSCOPE/RED DOT FINDER ASSEMBLY

(reflector and Maksutov)

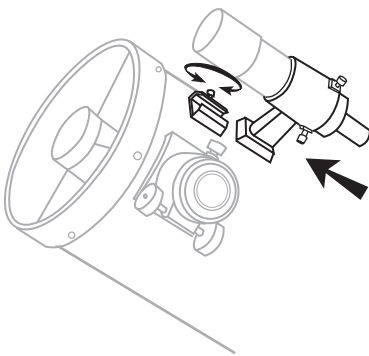


Fig.11

### ATTACHING THE FINDERSCOPE BRACKET/RED DOT FINDER (Fig.11)

- 1) Locate the finderscope optical assembly or Red Dot Finder.
- 2) Slide the finderscope bracket/Red Dot Finder into the rectangular slot and tighten the screw to hold the mount in place.

(refractor)

Fig.12



### ATTACHING THE FINDERSCOPE (Fig.12, 13, 14)

Fig.13

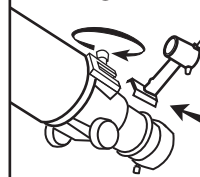
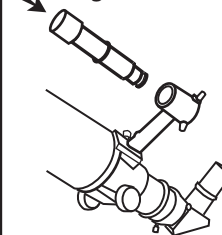


Fig.14



- 1) Locate the finderscope bracket. Carefully remove the rubber-o-ring from the finderscope bracket.
- 2) Position the o-ring into the groove located approximately half-way along the finderscope tube.
- 3) Locate the finderscope optical assembly.
- 4) Slide the finderscope bracket into the rectangular slot and tighten the screw to hold the mount in place.
- 5) Position the finderscope into its mount by sliding it backwards until the rubber o-ring seats in the finderscope mount.

## EYEPIECE ASSEMBLY

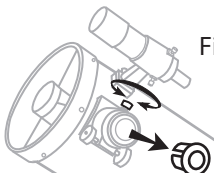


Fig.15

(reflector)

### INSERTING THE EYEPIECE (Fig.15, 16)

- 1) Unscrew the thumbscrews on the end of the focus tube to remove the black plastic end-cap.
- 2) Insert the desired eyepiece and secure it by retightening the thumbscrews.

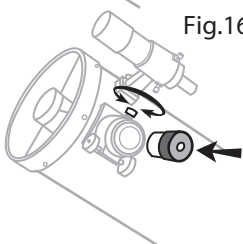


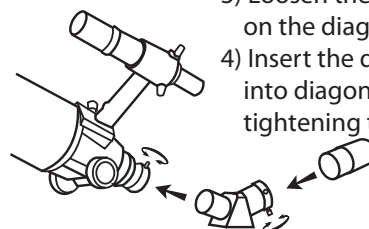
Fig.16

(refractor and Maksutov)

### INSERTING THE EYEPIECE (Fig.17)

- 1) Loosen the thumbscrew on the end of the focus tube.
- 2) Insert the diagonal into the focus tube and re-tighten the thumbscrew to hold the diagonal in place.
- 3) Loosen the thumbscrews on the diagonal.
- 4) Insert the desired eyepiece into diagonal and secure by re-tightening the thumbscrews.

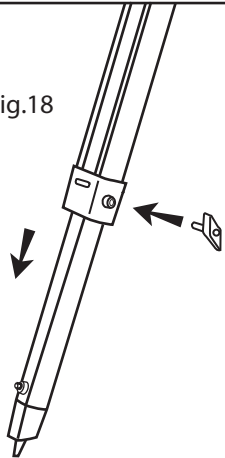
Fig.17



# FOR EQ5 MOUNT

## TRIPOD SET UP

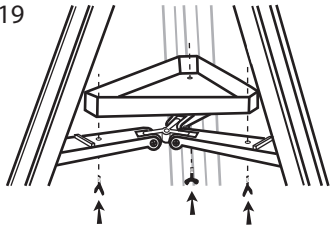
Fig.18



### ADJUSTING THE TRIPOD LEGS (Fig.18)

- 1) Slowly loosen the height adjustment clamp and gently pull out the lower section of each tripod leg. Tighten the clamps to hold the legs in place.
- 2) Spread the legs apart to stand the tripod upright.
- 3) Adjust the height of each tripod leg until the tripod head is properly leveled. Note that the tripod legs may not be at same length when the equatorial mount is level. Do not over tighten the clamps.

Fig.19



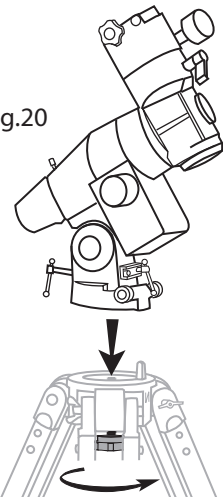
### ATTACHING THE ACCESSORY TRAY (Fig.19)

- 1) Place the accessory tray on top of the bracket, and secure with the locking thumb screws from underneath.

### ATTACHING MOUNT TO TRIPOD (Fig.20)

- 1) Align metal dowel on the tripod head with the gap between the azimuthal adjustment knobs underneath the mount. Tighten the knurled knob underneath the tripod head to secure mount to tripod.

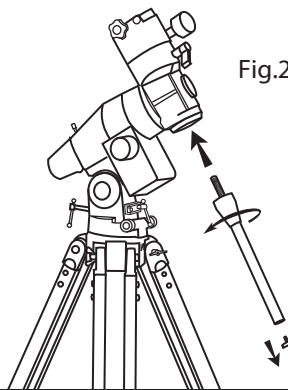
Fig.20



Note: Loosen the azimuthal adjustment knobs if mount does not fit into tripod head completely. Retighten knobs to secure.

## TELESCOPE ASSEMBLY

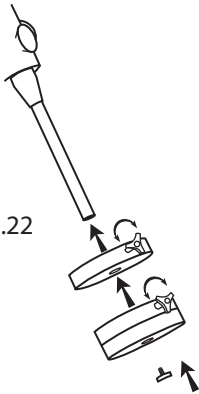
Fig.21



### INSTALLING COUNTERWEIGHT (Fig.21, 22)

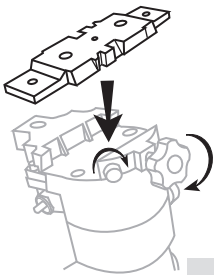
- 1) Locate counterweight rod.
- 2) Screw counterweight rod into threaded hole on the end of the declination shaft. Tighten locknut on the counterweight rod until it is locked against the mount.
- 3) Unscrew the threaded cap from the end of the counterweight rod.
- 4) Locate the counterweights and slide them halfway along the counterweight rod. Tighten the counterweight thumb screws to secure.
- 5) Replace the cap on the end of the counterweight rod.

Fig.22



(short mounting plate)

Fig.23



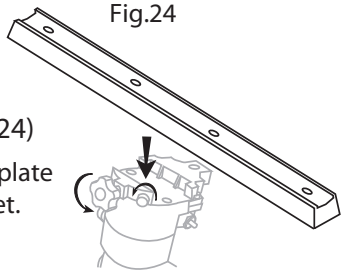
### ATTACHING THE MOUNTING PLATE (Fig.23)

- 1) Position the mounting plate on the mounting bracket.
- 2) Secure by tightening the two locking screws.

Note: The screws should align with the grooves in the side of the mounting bar.

(long mounting plate)

Fig.24



### ATTACHING THE MOUNTING PLATE (Fig.24)

- 1) Position the mounting plate on the mounting bracket.
- 2) Secure by tightening the two locking screws.



## TELESCOPE ASSEMBLY

### ATTACHING THE TUBE RINGS TO THE MOUNT (Fig.25)

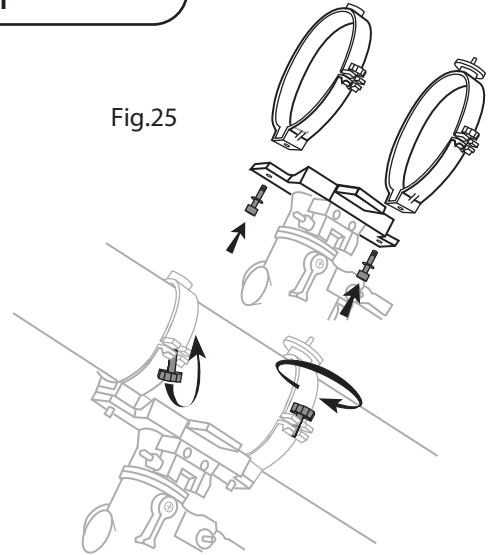
- 1) Remove the telescope tube assembly from its plastic packaging.
- 2) Remove the tube rings from the telescope by releasing their thumb nuts and opening their hinges.
- 3) Using the bolts provided, fasten the tube rings to the mount with the 10mm wrench provided.

Fig.25

### ATTACHING THE TELESCOPE MAIN TUBE TO THE TUBE RINGS (Fig.26)

- 1) Remove the telescope tube from the paper covering.
- 2) Find the center of balance of the telescope tube. Place this in between the two tube rings. Close the hinges around the telescope and fasten securely by tightening the thumb nuts.

Fig.26



## FINDERSCOPE ASSEMBLY

(reflector)

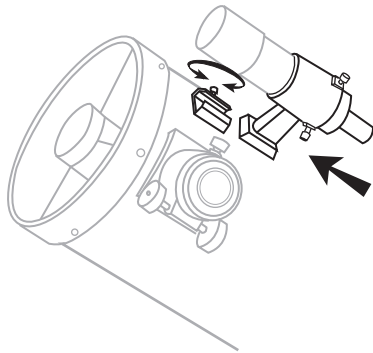


Fig.27

### ATTACHING THE FINDERSCOPE BRACKET (Fig.27)

- 1) Locate the finderscope optical assembly.
- 2) Slide the finderscope bracket into the rectangular slot and tighten the screw to hold the mount in place.

(refractor)

Fig.28



Fig.29

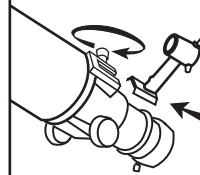
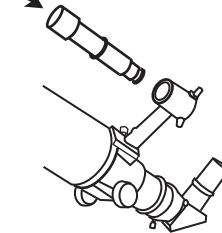


Fig.30



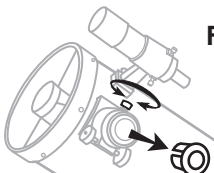
### ATTACHING THE FINDERSCOPE (Fig.28, 29, 30)

- 1) Locate the finderscope bracket. Carefully remove the rubber-o-ring from the finderscope bracket.
- 2) Position the o-ring into the groove located approximately half-way along the finderscope tube.
- 3) Locate the finderscope optical assembly.
- 4) Slide the finderscope bracket into the rectangular slot and tighten the screw to hold the mount in place.
- 5) Position the finderscope into its mount by sliding it backwards until the rubber o-ring seats in the finderscope mount.

## EYEPIECE ASSEMBLY

Fig.31

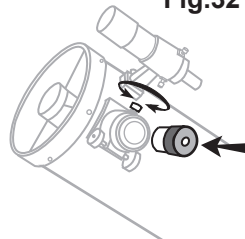
(reflector)



### INSERTING THE EYEPIECE (Fig.31, 32)

- 1) Unscrew the thumbscrews on the end of the focus tube to remove the black plastic end-cap.
- 2) Re-tighten thumb screws to hold the eyepiece in place.

Fig.32

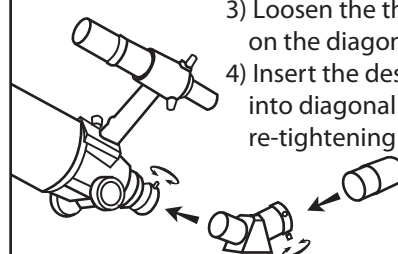


(refractor)

### INSERTING THE EYEPIECE (Fig.33)

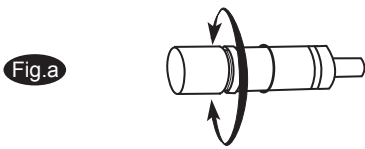
- 1) Loosen the thumbscrew on the end of the focus tube.
- 2) Insert the diagonal into the focus tube and re-tighten thumbscrew to hold the diagonal in place.
- 3) Loosen the thumbscrews on the diagonal.
- 4) Insert the desired eyepiece into diagonal and secure by re-tightening the thumbscrews.

Fig.33

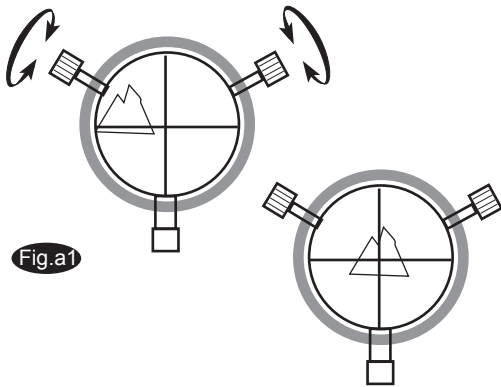


# OPERATING YOUR TELESCOPE

## Aligning the finderscope



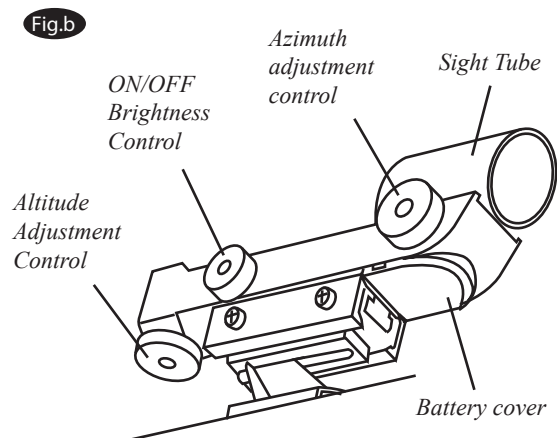
The finderscope (optical or red dot) is a very useful accessory that is included with your telescope. When the finderscope is correctly aligned with the telescope, objects can be quickly located and brought to the centre of the field. Alignment is best done outdoors in day light when it's easier to locate objects. If it is necessary to refocus your finderscope, sight on an object that is at least 500 yards (metres) away. Loosen the locking ring by unscrewing it back towards the bracket. The front lens holder can now be turned in and out to focus. When focus is reached, lock it in position with the locking ring (Fig.a).



- 1) Choose a distant object that is at least 500 yards away and point the main telescope at the object. Adjust the telescope so that the object is in the centre of the view in your eyepiece.
- 2) Check the finderscope to see if the object centred in the main telescope view is centred on the crosshairs.
- 3) Adjust the two small screws to centre the finderscope crosshairs on the object (Fig.a1).

## Using the Red Dot Finderscope

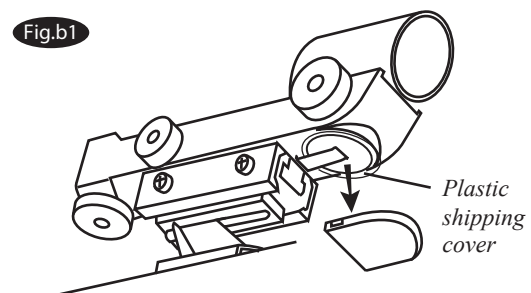
The Red Dot Finder is a zero magnification pointing tool that uses a coated glass window to superimpose the image of a small red dot onto the night sky. The Red Dot Finder is equipped with a variable brightness control, azimuth adjustment control, and altitude adjustment control (Fig.b). The Red Dot Finder is powered by a 3-volt lithium battery located underneath at the front. To use the Finder, simply look through the sight tube and move your telescope until the red dot merges with the object. Make sure to keep both eyes open when sighting.



### Aligning the Red Dot Finder

Like all finderscopes, the Red Dot Finder must be properly aligned with the main telescope before use. This is a simple process using the azimuth and altitude control knobs.

- 1) Open the battery cover by pulling it down (you can gently pry at the 2 small slots) and remove the plastic shipping cover over the battery (Fig.b1).
- 2) Turn on the Red Dot Finder by rotating the variable brightness control clockwise until you hear a "click". Continue rotating the control knob to increase the brightness level.
- 3) Insert a low power eyepiece into the telescope's focuser. Locate a bright object and position the telescope so that the object is in the centre of the field of view.
- 4) With both eyes open, look through the sight tube at the object. If the red dot overlaps the object, your Red Dot Finder is perfectly aligned. If not, turn its azimuth and altitude adjustment controls until the red dot is merged with the object.



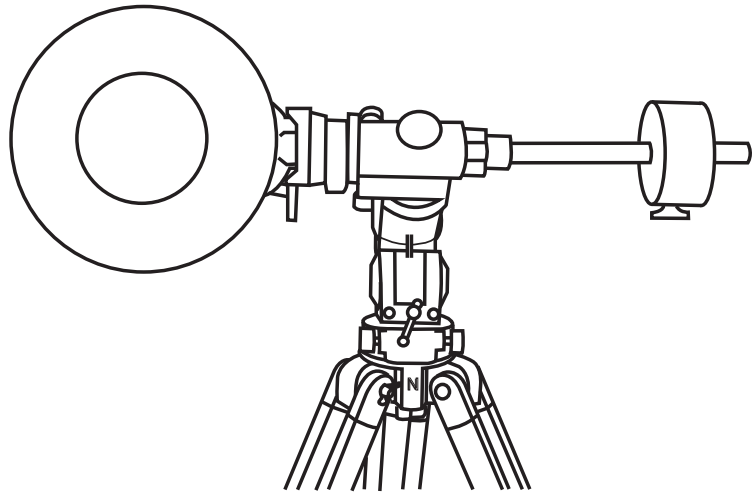
## Balancing the telescope

A Telescope should be balanced before each observing session. Balancing reduces stress on the telescope mount and allows precise control of micro-adjustment. A balanced telescope is specially critical when using the optional clock drive for astrophotography. The telescope should be balanced after all accessories (eyepiece, camera, etc.) have been attached. Before balancing your telescope, make sure that your tripod is balanced and on a stable surface. For photography, point the telescope in the direction you will be taking photos before performing the balancing steps.

### R.A. Balancing

- 1) For best results, adjust the altitude of the mount to between  $15^\circ$  and  $30^\circ$  if possible, by using the altitude adjustment T-bolt.
- 2) Slowly unlock the R.A. and Dec. lock knobs. Rotate the telescope until both the optical tube and the counterweight rod are horizontal to the ground, and the telescope tube is to the side of the mount (Fig.c).
- 3) Tighten the Dec. lock knob.
- 4) Move the counterweight(s) along the counterweight rod until the telescope is balanced and remains stationary when released.
- 5) Tighten the counterweight thumb screws to hold counterweight(s) in their new position.

Fig.c



### Dec. Balancing

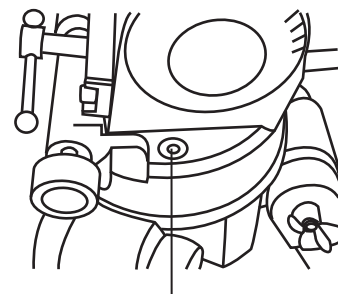
All accessories should be attached to the telescope before balancing around the declination axis. The R.A. balancing should be done before proceeding with Dec. balancing.

- 1) For best results, adjust the altitude of the mount to between  $60^\circ$  and  $75^\circ$  if possible.
- 2) Release the R.A. lock knob and rotate around the R.A. axis so that the counterweight rod is in a horizontal position. Tighten the R.A. lock knob.
- 3) Unlock the Dec. lock knob and rotate the telescope tube until it is parallel to the ground.
- 4) Slowly release the telescope and determine in which direction it rotates. Loosen the telescope tube rings and slide the telescope tube forward or backward in the rings until it is balanced.
- 5) Once the telescope no longer rotates from its parallel starting position, re-tighten the tube rings and the Dec. lock knob. Reset the altitude axis to your local latitude.

## Using the leveling bubble

For best telescope performance, the equatorial mount should be properly leveled. A level tripod allows easier fine adjustment of controls and better weight distribution. This equatorial mount includes a small leveling bubble near its base (Fig.d). Adjust the height of each tripod leg until the bubble appears in the center of the circle. Note that the tripod legs may not be at same length when the equatorial mount is level.

Fig.d

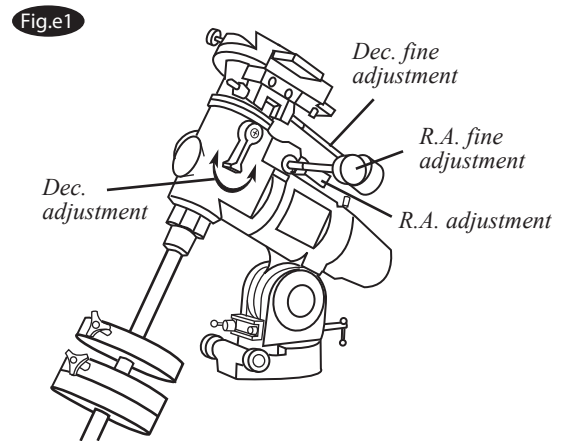
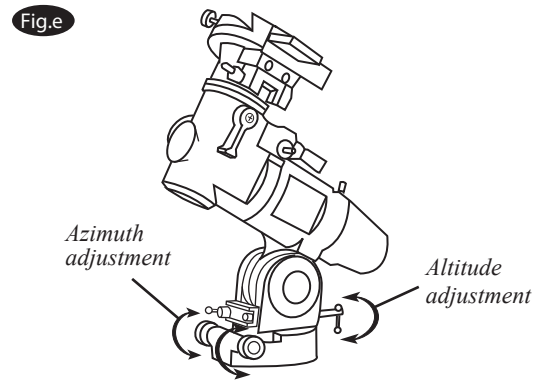
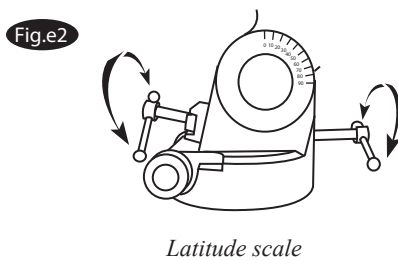


Leveling bubble

## Operating the NEQ3 mount

The NEQ3 mount has controls for both conventional altitude (up-down) and azimuth (left-right) directions of motion. These two adjustments are suggested for large direction changes and for terrestrial viewing. The two azimuth adjustment knobs located near the tripod head allow fine-adjustment of azimuth for polar alignment. Use the altitude adjustment T-bolts for altitude adjustments. These allow fine-adjustment for setting the mount to your local latitude. (Fig.e).

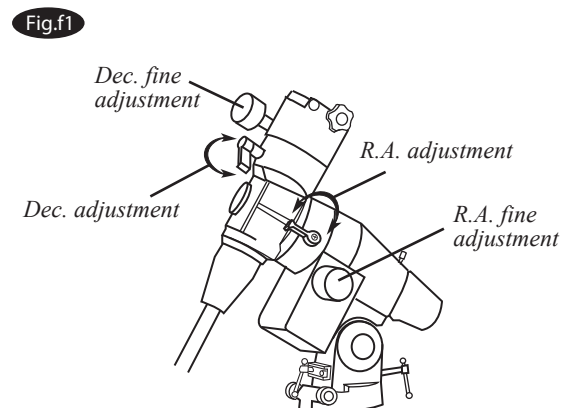
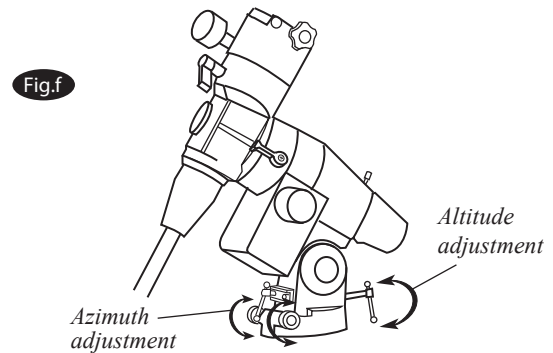
In addition, this mount has Right Ascension (hour angle) and Declination direction controls for polar-aligned astronomical observing. Loosen the lock knobs to make large direction changes. Use the control cables for fine adjustment after the lock knobs have both been locked (Fig.e1). An additional scale is included for the altitude axis. This allows polar alignment for your local latitude. (Fig.e2)



## Operating the EQ5 mount

The EQ5 mount has controls for both conventional altitude (up-down) and azimuth (left-right) directions of motion. These two adjustments are suggested for large direction changes and for terrestrial viewing. The two azimuth adjustment knobs located near the tripod head allow fine-adjustment of azimuth for polar alignment. Use the altitude adjustment T-bolts for altitude adjustments. These allow fine-adjustment for setting the mount to your local latitude. (Fig.f).

In addition, this mount has Right Ascension (hour angle) and declination direction controls for polar-aligned astronomical observing. Loosen the lock knobs to make large direction changes. Use the control cables for fine adjustment after the lock knobs have both been locked (Fig.f1). An additional scale is included for the altitude axis. This allows polar alignment for your local latitude. (Fig.e2)



## Using the Barlow lens (optional)

A Barlow is a negative lens which increases the magnifying power of an eyepiece, while reducing the field of view. It expands the cone of the focussed light before it reaches the focal point, so that the telescope's focal length appears longer to the eyepiece.

The Barlow is inserted between the focuser and the eyepiece in a reflector, and usually between the diagonal and the eyepiece in a refractor or a maksutov (Fig.g). With some telescopes, it can also be inserted between the focuser and the diagonal, and in this position it gives even greater magnification. For example, a 2X Barlow when inserted after the diagonal can become 3X when placed in front of the diagonal.

In addition to increasing magnification, the benefits of using a Barlow lens include improved eye relief, and reduced spherical aberration in the eyepiece. For this reason, a Barlow plus a lens often outperforms a single lens producing the same magnification. However, its greatest value may be that a Barlow effectively doubles the number of eyepieces in your collection.

## Focusing

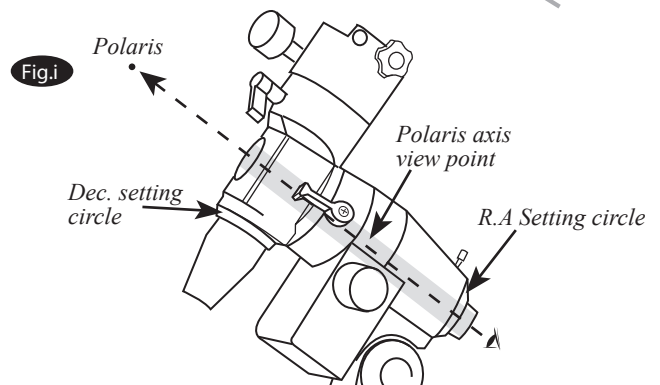
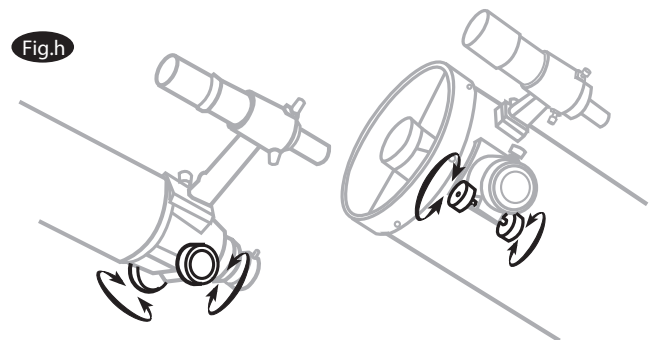
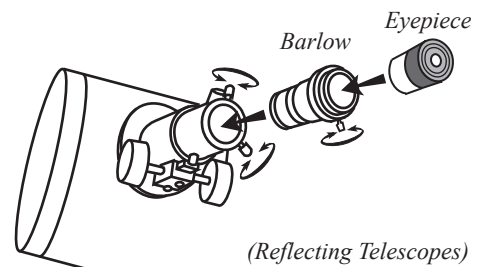
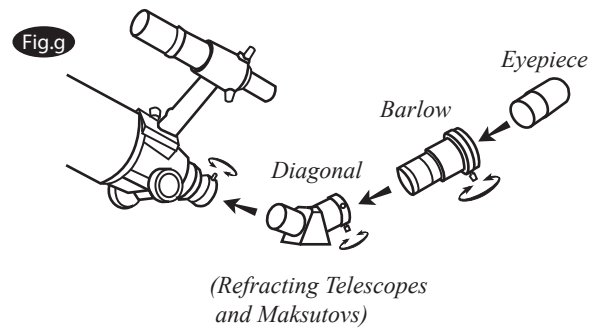
Slowly turn the focus knobs under the focuser, one way or the other, until the image in the eyepiece is sharp (Fig.h). The image usually has to be finely refocused over time, due to small variations caused by temperature changes, flexures, etc. This often happens with short focal ratio telescopes, particularly when they haven't yet reached outside temperature. Refocusing is almost always necessary when you change an eyepiece or add or remove a Barlow lens.

## Polar Alignment for Visual Use

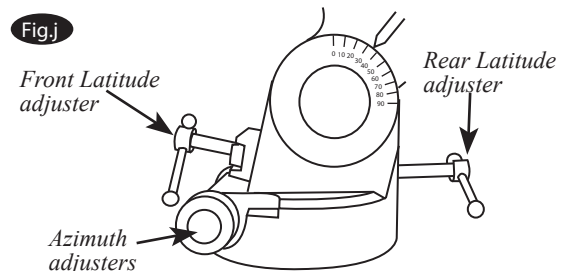
Tracking of celestial objects can be simplified by performing a procedure known as a polar alignment. For visual use the procedure does not require high precision. For satisfactory results all you need to do is point your mount at Polaris, the North Star.

To point at Polaris, start by aiming the north leg of the tripod north. Next, adjust the altitude angle of the mount so that you can see Polaris through the polar axis view port.

Note that the proper altitude angle is equal to your local latitude. If you know your local latitude simply adjust the front and back latitude adjustment bolts until the indicator points to your local latitude on the scale. Fig. j. To find your local latitude you can consult a road map, call your airport, or look it up on the Internet.



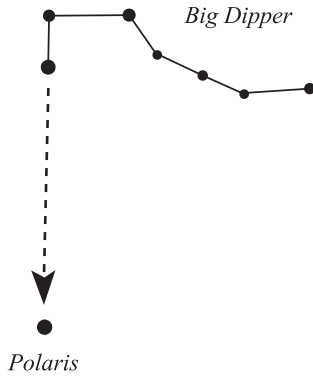
*If you can see Polaris through your polar scope view port, you are polar aligned sufficiently for most visual applications.*



*These are the main controls for adjusting the position of your mount to aim it at Polaris. Here, the latitude is set to approximately 40 degrees. East/west adjustments are made with the Azimuth adjusters. Up/down adjustments are made with the Latitude adjusters.*

If you cannot find your local latitude, then you can simply adjust the altitude of the polar axis until you can see Polaris through the view port. If you are not sure where to find Polaris, then review Figure k.

If you do know how to find Polaris, then you can skip to the summary of steps for polar aligning. Remember, as long as you place Polaris somewhere near the center of polar axis view port you will have an adequate polar alignment for most visual applications.



The Big Dipper conveniently points at Polaris, the North Star all year round for northern observers, but its orientation just after dark varies with the season. Use the right hand figure to help you find the Big Dipper (and Polaris) any time of year.



Positions shown are approximate for just after dark.

### Summary of Steps for Simplified Polar Alignment for Casual Observing

- 1) Assemble your tripod and mount and place them so that the tripod is level and the polar axis of the mount is pointing north. Remove the front and rear dust caps from the polar axis view port.
- 2) Adjust the altitude of your mount using the front and rear altitude adjustment bolts until the altitude indicator matches your local latitude.
- 3) From behind the mount, look through the polar axis view port and spot Polaris. Use the azimuth and altitude adjustment bolts to place Polaris near the center of the polar axis view port.

### Southern Hemisphere

In the Southern Hemisphere you must align the mount to the SCP by locating its position with star patterns, without the convenience of a nearby bright star. The closest star is the faint 5.5-mag. Sigma Octantis which is about one degree away. Two sets of pointers which help to locate the SCP are alpha and beta Crucis (in the Southern Cross) and a pointer running at a right angle to a line connecting alpha and beta Centauri (Fig.l)

## Pointing Your Telescope

Now that your mount is polar-aligned you'll want to point it to various locations in the sky. In the HOME position, your mount and telescope both point north in the direction of Polaris, the North Star. To point south you cannot simply rotate the telescope around the Dec axis, or you will end up pointing at the ground. To point south you must rotate the mount in both RA and in Dec.

Keep in mind that the counterweight(s) will always be placed on the side that the telescope is pointing to. So, if you are looking at an object in the west, the counterweight(s) will be on the west side of the mount. If you are looking to the east, they will be on the east side of the mount.

Fig.k

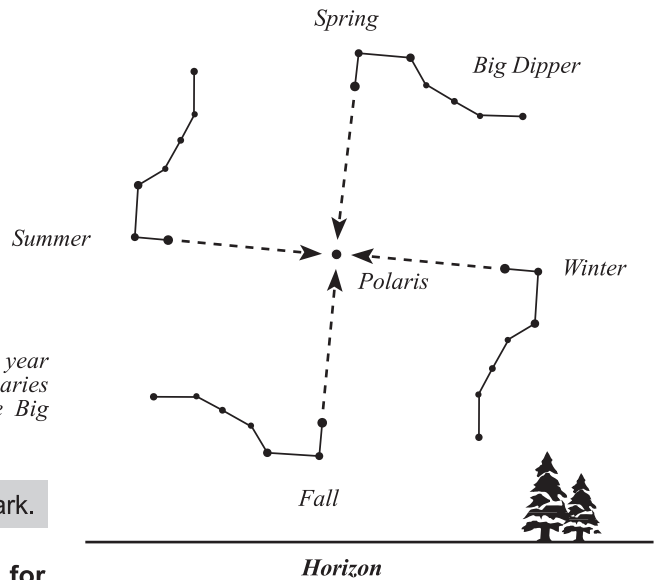


Fig.l

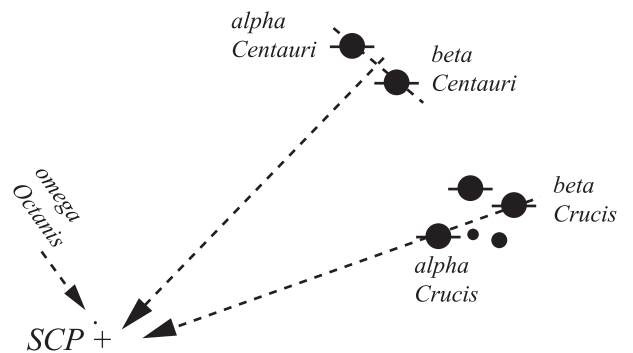
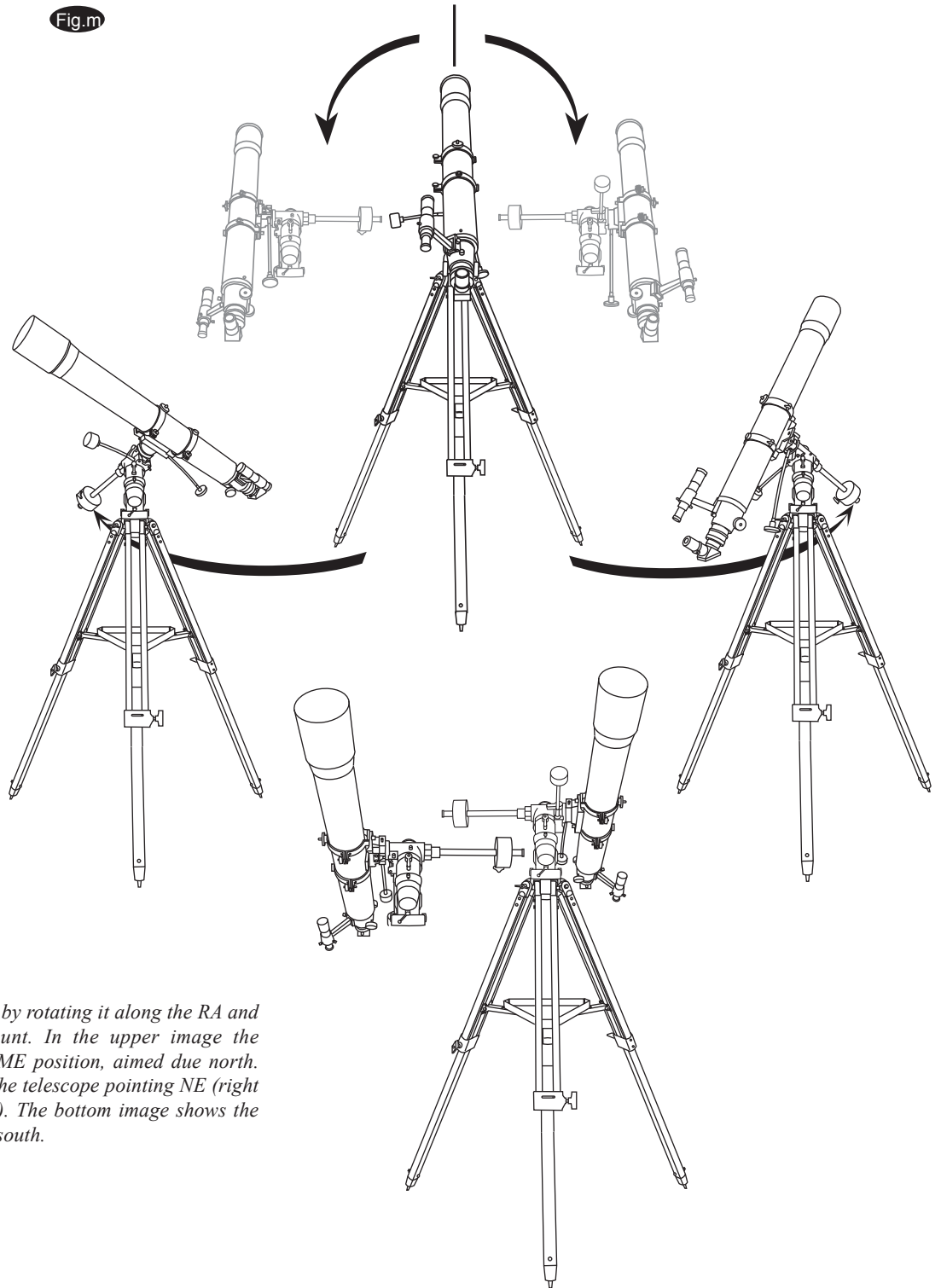


Fig.m



*You aim your telescope by rotating it along the RA and Dec axes of your mount. In the upper image the telescope is in the HOME position, aimed due north. The side images show the telescope pointing NE (right side) and SW (left side). The bottom image shows the telescope pointing due south.*

After pointing at an object and tracking it for a while you may find the counterweight(s) rise above the point of being parallel to the ground. If so, it is time to perform a meridian flip. This is necessary to prevent your telescope from eventually colliding with the mount or tripod.

To do a meridian flip, rotate your telescope 180 degrees in Dec and lock the Dec axis. Now, rotate your mount 12H in RA and lock the RA axis. Using the setting circles to assist you will help you do this more accurately.

When finished you should be pointing at the same object you were pointing at before, but from the opposite side of your mount. Don't forget to adjust your RA setting circles back to the coordinates of your object. Lock the setscrew when done.

## Using the Setting Circles

Now it is time to learn what those numbered dials are for! The dials are called setting circles and they can be used to help you find objects in the sky simply by dialing in a set of coordinates.

All objects in the sky have assigned coordinates labeled Right Ascension (RA for short) and Declination (Dec for short). The RA axis follows east/west movement of the sky and is the primary axis. By periodically rotating the RA axis you are able to follow the apparent motion of the sky and keep objects centered in your eyepiece. This is called tracking.

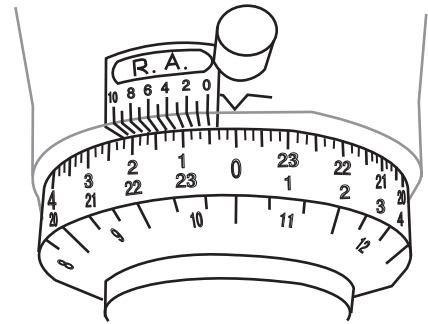
The Dec axis is for north/south positions. It is primarily used for finding objects, not for tracking them. It is normal, however, to make occasional adjustments to the Dec axis as well. The better your polar alignment, the fewer Dec adjustments you will need to make.

First you need to calibrate the RA axis (Fig.n). To do this align your telescope to an object with known coordinates and then rotate the RA setting circle to show those coordinates. Leave the setscrew unlocked at this point. Your Dec scale is factory set and does not need to be calibrated in this way. Once you are aimed at the known object the Dec scale should have the correct coordinate reading.

Now as you rotate the scope in RA and Dec, the setting circle values change. So, to find a specific object, you simply turn both the axes until the designated coordinates line up with the pointers on the respective scales. After finding the object, centre it in your eyepiece, then lock the RA set screw securely. This will prevent the RA setting from incrementing as the telescope tracks the object. You only want the RA setting circle to rotate with the mount when you are locating objects, not when tracking them.

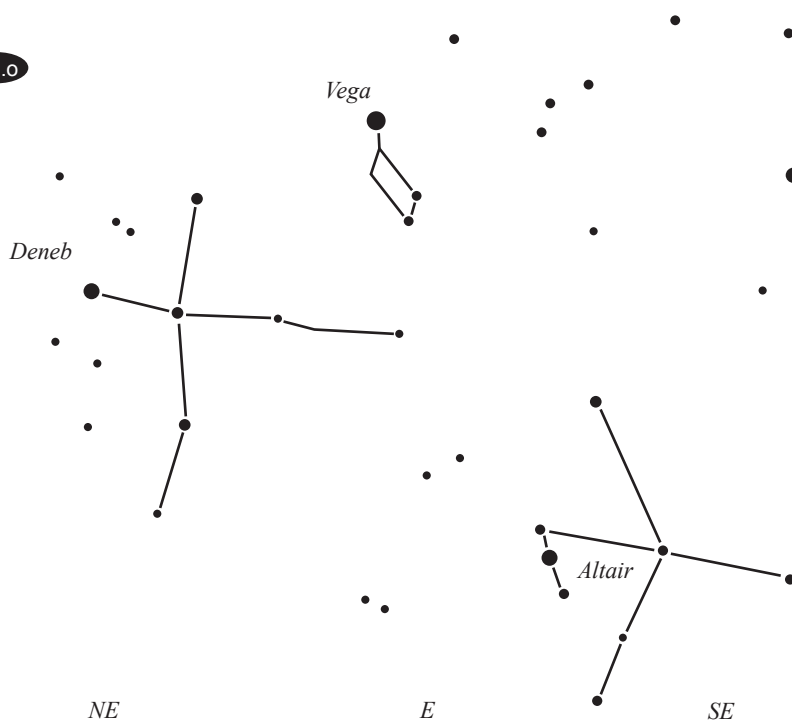
Let's do an example. During summer nights the star Vega shines brightly overhead (Fig.o). Vega is easy to find because it is so much brighter than any other stars in its general vicinity. It's easiest to find Vega by spotting the Summer Triangle. This is a trio of bright stars in the eastern sky consisting of Deneb (Cygnus), Altair (Aquila) and Vega (Lyra). Vega is the westernmost of the three stars. It will be highest overhead of the three for northern observers. Find Vega and centre it in your eyepiece.

Fig.n



The RA setting circle is numbered from 1 to 24 in 10 minute increments. The example above shows the mount is set to the RA coordinates of 8h 20m. The lower scale marked 1 to 12 is the date scale. The upper scale is the RA minute scale. Both of these can be ignored when using the setting circle scale for finding objects.

Fig.o



Vega is the brightest star in the Summer Triangle, which consists of Deneb (Cygnus), Altair (Aquila) and Vega (Lyra). In this image Vega is at the top. In the sky when facing east it will be the highest of the three stars with Deneb to its left (north) and Altair to its lower right (south).



Vega has the coordinates RA 18h 37m. With Vega centered in your eyepiece loosen the RA setting circle setscrew and rotate the scale until it reads 18h 36m. (If you are in the Northern hemisphere use the top row of numbers. If you are in the Southern hemisphere use the lower set of numbers.)

To do this turn the RA dial until 18 is lined up with the indicator. The small divisions are set at 10 minutes each, so rotate another 3 divisions past 18h in the direction of 19h. This puts you at 18h 30m. Since you are aiming for 18:36, rotate about half of one more division. That will put you approximately at 18:35, and that is close enough for visual purposes.

Now look at the Dec scale. It should be pointing at 39 degrees, which is the Declination of Vega. If it is not, loosen the Allen screw on the Dec scale and rotate the scale until it reads 39 degrees. Retighten the Allen screw when you are done. This will be the only time you will ever need to adjust the Dec scale.

Your mount is now calibrated on Vega and ready to point at other objects using the setting circles. Let's try it out.

The interesting Ring Nebula (M57) is nearby at: RA 18h 52m and Dec 33 degrees. Unlock the RA scale set screw, then unlock the RA axis and rotate the mount until the scale reads 18h 52m. Lock the RA axis but don't tighten the RA setscrew just yet. Now unlock the Dec axis and rotate the telescope until the Dec axis pointer is at 33 on the scale. Lock your Dec axis.

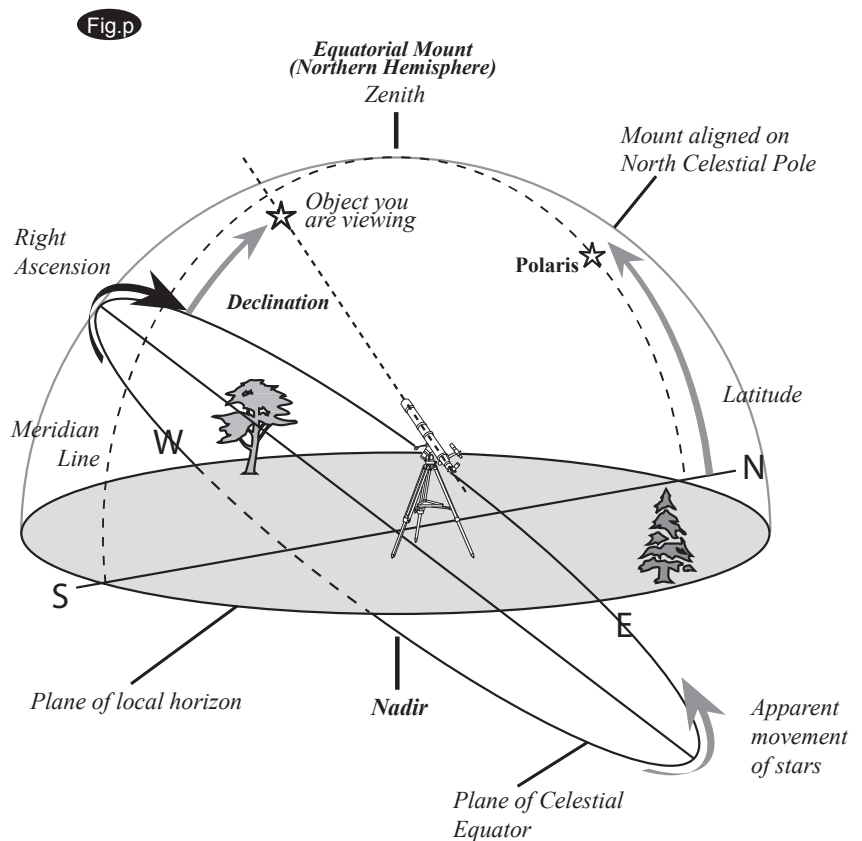
When you look through a low power eyepiece you should be able to detect the Ring Nebula in the field of view. Use your slow motion controls to centre it, then lock the RA setscrew by tightening it fully. When you are ready to move on to the next object, unlock the RA set screw, then rotate the RA and Dec axes until you arrive at the desired coordinates.

### Meridian Flips

The meridian is an imaginary line that runs directly overhead from north to south and divides the sky into east and west (Fig.p). You will find that any moves of the telescope that cause you to cross the meridian will invalidate your setting circles. If you switch from pointing in the eastern sky to an object in the western sky (or visa versa) you will need to perform a meridian flip and manually reset your RA setting circle.

The procedure for doing a meridian flip is described in the section on pointing your telescope. If you do a meridian flip and end up pointing at the same object you had been viewing before, don't forget to reset the RA setting circle to that object's coordinates. If you do a meridian flip and point at a new object, be sure to put its coordinates on the RA setting circle. As always, lock down the RA set screw when switching from finding objects to tracking them.

It is a good idea to plan your observing so that multiple objects in the west are viewed in sequence before viewing objects in the east. When viewing multiple objects on the same side of the sky you do not need to reset your RA setting circle as often. Why start in the west? We recommend this simply because objects in the western sky will set earlier than objects in the eastern sky. If you leave them to last, they may set before you find them!



## Choosing the appropriate eyepiece

### Calculating the magnification (power)

The magnification produced by a telescope is determined by the focal length of the eyepiece that is used with it. To determine a magnification for your telescope, divide its focal length by the focal length of the eyepieces you are going to use. For example, a 10mm focal length eyepiece will give 80X magnification with an 800mm focal length telescope.

$$\text{magnification} = \frac{\text{Focal length of the telescope}}{\text{Focal length of the eyepiece}} = \frac{800\text{mm}}{10\text{mm}} = 80\text{X}$$

When you are looking at astronomical objects, you are looking through a column of air that reaches to the edge of space and that column seldom stays still. Similarly, when viewing over land you are often looking through heat waves radiating from the ground, house, buildings, etc. Your telescope may be able to give very high magnification but what you end up magnifying is all the turbulence between the telescope and the subject. A good rule of thumb is that the usable magnification of a telescope is about 2X per mm of aperture under good conditions.

### Calculating the field of view

The size of the view that you see through your telescope is called the true (or actual) field of view and it is determined by the design of the eyepiece. Every eyepiece has a value, called the apparent field of view, which is supplied by the manufacturer. Field of view is usually measured in degrees and/or arc-minutes (there are 60 arc-minutes in a degree). The true field of view produced by your telescope is calculated by dividing the eyepiece's apparent field of view by the magnification that you previously calculated for the combination. Using the figures in the previous magnification example, if your 10mm eyepiece has an apparent field of view of 52 degrees, then the true field of view is 0.65 degrees or 39 arc-minutes.

$$\text{True Field of View} = \frac{\text{Apparent Field of View}}{\text{Magnification}} = \frac{52^\circ}{80\text{X}} = 0.65^\circ$$

To put this in perspective, the moon is about 0.5° or 30 arc-minutes in diameter, so this combination would be fine for viewing the whole moon with a little room to spare. Remember, too much magnification and too small a field of view can make it very hard to find things. It is usually best to start at a lower magnification with its wider field and then increase the magnification when you have found what you are looking for. First find the moon then look at the shadows in the craters!

### Calculating the exit pupil

The Exit Pupil is the diameter (in mm) of the narrowest point of the cone of light leaving your telescope. Knowing this value for a telescope-eyepiece combination tells you whether your eye is receiving all of the light that your primary lens or mirror is providing. The average person has a fully dilated pupil diameter of about 7mm. This value, varies a bit from person to person, is less until your eyes become fully dark adapted and decreases as you get older. To determine an exit pupil, you divide the diameter of the primary of your telescope (in mm) by the magnification.

$$\text{Exit Pupil} = \frac{\text{Diameter of Primary mirror in mm}}{\text{Magnification}}$$

For example, a 200mm f/5 telescope with a 40mm eyepiece produces a magnification of 25x and an exit pupil of 8mm. This combination can probably be used by a young person but would not be of much value to a senior. The same telescope used with a 32mm eyepiece gives a magnification of about 31x and an exit pupil of 6.4mm which should be fine for most dark adapted eyes. In contrast, a 200mm f/10 telescope with the 40mm eyepiece gives a magnification of 50x and an exit pupil of 4mm, which is fine for everyone.

# OBSERVING THE SKY

## Sky conditions

Sky conditions are usually defined by two atmospheric characteristics, seeing, or the steadiness of the air, and transparency, light scattering due to the amount of water vapour and particulate material in the air. When you observe the Moon and the planets, and they appear as though water is running over them, you probably have bad "seeing" because you are observing through turbulent air. In conditions of good "seeing", the stars appear steady, without twinkling, when you look at them with unassisted eyes (without a telescope). Ideal "transparency" is when the sky is inky black and the air is unpolluted.

## Selecting an observing site

Travel to the best site that is reasonably accessible. It should be away from city lights, and upwind from any source of air pollution. Always choose as high an elevation as possible; this will get you above some of the lights and pollution and will ensure that you aren't in any ground fog. Sometimes low fog banks help to block light pollution if you get above them. Try to have a dark, unobstructed view of the horizon, especially the southern horizon if you are in the Northern Hemisphere and vice versa. However, remember that the darkest sky is usually at the "Zenith", directly above your head. It is the shortest path through the atmosphere. Do not try to observe any object when the light path passes near any protrusion on the ground. Even extremely light winds can cause major air turbulence as they flow over the top of a building or wall.

Observing through a window is not recommended because the window glass will distort images considerably. And an open window can be even worse, because warmer indoor air will escape out the window, causing turbulence which also affects images. Astronomy is an outdoor activity.

## Choosing the best time to observe

The best conditions will have still air, and obviously, a clear view of the sky. It is not necessary that the sky be cloud-free. Often broken cloud conditions provide excellent seeing. Do not view immediately after sunset. After the sun goes down, the Earth is still cooling, causing air turbulence. As the night goes on, not only will seeing improve, but air pollution and ground lights will often diminish. Some of the best observing time is often in the early morning hours. Objects are best observed as they cross the meridian, which is an imaginary line that runs through the Zenith, due North-South. This is the point at which objects reach their highest points in the sky. Observing at this time reduces bad atmospheric effects. When observing near the horizon, you look through lots of atmosphere, complete with turbulence, dust particles and increased light pollution.

## Cooling the telescope

Telescopes require time to cool down to outside air temperature. This may take longer if there is a big difference between the temperature of the telescope and the outside air. This minimizes heat wave distortion inside telescope tube (tube currents). A rule of thumb is to allow 5 minutes per inch of aperture. For example, a 4 inch refractor would require at least 20 minutes, but an 8" reflector would require at least 40 minutes to cool off to outside conditions. Tip: use this time for polar alignment.

## Adapting your eyes

Do not expose your eyes to anything except red light for 30 minutes prior to observing. This allows your pupils to expand to their maximum diameter and build up the levels of optical pigments, which are rapidly lost if exposed to bright light. It is important to observe with both eyes open. This avoids fatigue at the eyepiece. If you find this too distracting, cover the non-used eye with your hand or an eye patch. Use averted vision on faint objects: The center of your eye is the least sensitive to low light levels. When viewing a faint object, don't look directly at it. Instead, look slightly to the side, and the object will appear brighter.

# PROPER CARE FOR YOUR TELESCOPE

## Collimating a Newtonian reflector

Collimation is the process of aligning the mirrors of your telescope so that they work in concert with each other to deliver properly focused light to your eyepiece. By observing out-of-focus star images, you can test whether your telescope's optics are aligned. Place a star in the centre of the field of view and move the focuser so that the image is slightly out of focus. If the seeing conditions are good, you will see a central circle of light (the Airy disc) surrounded by a number of diffraction rings. If the rings are symmetrical about the Airy disc, the telescope's optics are correctly collimated (Fig.q).



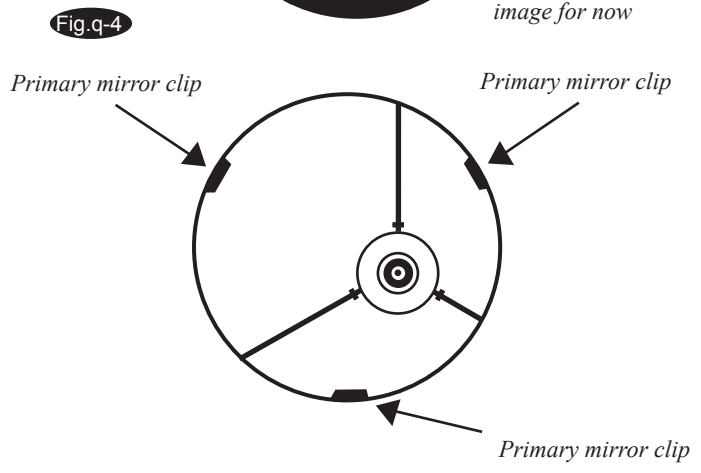
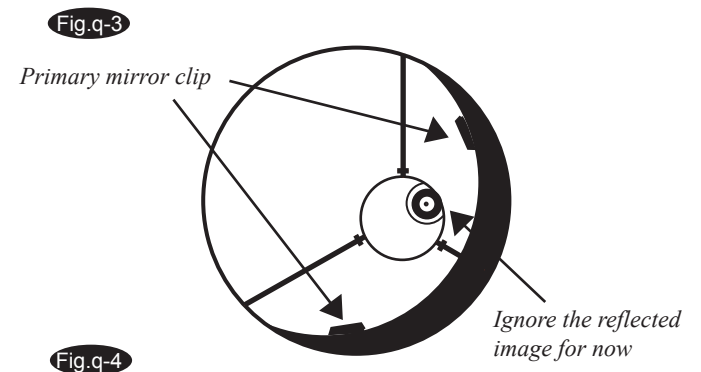
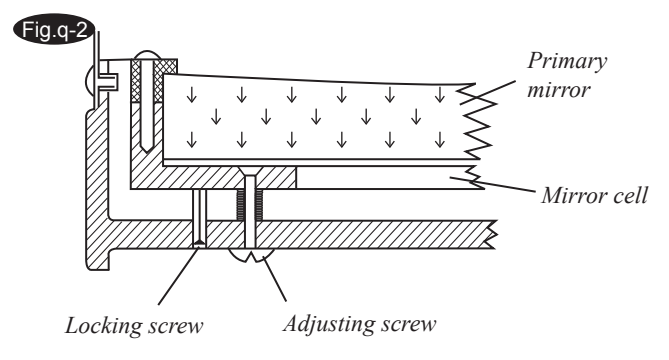
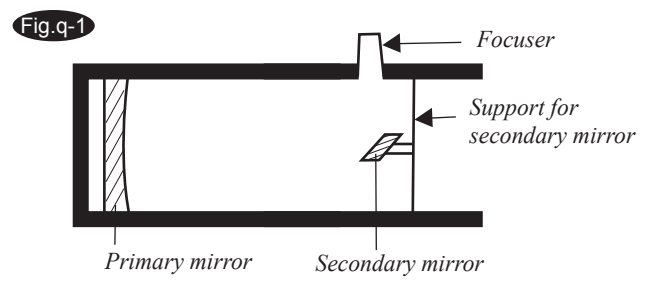
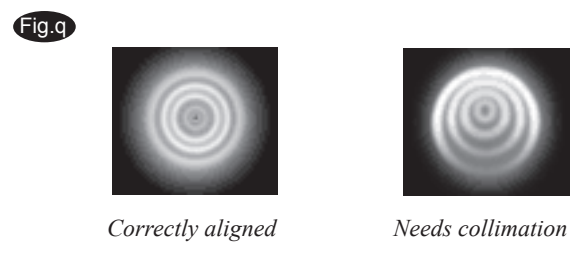
If you do not have a collimating tool, we suggest that you make a "collimating cap" out of a plastic 35mm film canister (black with gray lid). Drill or punch a small pinhole in the exact center of the lid and cut off the bottom of the canister. This device will keep your eye centered of the focuser tube. Insert the collimating cap into the focuser in place of a regular eyepiece.

Collimation is a painless process and works like this: Pull off the lens cap which covers the front of the telescope and look down the optical tube. At the bottom you will see the primary mirror held in place by three clips 120° apart, and at the top the small oval secondary mirror held in a support and tilted 45° toward the focuser outside the tube wall (Fig.q-1).

The secondary mirror is aligned by adjusting the three smaller screws surrounding the central bolt. The primary mirror is adjusted by the three adjusting screws at the back of your scope. The three locking screws beside them serve to hold the mirror in place after collimation. (Fig.q-2)

### Aligning the Secondary Mirror

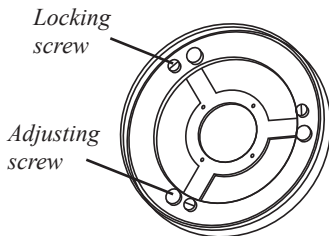
Point the telescope at a lit wall and insert the collimating cap into the focuser in place of a regular eyepiece. Look into the focuser through your collimating cap. You may have to twist the focus knob a few turns until the reflected image of the focuser is out of your view. Note: keep your eye against the back of the focus tube if collimating without a collimating cap. Ignore the reflected image of the collimating cap or your eye for now, instead look for the three clips holding the primary mirror in place. If you can't see them (Fig.q-3), it means that you will have to adjust the three bolts on the top of the secondary mirror holder, with possibly an Allen wrench or Phillip's screwdriver. You will have to



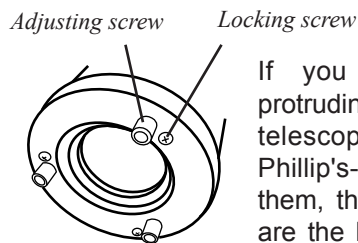
alternately loosen one and then compensate for the slack by tightening the other two. Stop when you see all three mirror clips (Fig.q-4). Make sure that all three small alignment screws are tightened to secure the secondary mirror in place.

### Aligning the Primary Mirror

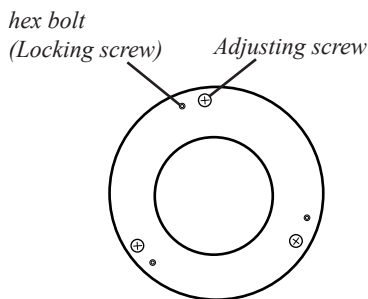
Find the three locking screws at the back of your telescope and loosen them by a few turns.



If you see 3 flat headed screws and 3 thumbscrews, the flat headed screws are the adjusting screws and the thumbscrews are the locking screws.



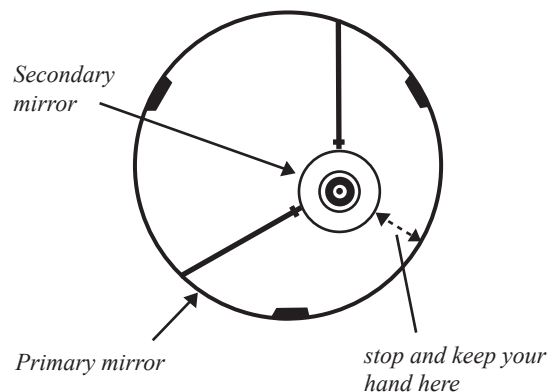
If you see 3 large nuts protruding from the back of your telescope and 3 small Phillip's-head screws besides them, the Phillip's-head screws are the locking screws and the large nuts are the adjusting screws.



If you see 3 hex bolts and 3 Phillip's head screws, the hex bolts are the locking screws and the Phillip's-head screws are the adjusting screws. You will need an Allen wrench to adjust the locking screws.

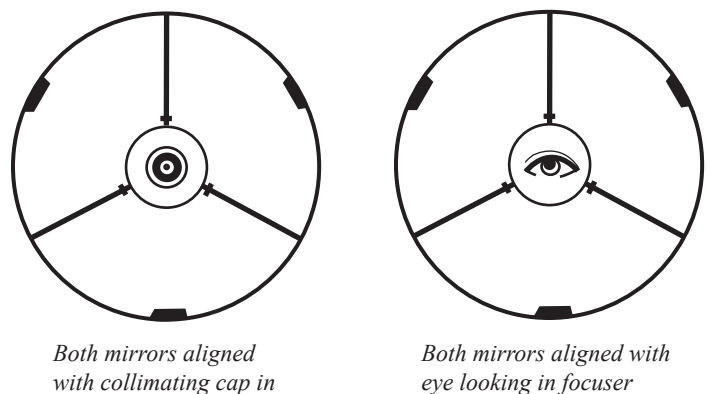
Fig.q-5

Now run your hand around the front of your telescope keeping your eye to the focuser, you will see the reflected image of your hand. The idea here is to see which way the primary mirror is defocused; you do this by stopping at the point where the reflected image of the secondary mirror is closest to the primary mirror's edge (Fig.q-5).



When you get to that point, stop and keep your hand there while looking at the back end of your telescope, is there an adjusting screw there? If there is you will want to loosen it (turn the screw to the left) to bring the mirror away from that point. If there isn't an adjusting screw there, then go across to the other side and tighten the adjusting screw on the other side. This will gradually bring the mirror into line until it looks like Fig.q-6. (It helps to have a friend to help for primary mirror collimation. Have your partner adjust the adjusting screws according to your directions while you look in the focuser.)

Fig.q-6



After dark go out and point your telescope at Polaris, the North Star. With an eyepiece in the focuser, take the image out of focus. You will see the same image only now, it will be illuminated by starlight. If necessary, repeat the collimating process only keep the star centered while tweaking the mirror.

## Collimating a refractor with the adjustable objective-lens cell

Collimation is the process of aligning the lenses of your telescope so that the light they collect will focus at the right spot at the back of your telescope for your eyepieces to work.

Collimation is a simple process and works like this:

Pull off the dew cap at the front of your telescope and look into the scope. The pair of lenses are held in a cell by a threaded ring. This cell is held in place by three pairs of screws spaced 120 degrees apart. The larger Phillip's head screws actually hold the cell on, while the smaller, buried Allen screws push against a ledge at the front of the tube and allow the cell to tilt slightly, by tension against the Phillips screws (Fig.r). The idea is to alternately loosen and tighten each against the other until you have a round star image.

There are a number of devices available for collimation. One of the best is your eyepiece and Polaris. For this purpose it is best that your telescope not be polar aligned, in fact point the mount head due east or west.

Use your lowest power (largest number) eyepiece to acquire Polaris, place it in the center of the eyepiece view. Now switch to your next higher power eyepiece, while keeping the image centered. The in-focus star image will have a bright innermost point, a slightly fainter inner ring and a fainter still outer ring that is hard to see (Fig.r-1). If it doesn't look like this, or you can't reach focus then start with: take out your star diagonal and look at the image slightly out of focus, this will allow you to gauge the deflection. A typical off-collimation image will have a bright spot off to one side when you bring the focus out (Fig.r-2).

The actual process is to slightly loosen the pair on the side the deflection is, slacken the Allen head screws then tighten the Phillip's head screws against them again. Check the star image again after moving it into the centre of the eyepiece. If you find your image getting worse, then go the other way, or slacken the other two Allen screws a little. Once you have a round star image you are set.

Fig.r

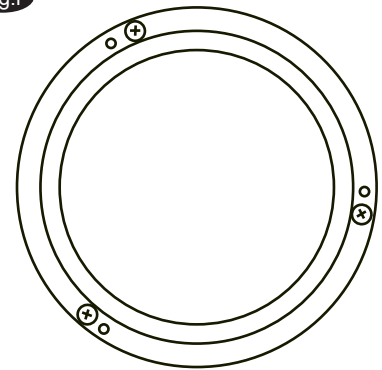
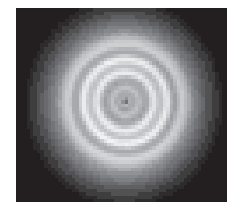
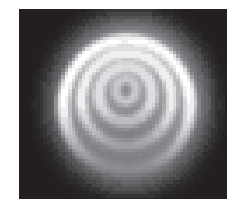


Fig.r-1



*Correctly aligned*

Fig.r-2



*Needs collimation*



It helps to have a friend to help with the collimation. Have your partner adjust the screws according to your directions while you look in the eyepiece.

## Cleaning your telescope

Replace the dust cap over the end of the telescope whenever it is not in use. This prevents dust from settling on the mirror or lens surfaces. Do not clean the mirror or lens unless you are familiar with optical surfaces. Clean the finderscope and eyepieces with special lens paper only. Eyepieces should be handled with care, avoid touching optical surfaces.

# APPENDIX A - PRECISE POLAR ALIGNMENT FOR NORTHERN HEMISPHERE

When your equatorial mount is polar-aligned it is able to track the sky easily and hold targets in the eyepiece with just occasional adjustments to the RA control cable. If your mount is motorized it can hold objects in the eyepiece almost indefinitely. An accurate polar alignment also greatly reduces the number of guiding corrections that are needed during long exposure astrophotography.

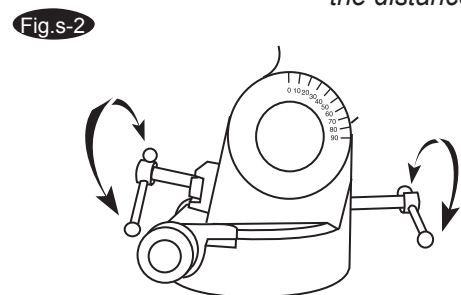
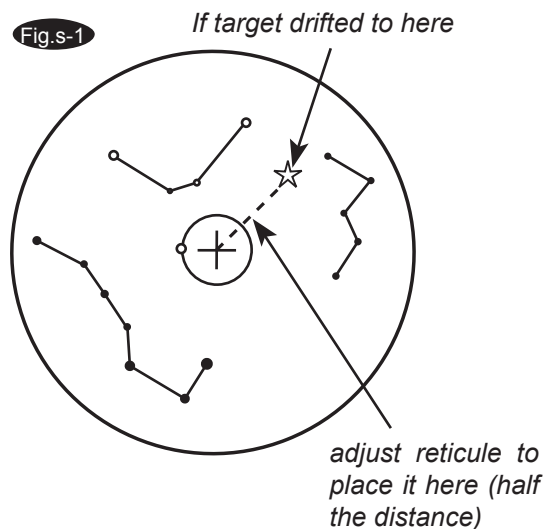
However, for all but the most critical photographic applications, your polar alignment does not need to be perfect. Your mount will provide excellent performance even if there is some error in the polar alignment. SkyWatcher has developed user-friendly equipment and procedures to minimize such errors, and this makes an adequate polar alignment easy to accomplish.

## PREPARING THE MOUNT

### Aligning the polar scope reticule

The polar scope needs to be aligned with the polar axis of your mount. The steps below tell you how to perform this alignment. Note, you can do this procedure at night while pointing at Polaris. However, it is probably easier to do it in the daytime using a distant point as your target (e.g. a street light a couple of hundred yards away). If doing the procedure during the day, you might find it convenient to set your altitude to near parallel with the ground to put the eyepiece of the polar scope into a comfortable position. Just be sure to leave room to make vertical adjustments in both directions. Also, do this procedure without a telescope or counterweights attached. It will make turning the mount a lot simpler.

1. Locate a distant object and place it under the cross at the centre of the polarscope reticule.
2. Rotate the mount in RA 180 degrees (i.e., 12 hours on the RA setting circle).
3. Note the displacement of your target from the centre of the crosshairs (Fig.s-1). If it is not displaced at all, it means your polar scope reticule is already properly aligned and you don't need to do any more. If it is displaced, continue with the next step of the alignment procedure.
4. Use the three adjustment screws on the polar scope to move the reticule so that exactly one-half of the displacement is corrected for. For example, if the displacement were about half an inch in the direction of 1 o'clock, then you would adjust the cross at the centre of the reticule to go half the distance in that direction (Figure s-2).
5. Now continue to move the cross using the altitude and azimuth adjusters on the mount. When the target is back under the cross, go back to step 2, but this time rotate the mount 180 degrees in the opposite direction. If you still get displacement of the target, repeat steps 3-5.



### Setting your latitude



One bolt should always be loose when doing adjustments.  
Gently tighten both bolts when your adjustment is complete.

Remove the caps from the upper and lower ends of the RA axis so you can look into the polar scope. Adjust the north and south T-bolts on the mount so the latitude indicator points to your local latitude (Fig.2). Look through the polar scope and adjust the azimuth and altitude controls as needed so that Polaris appears in the view of the polar scope. Once you see it you can use one of the simplified procedures below to place Polaris at the correct position for an accurate polar alignment.

## SIMPLIFIED POLAR ALIGNMENT PROCEDURES

The NEQ3 and EQ5 mounts have specially designed reticule patterns and simplified procedures to make polar aligning your mount very simple. In fact, if you purchased a SynScan equipped mount you can perform an extremely accurate polar alignment in less than two minutes! See the SynScan User manual for details.

If you do not have a SynScan mount you can still get a very good alignment without much bother. The two simple procedures detailed below work equally well. Use whichever one you like best.

### Pattern-based method

**Northern Hemisphere** - Identify the Big Dipper pattern in the constellation Ursa Major, or find the constellation Cassiopeia in the night sky. In spring and summer, the Big Dipper will be higher in the sky and easier to find. In fall and winter, Cassiopeia may be easier to use.

The patterns for both are etched on your polar scope reticule (Fig.S-3). Simply rotate your mount in RA until one of the patterns matches its actual orientation in the sky. Lock the RA axis. Now the small circle on the perimeter of the larger circle is in the correct position for locating Polaris.

Next, use your azimuth and altitude adjustment controls to place Polaris inside the small circle. Tighten your azimuth and altitude knobs, then tighten your locking shaft bolt to secure the mount to the tripod and you are done.

### Pattern-based method

Kochab is the brightest star in the bucket portion of the Little Dipper (Fig.S-4). It also happens to form a line with Polaris and the North Celestial Pole (NCP) - the point in space at which you want to aim your polar axis to achieve an accurate polar alignment. Kochab rotates around the NCP the way the hour hand rotates around a clock face, but it takes Kochab nearly 24 hours to make one revolution. We can use this behavior to help us achieve an accurate polar alignment quickly and simply.

First, identify the bright star Kochab in the bucket of the Little Dipper. Now look at Polaris and imagine it is the center of a clock face. Take note of what "time" Kochab appears. For example, if Kochab were directly to the right of Polaris, it would be at 3 o'clock. In the figure above, it is at about 8:00.

Now look into your polar scope. Rotate your mount in RA to place the Polaris indicator circle at the time indicated by Kochab clock method. Then, use your altitude and azimuth adjustment controls to put Polaris inside the circle. Tighten your controls and your locking shaft bolt and you are done.

### Southern Hemisphere

There is a 4-star pattern in the polar scope, which resembles the bucket of the Big Dipper. In the Southern Hemisphere, there is an Asterism in Octans, which has this shape. By rotating the R.A. axis and by adjusting the altitude and azimuth of the mount, the four stars in the Asterism can be placed in the circles in the Pole Finder. This procedure can be somewhat difficult in the city because all four of these stars are fainter than Magnitude 5.

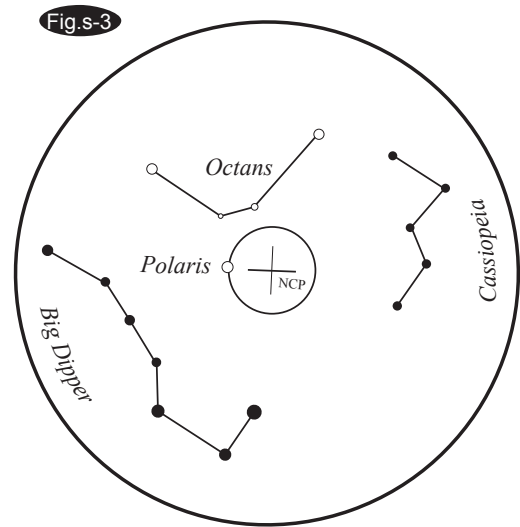


Fig.s-3

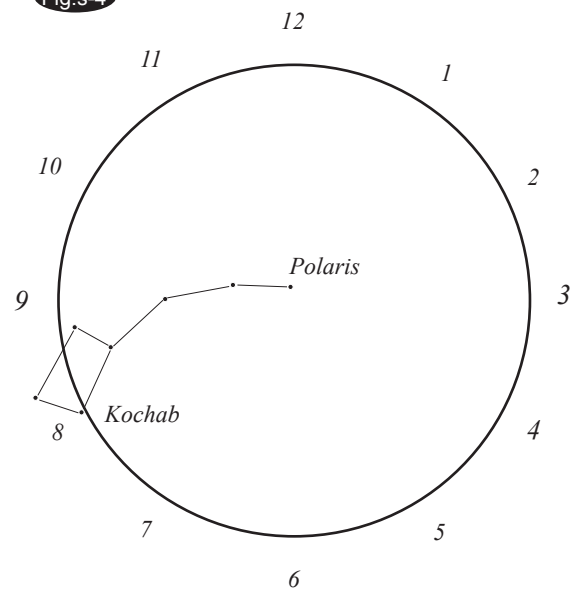


Fig.s-4  
Kochab is the brightest star in the bucket of the Little Dipper. Other stars in the region are quite dim and are not drawn here.



# APPENDIX B - OPTIONAL ACCESSORIES

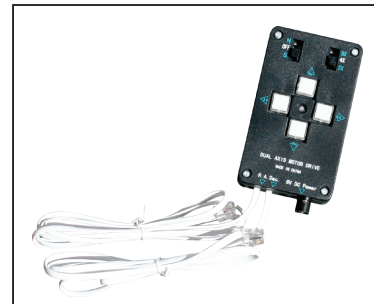
## NEQ3 & EQ5 SYNSCAN

Sky-Watcher offers simple solutions for users who would like to attach their smaller telescope to a convenient computerized system but do not wish to deal with the weight of the HEQ5 or EQ6 mount. The NEQ3 and EQ5 SynScan mounts use the same Go-To system found in the HEQ5 and EQ6 Pro mounts. It allows you to point the telescope at a specific object or even tour the skies at the touch of a button.



## DUAL AXIS MOTOR DRIVES

The EQ3 dual axis motor drives precisely control the telescopes' tracking speed to compensate for the earth's rotation. Available in 2x, 4x, and 8x speeds through the Hand Controller. These DC motor drives run on 4 "D" cell batteries (not included). Motors for both axes, clutches, cables, hand controller, and battery case are included.



## SINGLE AXIS MOTOR DRIVE

These single axis (R.A.) DC motor drives are powered by 4 "D" cell batteries (not included). A set of batteries will allow several nights of observing. 2x and 8x tracking speeds (2x and 4x for EQ1 model) are available through the hand controller. Motor, hand controller, and battery case are included.



## COLLIMATING EYEPIECE

The Sky-Watcher Collimation Eyepiece is ideal for precise collimation of Newtonians and refractors with an adjustable lenscells. This special eyepiece fits into 1¼" focusers or diagonals. Alignment is easy using the small opening on one end and thin crosshairs at the other end.



## WIDE-ANGLE EYEPIECES

These Sky-Watcher Wide Angle Eyepieces offer a generous 66° apparent field of view, allowing more sky to be viewed at one time. They provide sharp image right across the field. The rubber eyecups are included for viewing comfort and to keep out extraneous light.

Focal Lengths: 20mm, 15mm, 9mm, 6mm

Eyepiece Barrels: 1.25"

Eye-relief: 14.8mm (W6), 15mm (W9), 13mm (W15), 18mm (W20)



## DUAL FLASHLIGHT

These multipurpose flashlights provide instant switch between the night vision protecting red light and regular white light. A convenient control wheel is available for brightness adjustment.



## APPENDIX C - RECOMMENDED READING

### **A** Amateur Astronomy

Beginner's Guide to Amateur Astronomy: An Owner's Manual for the Night Sky by David J. Eicher and, Michael Emmerich (Kalmbach Publishing Co., Books Division, Waukesha, WI, 1993).

NightWatch: A Practical Guide to Viewing the Universe by Terence Dickinson, (Firefly Books, Willowdale, ON, Canada, 3rd edition, 1999).

Star Testing Astronomical Telescopes by Harold Richard Suiter, (Willmann-Bell, Inc., Richmond, VA, 1994).

Star Ware: The Amateur Astronomer's Ultimate Guide to Choosing, Buying, and Using Telescopes and Accessories by Philip S. Harrington (John Wiley & Sons, New York, 1998).

The Backyard Astronomer's Guide by Terence Dickinson and Alan Dyer (Firefly Books Ltd., Willowdale, ON, Canada, revised edition, 1994).

The Beginner's Observing Guide: An Introduction to the Night Sky for the Novice Stargazer by Leo Enright, (The Royal Astronomical Society of Canada, Toronto, ON, Canada, 1999).

The Deep Sky: An Introduction by Philip S. Harrington (Sky Publishing Corporation, Cambridge, MA, Sky & Telescope Observer's Guides Series, ed. Leif J. Robinson, 1997).

The Universe from Your Backyard: A Guide to Deep Sky Objects by David J. Eicher (Kalmbach Publishing Co., Books Division, Waukesha, WI, 1988).

Turn Left at Orion: A Hundred Night Sky Objects to See in a Small Telescope--and how to Find Them by Guy J. Consolmagno and Dan M. Davis, (Cambridge University Press, New York, 3rd edition, 2000)

### **A** Astro-photography

The Great Atlas of the Stars by Serge Brunier, Constellation photography by Akira Fujii (Firefly Books; Willowdale, ON, Canada 2001).

A Manual Of Advanced Celestial Photography by Brad D. Wallis and Robert W. Provin (Cambridge University Press; New York; 1984).

Astrophotography An Introduction by H.J.P. Arnold (Sky Publishing Corp., Cambridge, MA, Sky & Telescope Observer's Guides Series, ed. Leif J. Robinson, 1995).

Astrophotography for the Amateur by Michael Covington (Cambridge University Press, Cambridge, UK, 2nd edition, 1999).

Splendors of the Universe: A Practical Guide to Photographing the Night Sky by Terence Dickinson and Jack Newton (Firefly Books, Willowdale, ON, Canada, 1997).

Wide-Field Astrophotography by Robert Reeves (Willmann-Bell, Inc., Richmond, VA, 2000).

### **O**bservational References

A Field Guide to the Stars and Planets by Jay M. Pasachoff, (Houghton Mifflin Company, 1999).

Atlas of the Moon by Antonín Růkl (Kalmbach Publishing Co., Books Division, Waukesha, WI, 1993).

Burnham's Celestial Handbook: An Observer's Guide to the Universe Beyond the Solar System by Robert Burnham (Dover Publications, New York; 3- volume set, 1978).

Observer's Handbook by The Royal Astronomical Society of Canada, (University of Toronto Press, Toronto, ON, Canada, published annually).

Sky Atlas 2000.0 by Wil Tirion and Roger W. Sinnott (Sky Publishing Corp., Cambridge, MA, 2nd edition, 1998).

## **CAUTION!**



NEVER USE YOUR TELESCOPE TO LOOK DIRECTLY AT THE SUN. PERMANENT EYE DAMAGE WILL RESULT. USE A PROPER SOLAR FILTER FIRMLY MOUNTED ON THE FRONT OF THE TELESCOPE FOR VIEWING THE SUN. WHEN OBSERVING THE SUN, PLACE A DUST CAP OVER YOUR FINDERSCOPE OR REMOVE IT TO PROTECT YOU FROM ACCIDENTAL EXPOSURE. NEVER USE AN EYEPiece-TYPE SOLAR FILTER AND NEVER USE YOUR TELESCOPE TO PROJECT SUNLIGHT ONTO ANOTHER SURFACE, THE INTERNAL HEAT BUILD-UP WILL DAMAGE THE TELESCOPE OPTICAL ELEMENTS.