CELESTRON®

The G-8

Model #11023

8" OPTICAL TUBE ASSEMBLY

Model #11023-1

CG-5 EQ Mount

Model # 91515

INSTRUCTION MANUAL

TABLE OF CONTENTS

I N T R O D U C T I O N

Welcome to the Celestron world of amateur astronomy! For more than a quarter of a century, Celestron has provided amateur astronomers with the tools needed to explore the universe. The Celestron C8 is the most popular version in our telescope line because it combines large aperture optics with ease of use and portability. With a mirror diameter of 8 inches, your Celestron C8 has a light gathering power of 800 times that of the unaided human eye. Yet, the C8 optical system is extremely compact and portable despite its large aperture because it utilizes the Schmidt-Cassegrain design. This means you can take your C8 to the mountains, desert or wherever you observe.

The Celestron C8 is made of the highest quality materials to ensure stability and durability. All this adds up to a telescope that gives you a lifetime of pleasure with a minimal amount of maintenance. Furthermore, your Celestron C8 is versatile — it will grow as your interest grows.

However, your C8 telescope is not limited to astronomical viewing alone. It can be used as a terrestrial spotting scope to study the world around you. All you need to do is take the time to familiarize yourself with your C8 and its basic operation.

Your G-8 telescope (#11023) is comprised of two componets, the CG-5 equatorial mount and the 8" optical tube assembly. The first sections of this manual covers the assembly and use of the CG-5 Eq mount and the 8" optical tube assembly. The last sections of the manual describe how to use the G-8 telescope as a system and explores such topics as polar alignment, the celestial coordinate system and astrophotography.

It will take a few observing sessions to familiarize yourself with your telescope, so don't get discouraged. You should keep this manual handy until you have fully mastered your telescope's operation.

A Word of Caution

Your G-8 telescope is designed to give you hours of fun and rewarding observations. However, there are a few things to consider before using your telescope that will ensure your safety and protect your equipment.

NEVER LOOK DIRECTLY AT THE SUN WITH THE NAKED EYE OR WITH A TELESCOPE. PERMANENT AND IRREVERSIBLE EYE DAMAGE MAY RESULT.

NEVER USE YOUR TELESCOPE TO PROJECT AN IMAGE OF THE SUN ONTO ANY SURFACE. INTERNAL HEAT BUILD-UP CAN DAMAGE THE TELESCOPE AND/OR ANY ACCESSORIES ATTACHED TO IT.

NEVER USE AN EYEPIECE SOLAR FILTER OR A HERSCHEL WEDGE. INTERNAL HEAT BUILD-UP INSIDE THE TELESCOPE CAN CAUSE THESE DEVICES TO CRACK OR BREAK, ALLOWING UNFILTERED SUNLIGHT TO PASS THROUGH TO THE EYE.

NEVER LEAVE THE TELESCOPE UNSUPERVISED, EITHER WHEN CHILDREN ARE PRESENT OR ADULTS WHO MAY NOT BE FAMILIAR WITH THE CORRECT OPERATING PROCEDURES OF YOUR TELESCOPE.

NEVER POINT YOUR TELESCOPE AT THE SUN UNLESS YOU HAVE THE PROPER MYLAR SOLAR FILTER. WHEN USING YOUR TELESCOPE WITH THE CORRECT SOLAR FILTER, ALWAYS COVER THE FINDER. ALTHOUGH SMALL IN APERTURE, THIS INSTRUMENT HAS ENOUGH LIGHT GATHERING POWER TO CAUSE PERMANENT AND IRREVERSIBLE EYE DAMAGE. IN ADDITION, THE IMAGE PROJECTED BY THE FINDER IS HOT ENOUGH TO BURN SKIN OR CLOTHING.

The Schmidt-Cassegrain Optical System

A telescope is an instrument that collects and focuses light. The nature of the optical design determines how the light is focused. Some telescopes, known as refractors, use lenses while others, known as reflectors, use mirrors. The Schmidt-Cassegrain optical system (or Schmidt-Cass for short) uses a combination of mirrors and lenses and is referred to as a compound or catadioptric telescope. This unique design offers large diameter optics while maintaining very short tube lengths, making them extremely portable. The Schmidt-Cassegrain system consists of a zero power corrector plate, a spherical primary mirror, and a secondary mirror. Once light rays enter the optical system, they travel the length of the optical tube three times.

Inside the optical tube you will notice a black tube (not illustrated) that extends out from the center hole in the primary mirror. This is the primary baffle tube and it prevents stray light from passing through to the eyepiece or camera.

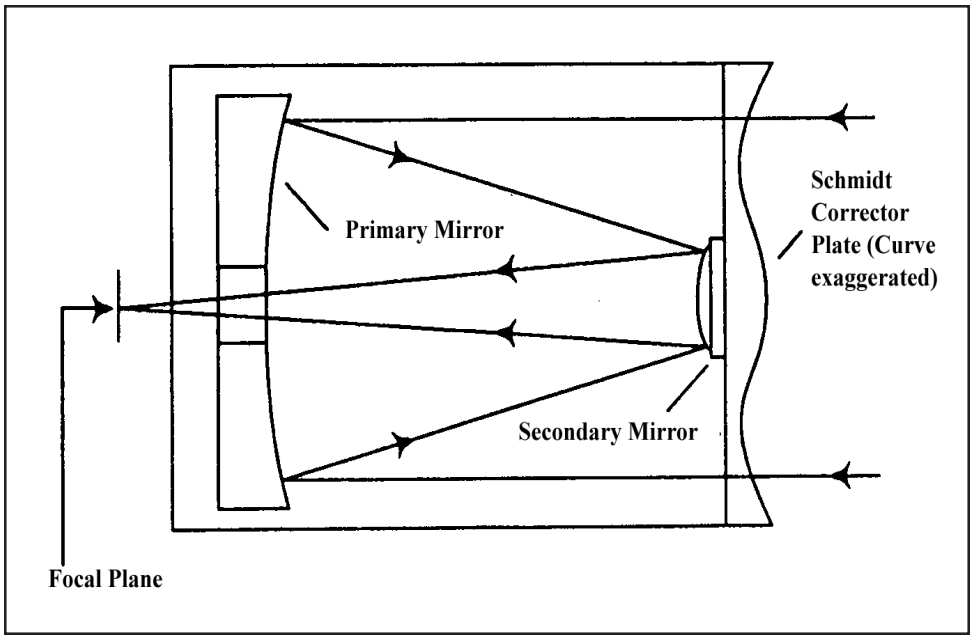


Figure 1-1

This cross-sectional diagram shows the light path of the Schmidt-Cassegrain optical system. Note that the light rays travel the length of the telescope tube three times, making this a compact optical design. Note that the curve of the corrector plate is greatly exaggerated.

ASSEMBLING YOUR G-8

The G-8 (#11023), is the only version of the C8 that is offered on a German equatorial mount. Like all Celestron 8 models, the G-8 uses a Schmidt-Cassegrain optical design. The G-8 is shipped in two boxes. The first contains the optical tube (i.e., telescope) and all the standard accessories, which include:

- 25mm SMA Ocular 1-1/4"
- Visual Back 1-1/4"
- Star Diagonal 1-1/4"
- 6x30mm Finder and Bracket
- Lens Cap

The second box contains the tripod, equatorial mount and the hardware needed to set it up. Included are the:

- CG-5 German Equatorial Mount
- Counterweight Bar
- Two Counterweights (3.6 Kg and 1.8 Kg)
- Declination (DEC) Slow Motion Knob
- Right Ascension (R.A.) Slow Motion Knob
- Adjustable Aluminium Tripod
- Accessory Tray

Unpacking Your G-8

When setting up the telescope, find a large, clear area where the parts can be laid out without fear of losing them. Start with the tripod and mount. Remove the contents of the box and place them neatly on your work surface. Leave the optical tube in its case until you are ready to attach it to the mount. Once your G-8 has been unpacked and assembled, you will not need the shipping boxes for everyday storage and transportation. However, you should save them in case you decide to ship your telescope via a common carrier. The foam lined footlocker for the optical tube should be kept handy for storage and transportation.

The G-8

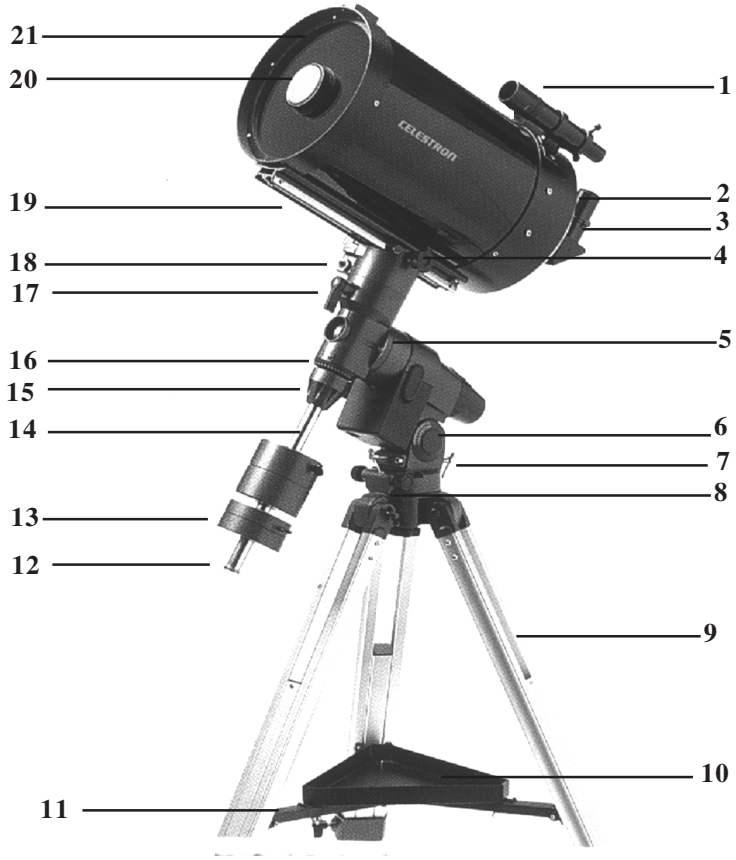


Figure 2-1

1. Finderscope
2. Eyepiece
3. Star Diagonal
4. Dovetail Bar Clamp Knob
5. R.A. Setting Circle
6. Latitude Scale
7. Latitude Adjustment Screw
8. Azimuth Adjustment Knob
9. Tripod
10. Accessory Tray
11. Leg Brace Assembly
12. Counterweight Safety Screw
13. Counterweights
14. Counterweight Shaft
15. Counterweights shaft Lock Collar
16. DEC Circle
17. DEC Lock Lever
18. DEC Slow Motion Shaft
19. Dovetail Slide Bar
20. Collimation Screw Cover
21. Corrector Plate

Assembling the CG-5 Equatorial Mount (#91515)

Setting Up the Tripod

The tripod comes fully assembled with the metal plate, called the tripod head, that holds the legs together at the top. In addition, the brackets that support the accessory tray are also attached to the tripod.

Stand the tripod upright and pull the tripod legs apart until the leg brace assembly for the accessory tray is fully extended (see figure 2-2). The tripod will now stand by itself. To increase the stability, tighten the bolts that hold the legs to the tripod head (use the appropriate size wrench from the supplied set). This will help minimize any flexure or wobble of the legs.

Adjusting the Tripod Height

Once the tripod is set up, you can adjust the height at which it stands. To do this:

1. Loosen the knob on the leg clamp so that the tripod leg can be adjusted.
2. Slide the center portion of the tripod leg away from the tripod head until it is at the desired height.
3. Tighten the knobs on each leg clamp to hold the legs in place.

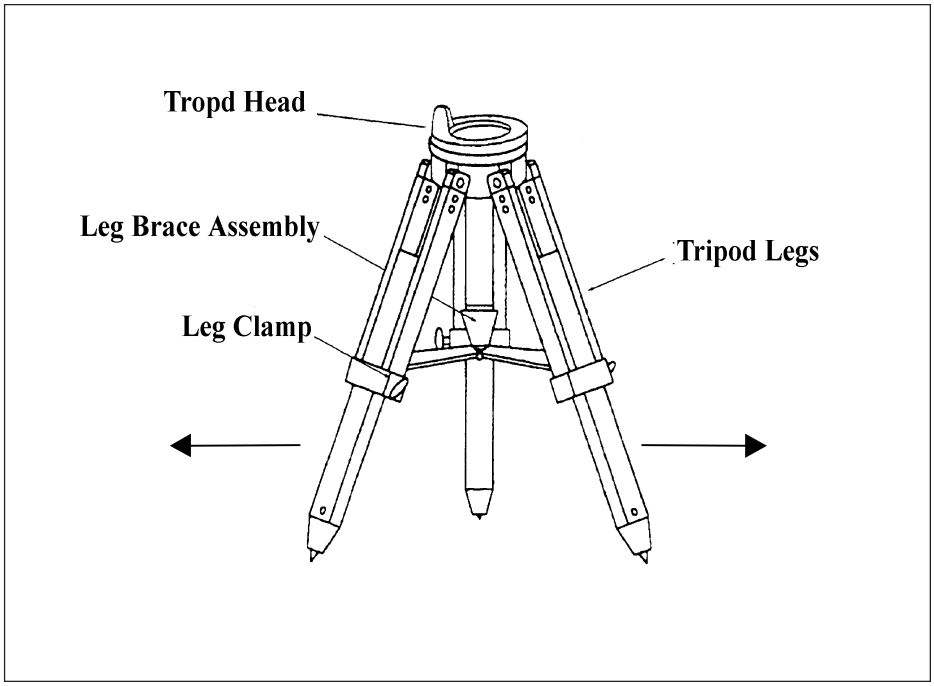


Figure 2-2

Setting up the tripod requires nothing more than pulling the tripod legs away from the tripod head. The height at which the tripod stands can be adjusted by sliding the slats in the center of each leg toward or away from the tripod head.

Attaching the Accessory Tray

With the tripod set up, you are ready to attach the accessory tray to the tripod. There are three wing bolts that hold the accessory tray to the bracket.

1. Locate the three wing bolts.
2. Place the accessory tray over the bracket and position it so the thread holes in the accessory tray are above the slotted holes in the bracket.
3. Insert the wing bolts up through the slotted holes in the bracket (see figure 2-3).
4. Thread the wing bolts into the holes in the accessory tray.
5. Tighten the wing bolts fully.

With the accessory tray in place, the tripod will be much more stable making it easier to attach the mount and telescope.

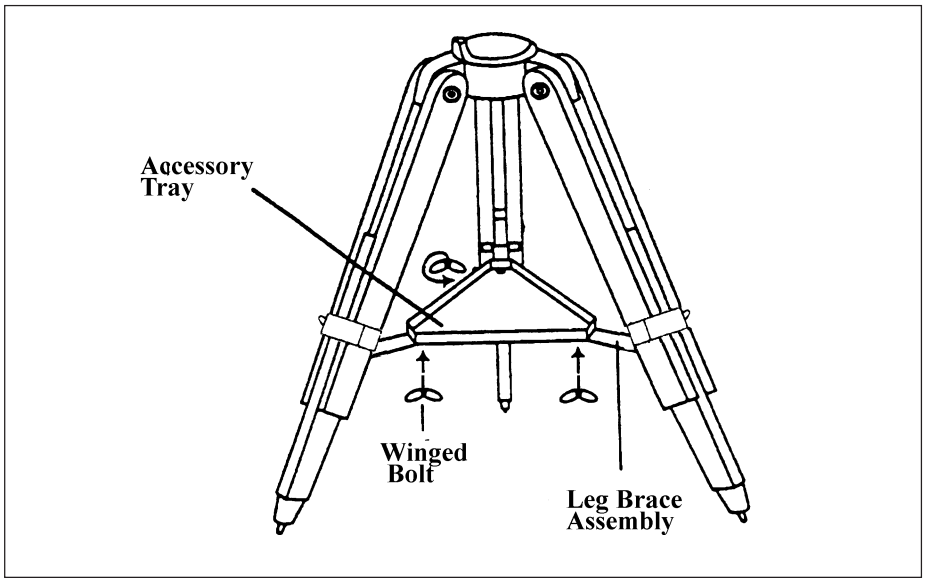


Figure 2-3

Attaching the Equatorial Mount

The equatorial mount allows you to tilt the telescope's axis of rotation so that you can track the stars as they move across the sky. The CG-5 mount is a German equatorial mount that attaches to the tripod head (i.e., metal plate on the tripod). On one side of the plate there is an "N" which signifies north. This side of the tripod will face north when setting up for an astronomical observing session. Above the "N" is a peg about 3/4" high that points straight up. To attach the equatorial head:

1. Locate the azimuth adjustment screws on the equatorial mount.

2. Retract the screws so they no longer extend into the azimuth housing (rectangular extrusion) on the mount. **Do NOT remove the screws since they are needed later for polar alignment.**

3. Hold the equatorial mount over the tripod head so that the azimuth housing is above the metal peg.

4. Place the equatorial mount on the tripod head so that the two are flush.

5. Tighten the knob on the underside of the tripod head to hold the equatorial mount firmly in place. The knob is already attached and can **NOT** be removed.

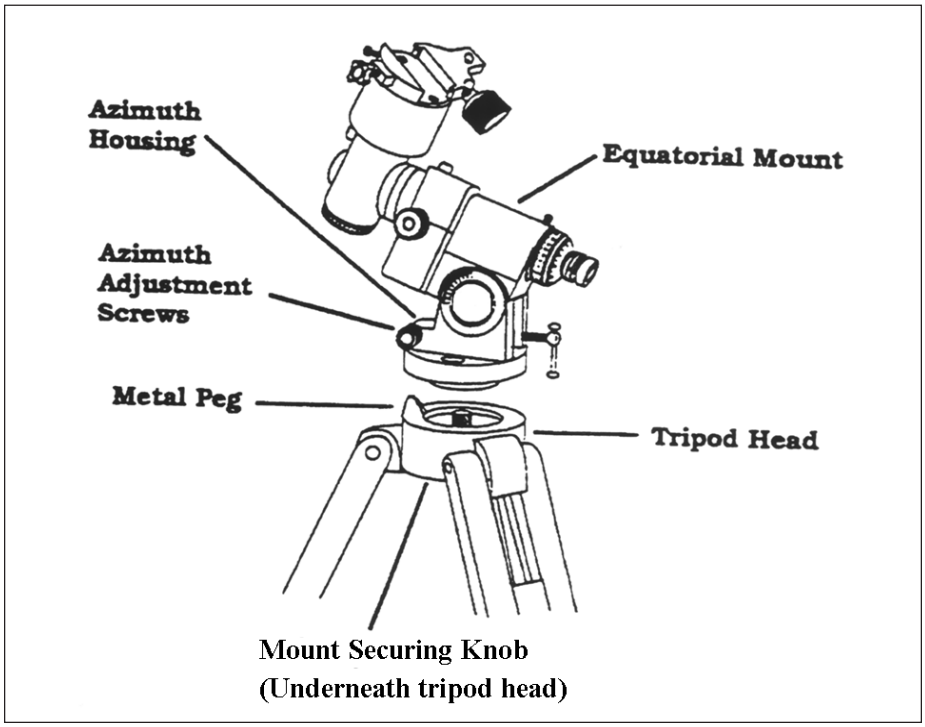


Figure 2-4

Attaching the R.A. Slow Motion Knob

With the mount securely in place, you are ready to attach some of the accessories (the telescope tube will be added last). Start with the Right Ascension (R.A.) slow motion knob. The R.A. slow motion knob allows you to make fine pointing adjustments in the direction the telescope is aiming (once it is attached to the mount). To install the knob:

1. Locate the hard plastic shell under the R.A. shafts.

2. Remove either of the two oval tabs by pulling tightly.

3. Line up the flat area on the inner portion of the R.A. slow motion knob with the flat area on the R.A. shaft (see figure 2-5).

4. Slide the R.A. slow motion knob onto the R.A. shaft.

The knob is a tension fit, so sliding it on holds it in place. As mentioned above, there are two R.A. shafts, one on either side of the mount. It makes no difference which shaft you use since both work the same. Use whichever one you find more convenient. If, after a few observing sessions, you find the R.A. slow motion knob is more accessible from the other side, pull firmly to remove the knob, then install it on the opposite side.

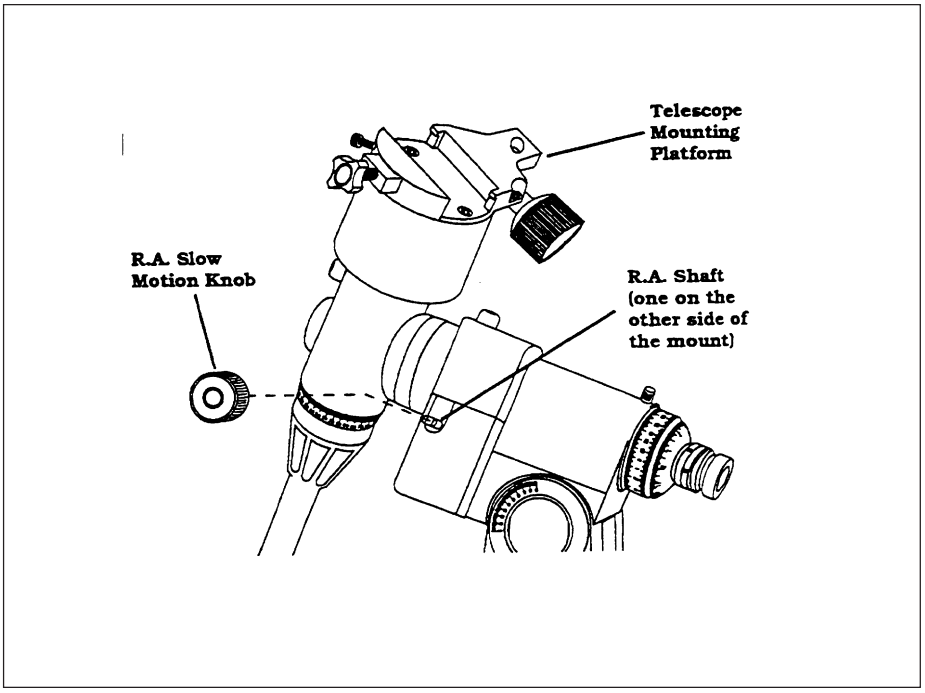


Figure 2-5

Attaching the Declination Slow Motion Knob

Like the R.A. slow motion knob, the DEC slow motion knob allows you to make fine pointing adjustments in the direction the telescope is pointed.

The DEC slow motion knob attaches in the same manner as the R.A. knob. The shaft that the DEC slow motion knob fits over is toward the top of the mount, just below the telescope mounting platform. Once again, you have two shafts to choose from. Use the shaft that is pointing toward the ground. This makes it easy to reach while looking through the telescope, something which is quite important when you are observing.

1. Line up the flat area on the inner portion of the DEC slow motion knob with the flat area on the DEC shaft.

2. Slide the DEC slow motion knob over the DEC shaft (see figure 2-6).

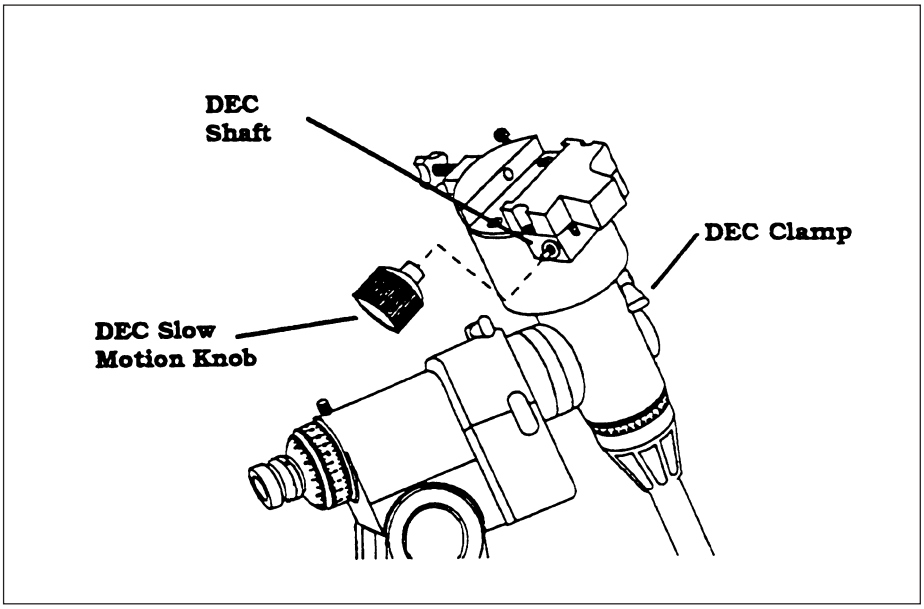


Figure 2-6

Attaching the Counterweight Bar and Counterweights

The last item to be mounted before the telescope tube is the counterweight bar and counterweights. Used to balanced the telescope, the counterweight bar attaches to the opposite side of the mount as the telescope. To install the counterweight bar:

1. Retract the counterweight bar lock nut by turning it counterclockwise. This will expose the threads on the end of the counterweight bar.

2. Thread the counterweight bar into the mount completely. Once again, **it threads into the mount opposite the telescope** (see figure 2-7).

3. Tighten the counterweight bar lock nut fully for added support.

The counterweight bar is now installed. With the counterweight bar in place, you are ready to attach the counterweights.

1. Lock the DEC clamp to hold the mount in place.

2. Remove the safety thumbscrew on the end of the counterweight bar.

3. Loosen the set screw on the counterweight itself so that the central hole of the counterweight is unobstructed.

4. Slide the counterweight onto the counterweight bar. Move it high enough to allow room for the second weight (see figure 2-7).

5. Tighten the set screw on the counterweight to hold it in position.

6. Repeat this process for the second weight.

7. Replace the safety thumbscrew on the end of the counterweight bar. The thumbscrew will prevent the counterweights from sliding off the bar should they ever become loose.

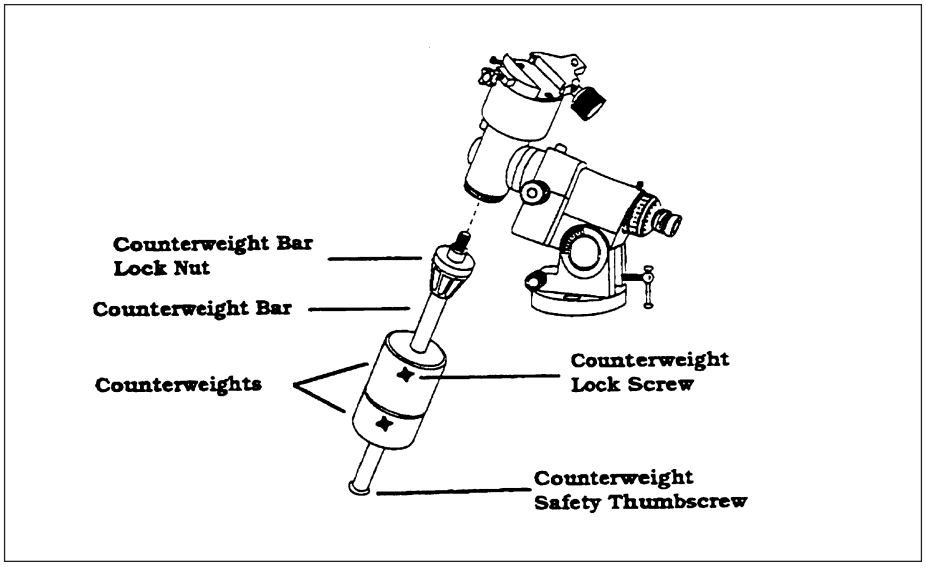


Figure 2-7

Attaching the Telescope to the Mount

With the mount fully assembled, you are ready to attach the telescope to the mount.

- **Before you attach the optical tube, fully tighten the right ascension and declination clamps. This will prevent the telescope from moving suddenly once attached to the mount.**

1. Loosen the hand knob on the side of the CG-5 mount.
2. Slide the dovetail bar that is attached to the telescope onto the CG-5 mount (see figure 2-8).
3. Tighten the knob on the CG-5 mount to hold the telescope in place.

NOTE: Never loosen any of the knobs on the telescope tube or mount. Also, be sure that the corrector end of the telescope is pointing away from the ground at all times.

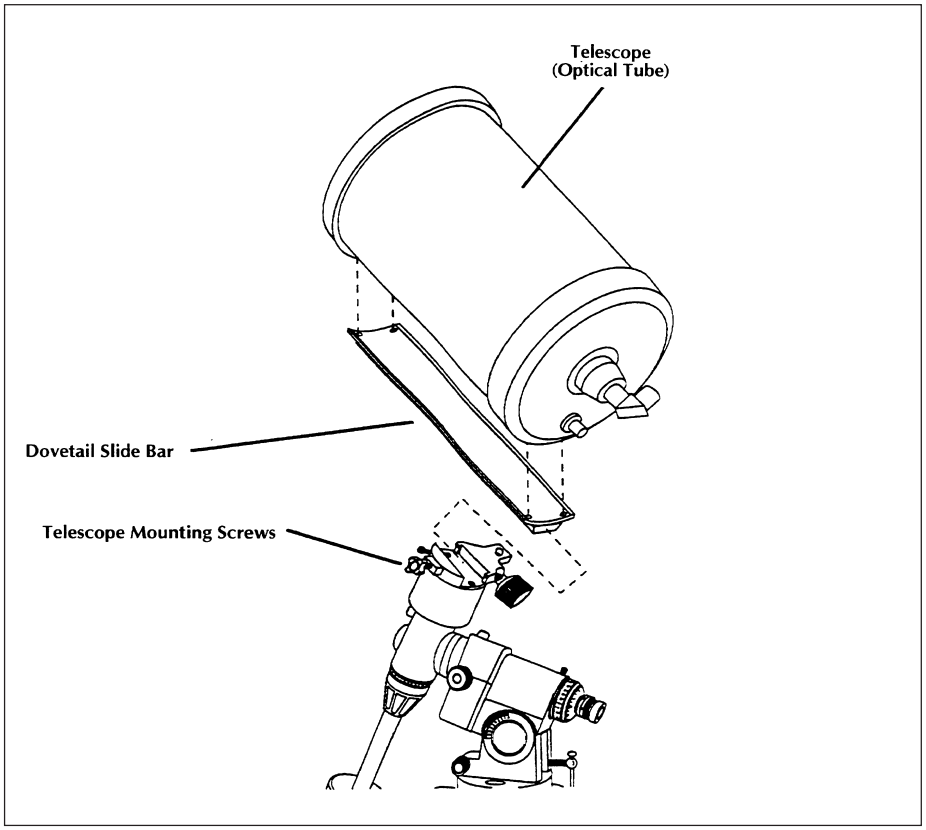


Figure 2-8

This illustration shows the correct mounting procedure for the optical tube onto the CG-5 mount. The dovetail slide bar has been attached to the telescope tube and is ready to attach to the CG-5 mount.

Removing the Lens Cap

The G-8 lens cap utilizes a bayonet-type locking mechanism to hold it in place. To remove the lens cap, hold the cover firmly and rotate the outer edge 1/2" counterclockwise and pull off.

Balancing the Telescope in R.A.

To eliminate undue stress on the mount, the telescope should be properly balanced around the polar axis. In addition, proper balancing is crucial for accurate tracking if using an optional motor drive. To balance the mount:

1. Release the R.A. Clamp and position the telescope off to one side of the mount (make sure that the balance bracket thumbscrew is tight). The counterweight bar will extend horizontally on the opposite side of the mount (see figure 2-9).

2. Release the telescope — **GRADUALLY** — to see which way the telescope "rolls."

3. Loosen the set screw on one or both counterweights.

4. Move the counterweights to a point where they balance the telescope (i.e., it remains stationary when the R.A. clamp is released).

5. Tighten the set screw to hold the counterweight(s) in place.

These are general balance instructions and will reduce undue stress on the mount. When taking astrophotographs, this balance process should be done for the specific area at which the telescope is pointing.

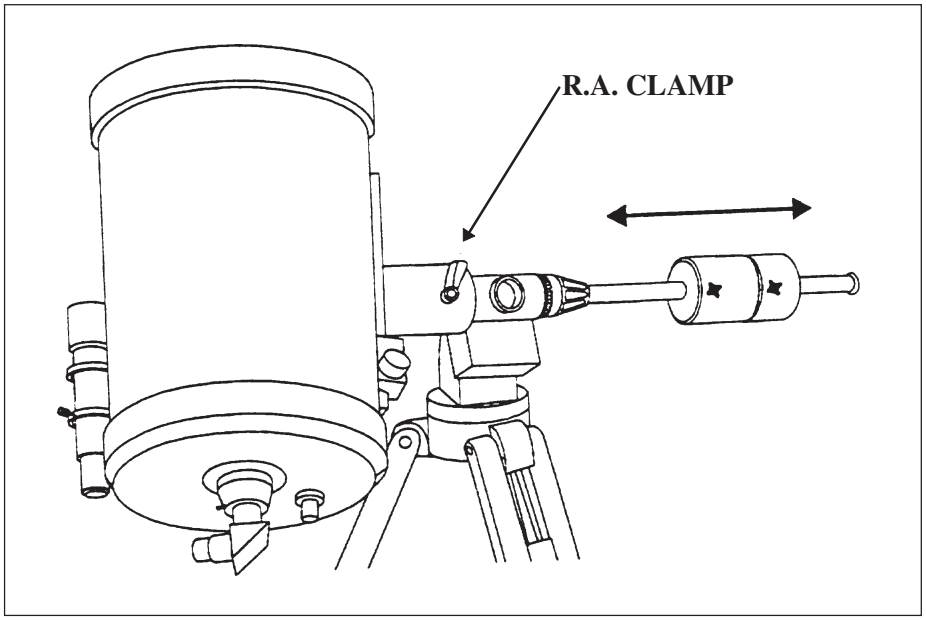


Figure 2-9

The telescope should be balanced after all the standard accessories (i.e., star diagonal, eyepiece, etc.) have been attached to the telescope. The correct procedure for attaching these accessories is discussed in the section on "Telescope Basics."

Balancing the Telescope in DEC

The telescope should also be balanced on the declination axis to prevent any sudden motions when the DEC clamp is released. To balance the telescope in DEC:

1. Release the R.A. clamp and rotate the telescope so that it is on one side of the mount (i.e., as described in the previous section on balancing the telescope in R.A.).

2. Lock the R.A. clamp to hold the telescope in place.

3. Release the DEC clamp and rotate the telescope until the tube is parallel to the ground (see figure 2-10).

4. Release the tube — **GRADUALLY** — to see which way it rotates around the declination axis. **DO NOT LET GO OF THE TELESCOPE TUBE COMPLETELY!**

5. Slightly loosen the balance bracket thumbscrew and slide the telescope either forward or backward until it remains stationary when the DEC clamp is released. **Do NOT let go of the telescope tube while the balance bracket thumbscrew is loose.**

6. Tighten the thumbscrew firmly to hold the telescope in place.

Like the R.A. balance, these are general balance instructions and will reduce undue stress on the mount. When taking astrophotographs, this balance process should be done for the specific area at which the telescope is pointing.

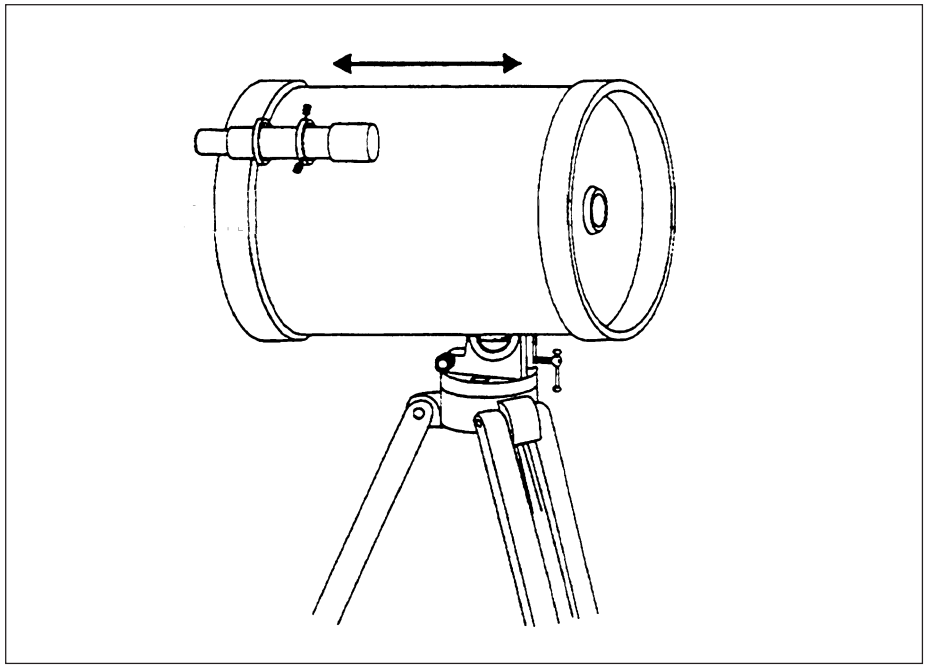


Figure 2-10

As with R.A., the telescope should be balanced in DEC after all the standard accessories (i.e., star diagonal, eyepiece, etc.) have been attached to the telescope.

Adjusting the Mount in Altitude

For the purpose of polar alignment, there are two directions in which the mount can be adjusted; vertically, which is called altitude and horizontally, which is called azimuth. There are several ways to align on the celestial pole, many of which are discussed later in this manual. This section simply covers the correct movement of the mount during the polar alignment process. To adjust the mount in altitude (i.e., raise or lower the angle of the polar axis), turn the altitude adjustment screw:

- Turning the knob clockwise increases the angle at which the polar axis is pointing
- Turning the handle counterclockwise lowers the angle at which the polar axis is pointing.

The latitude adjustment on the CG-5 mount has a range of 40°, starting at 20° going up to 60°.

Adjusting the Mount in Azimuth

For rough adjustments in azimuth, simply pick up the telescope and tripod and move it. For fine adjustments in azimuth:

1. Turn the azimuth adjustment screws located on either side of the azimuth housing. While standing behind the telescope, the knobs are on the front of the mount.
   - Turning the right adjustment knob clockwise moves the mount toward the right.
   - Turning the left adjustment knob clockwise moves the mount to the left.

Both screws push off of the peg on the tripod head, which means you may have to loosen one screw while tightening the other. The screw that holds the equatorial mount to the tripod may have to be loosened slightly.

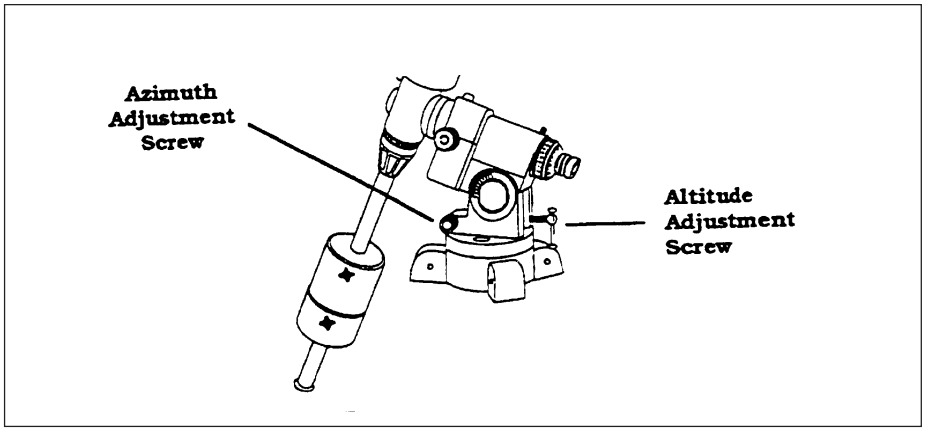


Figure 2-11

Disassembling and Transporting Your G-8

The entire telescope and mount is light enough to pick up and carry outside for a casual observing session. If, however, you want to transport your G-8 to a remote observing location, you must partially disassemble it. Here's how:

1. Remove the telescope from the equatorial mount. Return it to the shipping carton to ensure safe transportation.

2. Remove the three wing bolts that hold the accessory tray to the tripod.

3. Pull the accessory tray off the bracket.

4. Thread the wing bolts back onto the accessory tray once they are removed from the bracket. This will eliminate the possibility of losing them.

5. Fold the tripod legs together and you are ready to transport your G-8 telescope.

The equatorial mount does **NOT** have to be removed if you are transporting the telescope yourself. However, you may want to remove the counterweights from the counterweight bar to lighten the mount.

If you are shipping the telescope via a common carrier, you should completely disassemble the telescope and return all parts to their original shipping container.

Storing Your G-8

When not in use, your Celestron G-8 can be left fully assembled and set up. However, all lens and eyepiece covers should be put back in place. The opening to the rear cell must also be covered. This will reduce the amount of dust build-up on the optical surfaces and reduce the number of times you need to clean the instrument. You may want to return everything to its original shipping container and store all the parts there. If this is the case, all optical surfaces should still be covered to prevent dust build-up.

What Next?

Now that you have completed assembling your G-8, you are ready to begin attaching the accessories. Please turn to the section on "Telescope Basics" for more information.

THE 8" OPTICAL TUBE ASSEMBLY (#11023-1)

The Celestron 8 Optical Tube Assembly (OTA) is simply the telescope without an equatorial mount and clock drive unit. In its standard configuration, the C8 Optical Tube Assembly is designed to attach to a standard, but very rigid, photographic tripod for terrestrial viewing. However, this does not mean that the C8 Optical Tube Assembly can not be used for astronomical viewing. It can also be used with your own heavy duty German equatorial mount or it can be used as an altazimuth telescope for casual astronomical observations. The C8 Optical Tube Assembly (11023-1) is shipped in one carton which contains the telescope and all standard accessories which include:

- 25mm SMA Ocular 1-1/4"
- Visual Back 1-1/4"
- Star Diagonal 1-1/4"
- 6x30mm Finder and Bracket
- Balance Bracket (for tripod adaption) - Dovetail Slide Bar
- Lens Cap

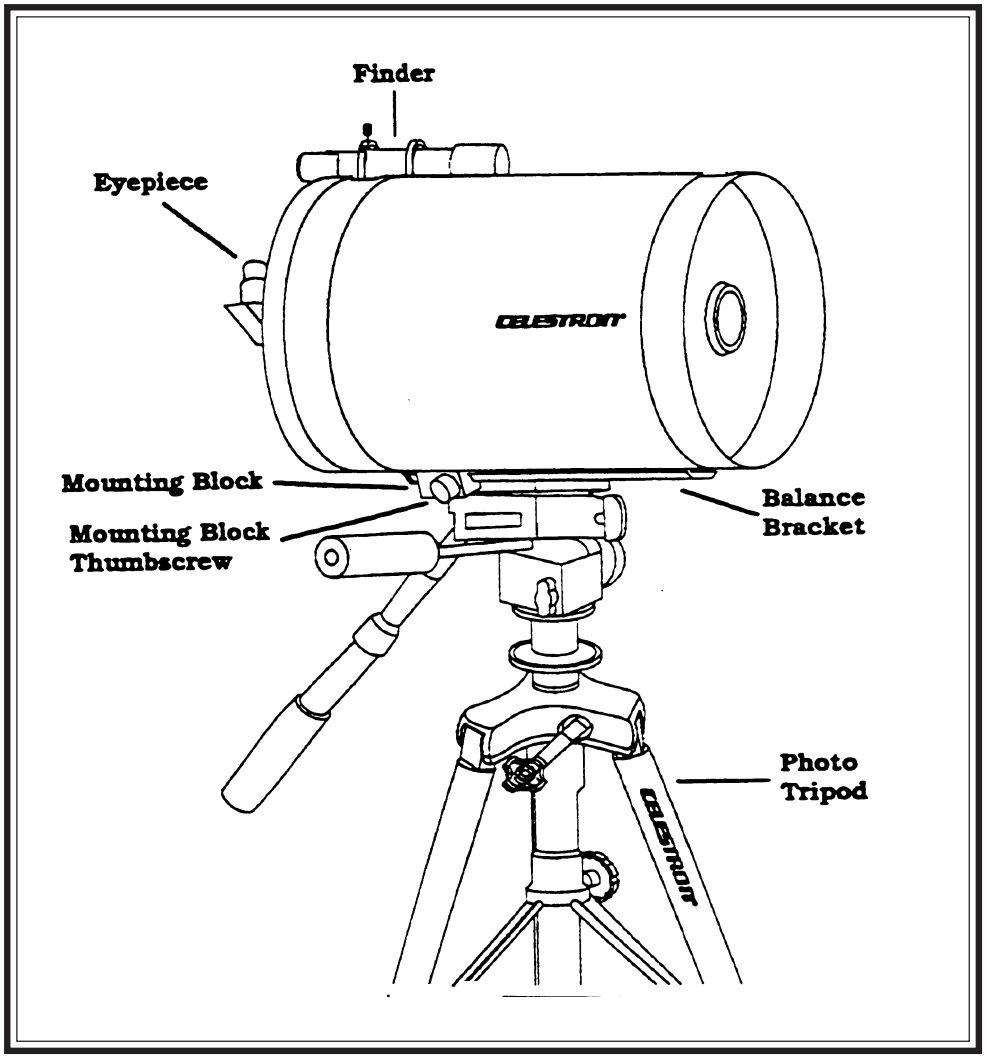


Figure 3-1

Setting Up Your C8 OTA

The C8 Optical Tube Assembly attaches to any photographic tripod with a 1/4x20 threaded screw. The telescope attaches to the tripod via a balance bracket which has two 1/4x20 holes. The two holes are on either end of the bracket. The bracket is held to the C8 by a small thumbscrew. **Be sure the thumbscrew is tight BEFORE you attempt to attach your C8 Optical Tube Assembly to a tripod.** To attach the C8 optical tube to a photographic tripod:

1. Place either of the 1/4x20 holes in the balance bracket over the 1/4x20 screw on your photographic tripod.

2. Tighten the screw to hold the bracket in place.

Once this is done you are ready to attach the finder and accessories. Attaching the finder is described in the following section, while attaching the accessories is described under "Telescope Basics."

WARNING: Never loosen the balance bracket thumbscrew unless you have a firm hold of the telescope tube. Also, be sure that the corrector end of the telescope is pointing away from the ground at all times.

Installing the Finder

The C8 Optical Tube Assembly (#11023-1) comes standard with a 6x30mm finder. To ensure the finder and bracket are not damaged during shipping, they are **NOT** attached to the telescope. Begin by removing the finder and mounting hardware from the plastic shipping wrapper. Included with the finder are five Allen head screws: two hold the bracket to the telescope and three hold the finder in place inside the bracket. The three that hold the finder in place are easy to identify since they are nylon. In addition, there is also a rubber O-ring. This will slide over the finder to keep it secure in the bracket. Mounting the finder and bracket is a two step process; first mount the bracket to the telescope, then mount the finder in the bracket.

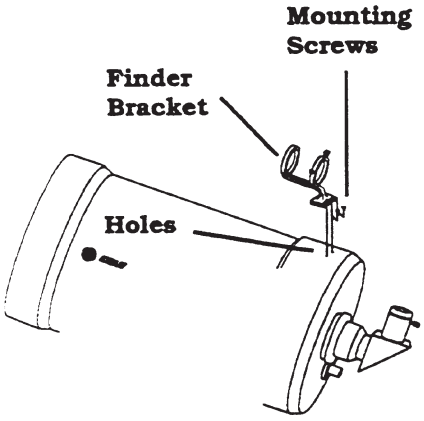


Figure 3-2

Attaching the Finder Bracket to the Telescope

1. Locate the two holes in the rear cell of the telescope just left of center (when looking from the back of the tube).

2. Remove the tape covering the two holes. The tape prevents dust and moisture from entering the optical tube.

3. Place the finder bracket over the holes. The bracket should be oriented so that the ring with the holes for the adjustment screws is closer to the rear cell of the telescope.

4. Thread the screws in by hand and then tighten with one of the Allen wrenches provided.

Attaching the Finder to the Bracket

With the bracket firmly attached to the telescope, you are ready to attach the finder to the bracket.

1. Thread the three screws into the finder bracket that will hold the finder in place. Do not thread them in completely or they will interfere with the placement of the finder. Tighten the screws until the heads are flush with the inner diameter of the bracket ring.

2. Slide the rubber O-ring onto the back of the finder (it will **NOT** fit over the objective end of the finder). It may need to be stretched a little.

3. Position the O-ring on the main body of the finder so that it is toward the front (i.e., objective) end of the finder.

4. Slide the finder, eyepiece end first, into the front ring of the bracket. Push it back until the O-ring is snug inside the front ring of the bracket.

5. Hand tighten the three set screws until snug.

To properly align the finder, please see the section on “Aligning the Finder.”

With the finder in place you are ready to attach the standard accessories, align the finder, and have a look through the telescope. All of these functions are described in the following section.

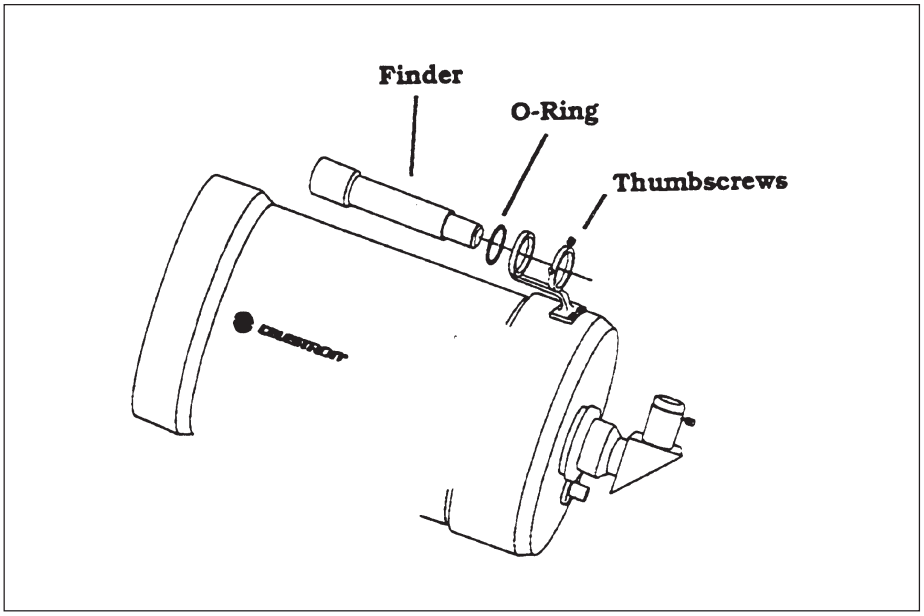


Figure 3-3

Removing the Lens Cap

The C8 Optical Tube Assembly lens cap utilizes a simple locking mechanism to hold it in place. To remove the lens cap, hold the cover firmly and rotate the outer edge 1/2" counterclockwise and pull off.

TELESCOPE BASICS

Once your telescope has been fully assembled, you are ready to attach the accessories and have a look. This section deals with basic telescope operations that are common to all Celestron 8 telescopes.

Attaching the Accessories

There are several accessories that come standard with all the Celestron 8 telescopes. The installation and use of each of these is described in this section.

The Visual Back

The visual back is the accessory that allows you to attach all visual accessories to the telescope. The G-8, and the C8 Optical Tube come with the visual back installed. If it is not already on the tube it can be attached as follows:

1. Remove the rubber cover on the rear cell.

2. Place the knurled slip ring on the visual back over the threads on the rear cell (see figure 4-2).

3. Hold the visual back with the set screw in a convenient position and rotate the knurled slip ring clockwise until tight.

Once this is done, you are ready to attach other accessories, such as eyepieces, diagonal prisms, etc.

If you want to remove the visual back, rotate the slip ring counterclockwise until it is free of the rear cell.

The Star Diagonal

The star diagonal uses a mirror that reflects the light at a right angle to the light path of the telescope. This allows you to observe in positions that are physically more comfortable than if you were to look straight through. To attach the star diagonal:

1. Turn the set screw on the visual back until it no longer extends into (i.e., obstructs) its inner diameter of the visual back.

2. Slide the chrome portion of the star diagonal into the visual back (see figure 4-2).

3. Tighten the set screw to hold the star diagonal in place.

If you wish to change the orientation of the star diagonal, loosen the set screw on the visual back until the star diagonal rotates freely. Rotate the diagonal to the desired position and tighten the set screw.

The Eyepiece

The eyepiece, or ocular, is an optical element that magnifies the image focused by the telescope. The eyepiece(s) fits into either the visual back directly (see figure 4-1), the star diagonal, or an erect image diagonal. To attach an eyepiece:

1. Loosen the set screw on the star diagonal so that it does not obstruct the inner diameter of the eyepiece end of the diagonal.

2. Slide the chrome portion of the eyepiece into the star diagonal (see figure 4-2).

3. Tighten the set screw to hold the eyepiece in place.

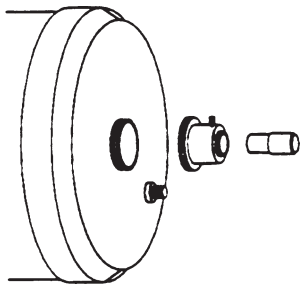


Figure 4-1

To remove the eyepiece, loosen the set screw on the star diagonal and slide the eyepiece out. You can then replace it with another ocular.

Eyepieces are commonly referred to by focal length and barrel diameter. The focal length of each eyepiece is printed on the eyepiece barrel. The longer the focal length (i.e., the larger the number) the lower the eyepiece magnification (i.e., power) and the shorter the focal length (i.e., the smaller the number) the higher the magnification. Generally, you will use low-to-moderate power when viewing. For more information on how to determine power, see the section on "Calculating Magnification."

Barrel diameter is the diameter of the barrel that slides into the star diagonal or visual back. All Celestron C8 telescopes use eyepieces with a 1-1/4" barrel diameter.

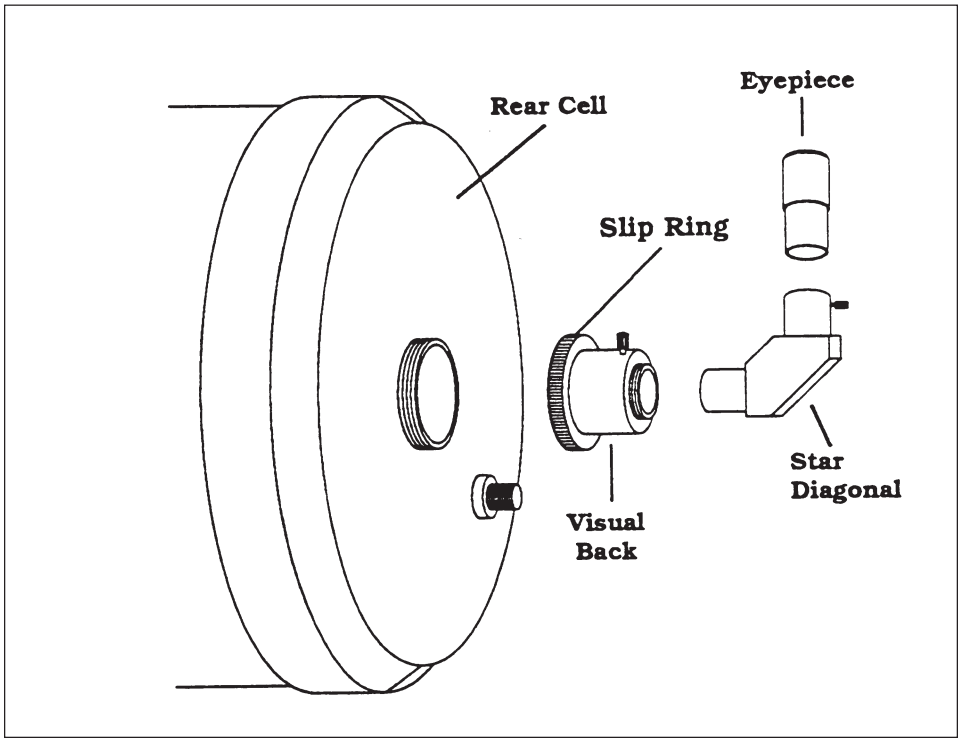


Figure 4-2

Image Orientation

It should be noted that the image orientation will change depending on the viewing configuration. When using the star diagonal, the image is right-side-up, but reversed from left-to-right. If inserting the eyepiece into the visual back (i.e., without the star diagonal), the image is inverted (upside down and reversed from left-to-right). This holds true for the 6x30 finder as well as the telescope. For correct orientation through the telescope, which is important primarily for terrestrial observing, use the optional 45° erect image diagonal 1-1/4" (#94112-A).

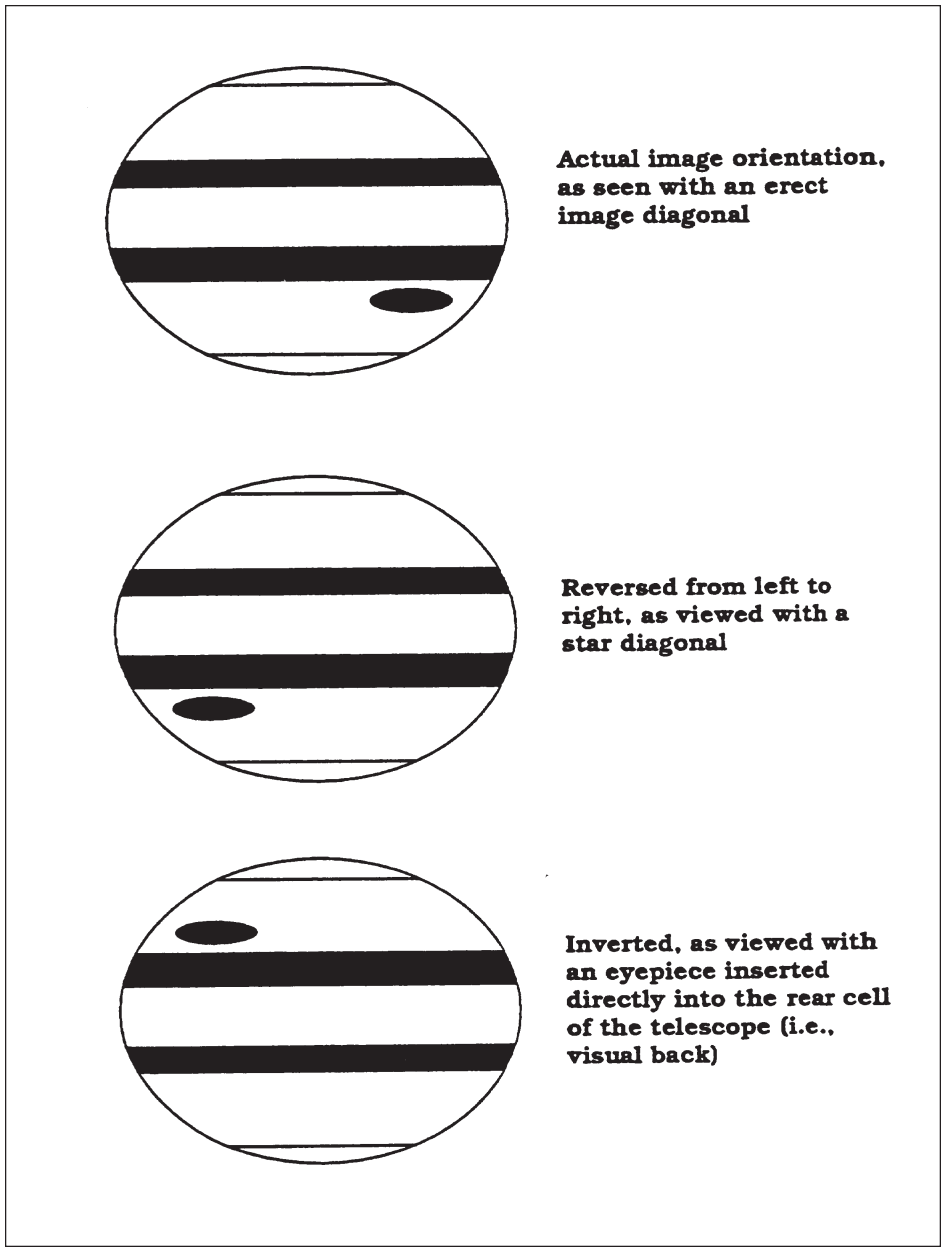


Figure 4-3

These simplified drawings of the planet Jupiter illustrate the different image orientations obtained when using various viewing configurations.

Focusing

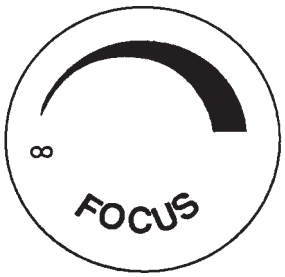


Figure 4-4

The decal on the end of the focus knob shows the correct rotational direction for focusing the C8.

Each of the Celestron 8 telescopes uses the same focusing mechanism. The primary mirror is mounted on a ring which slides back and forth on the primary baffle tube (see figure 4-5). The focusing knob, which moves the primary mirror, is on the rear cell of the telescope. To focus, turn the focusing knob until the image is sharp. If the knob will not turn, it has reached the end of its travel on the focusing mechanism. Turn the knob in the opposite direction until the image is sharp. Once an image is in focus, turn the knob clockwise to focus on a closer object and counterclockwise for a more distant object (see figure 4-4). A single turn of the focusing knob moves the primary mirror only slightly. Therefore, it will take many turns (about 40) to go from close focus (approximately 25 feet) to infinity.

For astronomical viewing, out of focus star images are very diffuse making them difficult, if not impossible, to see. If you turn the focus knob too quickly, you can go right through focus without seeing the image. To avoid this problem, your first astronomical target should be a bright object (like the Moon or a planet) so that the image is visible even when out of focus.

Critical focusing is best accomplished when the focusing knob is turned in such a manner that the mirror moves against the pull of gravity. In doing so, any mirror shift is minimized. For astronomical observing, both visually and photographically, this is done by turning the focus knob counterclockwise.

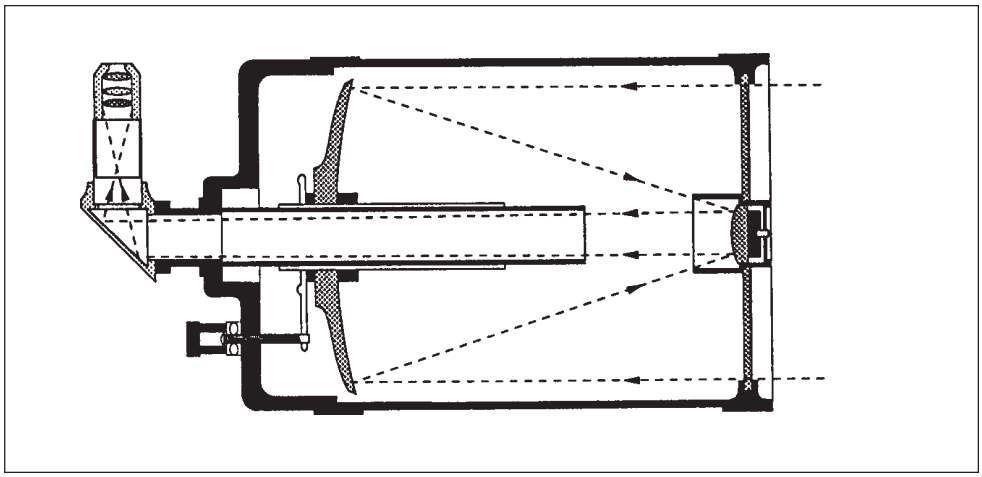


Figure 4-5

This diagram shows the focusing mechanism of the C8 telescopes.

Aligning the Finder

The G-8 and the C8 Optical Tube Assembly come with a 6x30mm finder. The finder is designed to help you find objects that are easily overlooked in the main optics of the telescope. The first number used to describe the finder is the power. The second number is the diameter of the objective lens in millimeters. For example, the G-8 finder is 6x30 which means it is 6 power and has a 30mm objective lens. Incidentally, power is always compared to the unaided human eye. So, a 6 power finder magnifies images six times more than the human eye.

To make things a little easier, you should align the finder during the day when it is easier to locate objects. To align the finder:

1. Choose a conspicuous object that is over 500 yards away. This will eliminate any possible parallax effect.

2. Point your telescope at the target and center it in the main optics of the telescope.

3. Lock the R.A. and DEC clamps to hold the telescope in place.

4. Check the finder to see where the object is located in the field of view.

5. Adjust the screws on the finder bracket, tightening one while loosening another, until the cross hairs are centered on the target.

6. Tighten each screw an additional quarter of a turn until you are sure they will not come loose easily.

Accurate alignment of the finder will make it much easier to find objects in the main optical tube.

Your First Look

With the telescope fully assembled and all the accessories attached you are ready for your first look. Your first look should be done in the daytime when it will be easier to locate the locking clamps and adjustment handles. This will help to familiarize you with your telescope, thus making it easier to use at night.

Daytime Observing

As mentioned in the introduction, your Celestron G-8 telescope works well as a terrestrial spotting scope. When not used to examine objects in the night sky, it can be used to study objects here on Earth.

WARNING! **NEVER POINT YOUR TELESCOPE AT THE SUN UNLESS YOU HAVE THE PROPER MYLAR SOLAR FILTER. PERMANENT AND IRREVERSIBLE EYE DAMAGE MAY RESULT AS WELL AS DAMAGE TO YOUR TELESCOPE. ALSO, NEVER LEAVE YOUR TELESCOPE UNATTENDED DURING A DAYTIME OBSERVING SESSION, ESPECIALLY WHEN CHILDREN ARE PRESENT.**

1. Begin by finding a distant object that is fairly bright.
2. Insert the eyepiece (one with a large focal length) into the telescope.
3. Release the R.A. and DEC clamps and point the telescope at the object you selected.
4. Locate the object in your finder and lock the R.A. and DEC clamps.
5. Use the slow motion knobs to center the object in the field of the finder.
6. Once centered, look through the main optics and the object will be there (if you aligned the finder first).

Try using optional eyepieces to see how the field changes with various magnifications. Casual terrestrial observing can be done with the telescope and German mount placed on a flat, sturdy surface. In this configuration, the R.A. and DEC slow motion knobs control the horizontal and vertical adjustments, respectively.

The optical tube assembly, when mounted on a photographic tripod, functions like an altazimuth telescope. Furthermore, the G-8, when removed from the mount, operates like the optical tube assembly.

Nighttime Observing

Looking at objects in the sky is quite different than looking at objects on Earth. For one, many objects seen in the daytime are easy to see with the naked eye and can be located by using landmarks. In addition, objects on the ground are stationary, at least for the most part. In the night sky you will see a tremendous amount of stars through the telescope that are not visible to the naked eye. One way to find objects (at least initially) is by using other stars to guide you there. This method of finding objects, known as star hopping, is very accurate. Yet it requires a fair amount of time to learn the stars well enough to guide you to other objects. In addition, the stars will appear to drift out of the field of view. This is due to the Earth's rotation. In fact, anything in the sky, day or night, will drift out unless the telescope has been polar-aligned and the optional motor drive is running. There is more on this in the section on "Polar Alignment."

1. Orient the telescope so that the equatorial mount is pointing north, as close to true north as possible. You can use a landmark that you know faces north to get you in the general direction.

2. Adjust the mount until the latitude indicator points to the latitude of your observing site.

3. Insert the eyepiece (low power) into the telescope to give you the widest field possible.

4. You are now ready to observe.

5. Release the right ascension and declination clamps and point the telescope at the desired target. The Moon or one of the brighter planets is an ideal first target.

6. Locate the object in the finder.

7. Lock the R.A. and DEC clamps to hold the telescope in place.

8. Center the object in the finder using the slow motion knobs.

9. Turn the focus knob until the image is sharp.

10. Take your time and study your subject. If looking at the Moon, look for small details in the craters.

That's all there is to using your Celestron telescope. However, don't limit your view of an object to a single eyepiece. After a few minutes, try using a different optional eyepiece, a more powerful one. This gives you an idea of how the field of view changes.

Calculating Magnification

You can change the power of your Celestron G-8 telescope just by changing the eyepiece (ocular). To determine the magnification for your telescope, you would simply divide the focal length of the telescope (2000mm) by the focal length of the eyepiece that you are using. In equation format, the formula looks like this:

$$\text{Magnification} = \frac{\text{Focal Length of Telescope (mm)}}{\text{Focal Length of Eyepiece (mm)}}$$

Let's say, for example, that you are using a 10mm eyepiece. To determine the magnification, simply divide the focal length of your C8 (2000mm) by the focal length of the eyepiece (10mm). Dividing 2000 by 10 yields a magnification of 200 power.

Although the power is variable, each instrument has a limit to the highest useful magnification. The general rule is that 60 power can be used for every inch of aperture. For example, the C8 is 8" in diameter. Multiplying 8 by 60 gives a maximum useful magnification of 480 power. Although this is the maximum useful magnification, due to limiting atmospheric conditions most observing is done in the range of 20 to 35 power for every inch of aperture which is 160 to 280 power for the G-8.

Determining Field of View

Determining the field of view is important if you want to get an idea of the size of the object you are observing. To calculate the actual field of view, divide the apparent field of the eyepiece (supplied by the eyepiece manufacturer) by the magnification. In equation format, the formula looks like this:

$$\text{True Field} = \frac{\text{Apparent Field of Eyepiece}}{\text{Magnification}}$$

Using the example we started with above, we can determine the field of view using the same 10mm eyepiece. The 10mm eyepiece has an apparent field of view of 46°. Divide the 46° by the magnification, which is 200 power. This yields an actual field of .2°, or a little less than a quarter of a degree.

For terrestrial viewing, field size is often referred to as feet at a thousand yards. To convert this to feet at one thousand yards, multiply the actual field of .2° by 52.5. This produces a field width of 10.5 feet at one thousand yards.

The apparent field of each eyepiece that Celestron manufacturers is found in the Celestron Accessory Catalog (#93685).

General Observing Hints

When working with any optical instrument, there are a few things to remember to ensure you get the best possible image.

- Never look through window glass. Glass found in household windows is optically imperfect and, as a result, may vary in thickness from one part of a window to the next. This inconsistency can and will affect the ability to focus your telescope. In most cases you will not be able to achieve a truly sharp image. In some cases, you may actually see a double image.

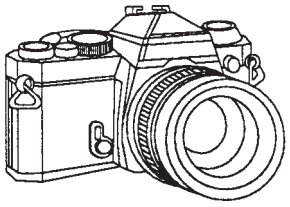
- Never look across or over objects that are producing heat waves. This includes asphalt parking lots on hot summer days or building rooftops.

- Hazy skies, fog, and mist can also make it difficult to focus when viewing terrestrially. The amount of detail seen under these conditions is greatly reduced. Also, when photographing under these conditions, the processed film may come out a little grainier than normal with lower contrast.

- When using your C8 as a telephoto lens, the split screen or microprism focuser of the 35mm SLR camera may "black out." This is common with all long focal length lenses. If this happens, use the ground glass portion of your focusing screen. To achieve a very sharp focus, consider using a focusing magnifier. These are readily available from your local camera store.

- If you wear corrective lenses (specifically glasses), you may want to remove them when observing with an eyepiece attached to your C8. When using a camera, however, you should always wear corrective lenses to ensure the sharpest possible focus. If you have astigmatism, corrective lenses should be worn at all times.

General Photography Hints



Your Celestron telescope can be used for both terrestrial and astronomical photography. Your G-8 has a fixed aperture and, as a result, a fixed f/ratio. To properly expose your subjects photographically, you need to set your shutter speed accordingly. Most 35mm single lens reflex (SLR) cameras offer through-the-lens metering that lets you know if your picture is under or overexposed. This is important for terrestrial photography where exposure times are measured in fractions of a second. In astrophotography, the exposures are much longer, requiring that you use the "B" setting on your camera. The actual exposure time is determined by how long you keep the shutter open. More on this in the section on "Celestial Photography."

To reduce vibration when tripping the shutter, use a cable release. Releasing the shutter manually can cause vibration, something that produces blurred photos. A cable release allows you to keep your hands clear of the camera and telescope, thus reducing the possibility of shaking the telescope. Mechanical shutter releases can be used, though air-type releases are best.

A S T R O N O M Y B A S I C S

This section deals with observational astronomy in general. It includes information on the night sky, polar alignment, and using your telescope for astronomical observations.

The Celestial Coordinate System

In order to help find objects in the sky, astronomers use a celestial coordinate system which is similar to our geographical coordinate system here on Earth. The celestial coordinate system has poles, lines of longitude and latitude, and an equator. For the most part, these remain fixed against the background stars.

The celestial equator runs 360 degrees around the Earth and separates the northern celestial hemisphere from the southern. Like the Earth's equator it bears a reading of zero degrees. On Earth this would be latitude. However, in the sky this is now referred to as declination, or DEC for short. Lines of declination above and below the celestial equator are labeled for their angular distance from the equator. The lines are broken down into degrees, minutes, and seconds of arc. Declination readings south of the equator carry a minus sign (-) in front of the number and those north are often preceded by a plus sign (+).

The celestial equivalent of longitude is called Right Ascension, or R.A. for short. Like the Earth's lines of longitude, they run from pole to pole and are evenly spaced 15 degrees apart. Although the longitude lines are separated by an angular distance, they are also a measure of time. Each line of longitude is one hour apart from the next. Since the Earth rotates once every 24 hours, there are 24 lines total. The R.A. coordinates are marked off in units of time. It begins with an arbitrary point in the constellation of Pisces designated as 0 hours, 0 minutes, 0 seconds. All other points are designated by how far (i.e., how long) they lag behind this coordinate after it passes overhead moving toward the west.

Your Celestron telescope comes equipped with setting circles that translate the celestial coordinates into a precise location for the telescope to point. The setting circles will not work properly until you have polar aligned the telescope and set the R.A. setting circle. Note that the process of polar alignment sets the declination setting circle.

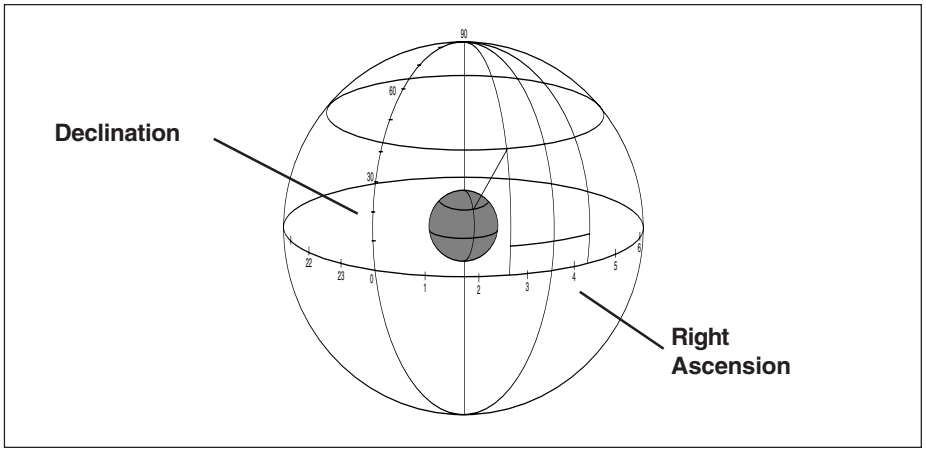


Figure 5-1

Motion of the Stars

Like the Sun, the stars also appear to move across the sky. This motion is caused by the Earth's rotation. For observers in the northern hemisphere, all stars appear to move around the north celestial pole. For observers in the southern hemisphere, all stars appear to move around the south celestial pole. This means that over a 24-hour period, any given star will scribe out a complete circle around its respective celestial pole. The farther you move away from the celestial pole, the larger this circle becomes and is largest at the celestial equator. Stars near the celestial equator rise in the east and set in the west. However, stars near the celestial poles are always above the horizon. They are said to be circumpolar because they don't rise and set. You will never see the stars complete one circle because the sunlight during the day washes out the starlight. However, part of this circular motion of stars in this region of the sky can be seen by setting up a camera on a tripod and opening the shutter for a couple of hours. The processed film will reveal circular arcs that are centered on the pole. This information will be useful for certain methods of polar alignment.

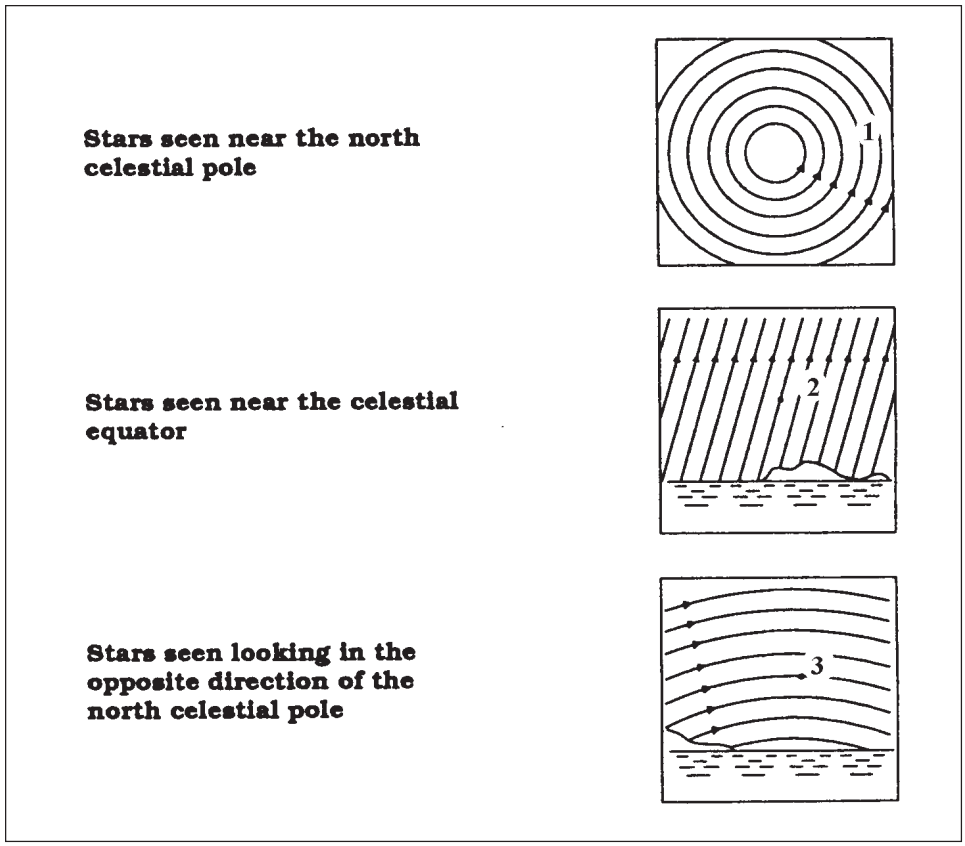


Figure 5-2

All stars appear to rotate around the celestial poles. However, the appearance of this motion varies depending on where you are looking in the sky. Near the north celestial pole the stars scribe out recognizable circles centered on the pole (1). Stars near the celestial equator also follow circular paths around the pole. But, the complete path is interrupted by the horizon. These appear to rise in the east and set in the west (2). Looking toward the opposite pole, stars curve or arc in the opposite direction scribing a circle around the opposite pole (3).

Polar Alignment

In order for the telescope to track the stars it must meet two criteria. First, you need a drive motor that will move at the same rate as the stars. For the G-8 there are two optional motor drives (#93518 and #93820-C) that can be fitted to it. The second thing you need is to set the telescope's axis of rotation so that it tracks in the right direction. Since the motion of the stars across the sky is caused by the Earth's rotation about its axis, the telescope's axis must be made parallel to the Earth's axis.

Polar alignment is the process by which the telescope's axis of rotation is aligned (made parallel) with the Earth's axis of rotation. Once aligned, a telescope with a clock drive will track the stars as they move across the sky. The result is that objects observed through the telescope will appear stationary (i.e., they will not drift out of the field of view). If your telescope does not use a motor drive, all objects in the sky (day or night) will drift out of the field. This apparent motion is caused by the Earth's rotation. Even if you are not using a motor drive, polar alignment is still desirable since it will reduce the number of corrections needed to follow an object and will limit all corrections to one axis (R.A.). There are several methods of polar alignment, all of which work on a similar principle, but are performed somewhat differently. Each method will be considered separately, beginning with the easier methods and working to the more difficult, but more precise.

Although there are several methods mentioned here, you will never use all of them during one particular observing session. Instead, you may use only one if it is a casual observing session. Or, if you plan on astrophotography, you may use two methods — one for rough alignment followed by a more accurate method.

Definition:

The polar axis is the axis around which the telescope rotates when moving the telescope in right ascension. This axis remains stationary as the telescope moves in right ascension and declination.

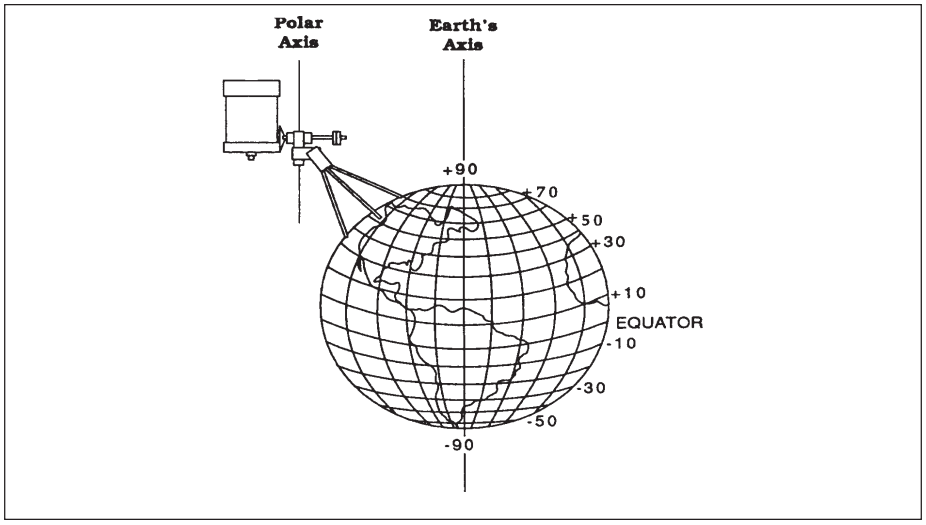


Figure 5-3

When the telescope's axis of rotation is parallel to the Earth's axis, stars viewed through the telescope appear stationary when using a motor drive.

Finding the Pole

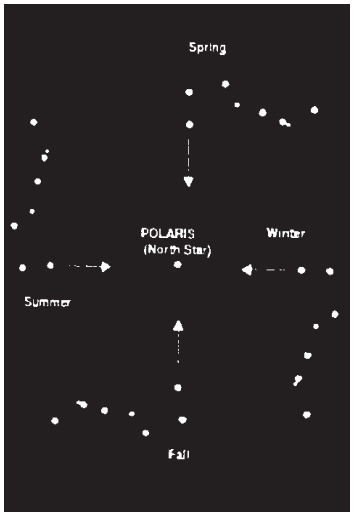


Figure 5-4

The position of the Big Dipper changes throughout the year and throughout the night.

For each hemisphere, there is a point in the sky around which all the other stars appear to rotate. These points are called the celestial poles and are named for the hemisphere in which they reside. For example, in the northern hemisphere all stars move around the north celestial pole. When the telescope's polar axis is pointed at the celestial pole, it is parallel to the Earth's rotational axis.

Many of the methods of polar alignment require that you know how to find the celestial pole by identifying stars in the area. For those in the northern hemisphere, finding the celestial pole is relatively easy. Fortunately, we have a naked eye star less than a degree away. This star, Polaris, is the end star in the handle of the Little Dipper (see figure 5-5). Since the Little Dipper (technically called Ursa Minor) is not one of the brightest constellations in the sky, it may be difficult to locate, especially from urban areas. If this is the case, use the two end stars in the bowl of the Big Dipper. Draw an imaginary line through them (about five times the distance between these two stars) toward the Little Dipper. They will point to Polaris. The position of the Big Dipper will change during the year and throughout the course of the night (see figure 5-4). When the Big Dipper is difficult to locate, try using Cassiopia.

Observers in the southern hemisphere are not as fortunate as those in the northern hemisphere. The stars around the south celestial pole are not nearly as bright as those around the north. The closest star that is relatively bright is Sigma Octantis. This star is just within naked eye limit (magnitude 5.5) and lies 59 arc minutes from the pole. For more information about stars around the south celestial pole, please consult a star atlas.

While it may seem that pointing at the pole star produces a parallax effect, especially for observers near the equator, this effect is negligible since Polaris is so far away.

Definition:

The north celestial pole is the point in the northern sky around which all stars appear to rotate. The counterpart in the southern hemisphere is referred to as the south celestial pole.

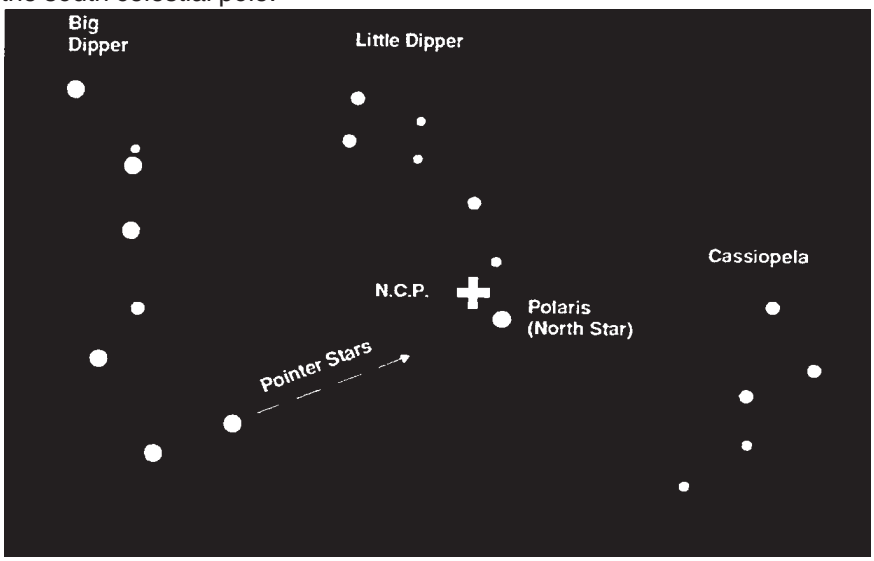


Figure 5-5

The two stars in the front of the bowl of the Big Dipper point to Polaris which is less than one degree from the true (north) celestial pole. Cassiopia, the "W" shaped constellation is on the opposite side of the pole from the Big Dipper. The North Celestial Pole (N.C.P.) is marked by the "+" sign.

Latitude Scales

The easiest way to polar align a telescope is with a latitude scale. Unlike other methods that require you to find the celestial pole by identifying certain stars near it, this method works off of a known constant to determine how high the polar axis should be pointed. The latitude range varies depending upon the C8 you own. The range for the G-8 is 40°.

The constant, mentioned above, is a relationship between your latitude and the angular distance the celestial pole is above the northern (or southern) horizon. The angular distance from the northern horizon to the north celestial pole is always equal to your latitude. To illustrate this, imagine that you are standing on the north pole, latitude +90°. The north celestial pole, which has a declination of +90°, would be directly overhead (i.e., 90 above the horizon). Now let's say that you move one degree south. Your latitude is now +89° and the celestial pole is no longer directly overhead. It has moved one degree closer toward the northern horizon. This means the pole is now 89° above the northern horizon. If you move one degree further south, the same thing happens again. As you can see from this example, the distance from the northern horizon to the celestial pole is always equal to your latitude.

If you are observing from Los Angeles, which has a latitude of 34°, then the celestial pole would be 34° above the northern horizon. All a latitude scale does then is to point the polar axis of the telescope at the right elevation above the northern (or southern) horizon. To align your telescope:

1. Point your telescope due north. Use a landmark that you know faces north.

2. Level the tripod by raising or lowering the legs as needed. There is a bubble level built into the tripod of the CG-5 mount for this purpose.

3. Adjust the telescope mount in altitude until the latitude indicator points to your latitude.

This method can be done in daylight, thus eliminating the need to fumble around in the dark. Although this method does **NOT** put you directly on the pole, it will limit the number of corrections needed when tracking an object. It will also be accurate enough for short exposure prime focus planetary photography (a couple of seconds) and short exposure piggyback astrophotography.

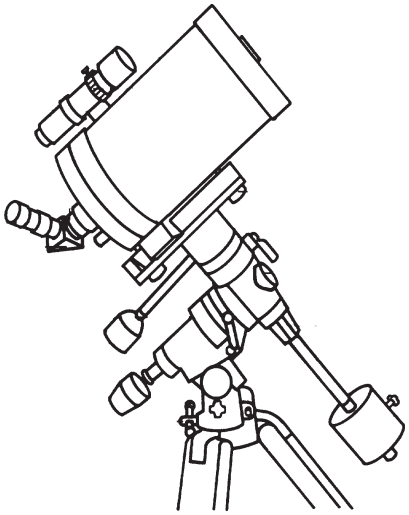


Figure 5-6

Pointing at Polaris

This method utilizes Polaris as a guidepost to the celestial pole. Since Polaris is less than a degree from the celestial pole, many amateurs simply point the polar axis of their telescope at Polaris. Although this is by no means a perfect alignment, it is close. To align using this method:

Align the finderscope with the main optical tube as described in the "Aligning the Finder" section earlier in the manual.

1 Set the telescope up so that the polar axis is pointing north and the counterweight shaft is rotated towards the ground.

2 Release the DEC clamp and move the telescope so that the optical tube is directly over the polar axis (see figure 5-6).

3 Move the mount in altitude and/or azimuth until Polaris is in the field of view of the finder. Rough azimuth adjustments can be made by moving the tripod .

4 Center Polaris using the fine altitude and azimuth controls (see figure 5-7). **Remember, do not move the telescope in R.A. or DEC. You want to adjust the direction the mount is pointing and you are using the telescope to see where the mount is pointing.**

5 Once Polaris is in the finder it should also be centered in the telescope. If not, use the fine adjustment controls to center Polaris in the telescope field.

6 Rotate the Declination circle, just above the counterweight shaft, to read 90°. Do not move the Declination circle by hand after it is set.

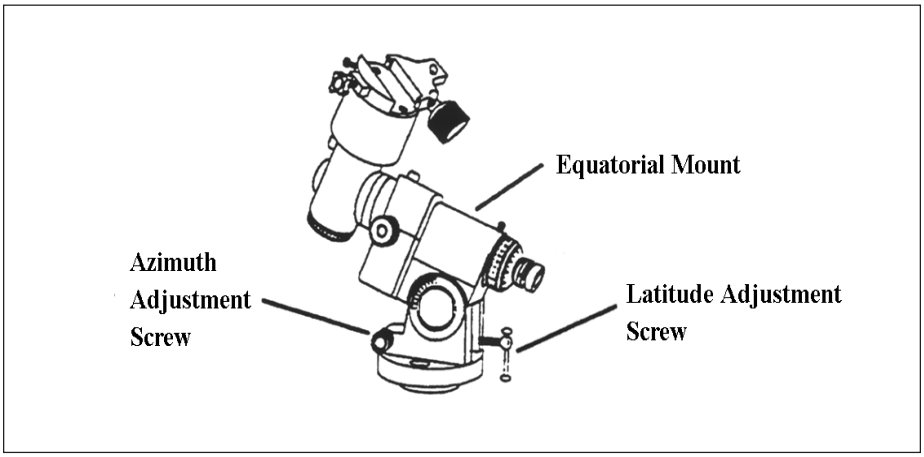


Figure 5-7

Declination Drift

This method of polar alignment allows you to get the most accurate alignment on the celestial pole and is required if you want to do long exposure deep-sky astrophotography through the telescope. The declination drift method requires that you monitor the drift of selected guide stars. The drift of each guide star tells you how far away the polar axis is pointing from the true celestial pole and in what direction. Although declination drift is quite simple and straightforward, it requires a great deal of time and patience to complete when first attempted. The declination drift method should be done after any one of the previously mentioned methods has been completed.

To perform the declination drift method you need to choose two bright stars. One should be near the eastern horizon and one due south near the meridian. Both stars should be near the celestial equator (i.e., 0° declination). You will monitor the drift of each star one at a time and in declination only. While monitoring a star on the meridian, any misalignment in the east-west direction will be revealed. While monitoring a star near the east/west horizon, any misalignment in the north-south direction will be revealed. As for hardware, you will need an illuminated reticle ocular to help you recognize any drift. For very close alignment, a Barlow lens is also recommended since it increases the magnification and reveals any drift faster.

When looking due south with the scope on the side of the mount, insert the diagonal so it points straight up. Insert a cross hair ocular and align the cross hairs to be parallel to declination and right ascension motion.

First choose your star near where the celestial equator and the meridian meet. The star should be approximately ±1/2 hour of the meridian and ±5 degrees of the celestial equator. Center the star in the field of your telescope and monitor the drift in declination.

- If the star drifts south, the polar axis is too far east.
- If the star drifts north, the polar axis is too far west.

Make the appropriate adjustments to the polar axis to eliminate any drift. Once you have managed to eliminate all drift, move to the star near the eastern horizon. The star should be 20 degrees above the horizon and ± 5 degrees off of the celestial equator.

- If the star drifts south, the polar axis is too low.
- If the star drifts north, the polar axis is too high.

Once again, make the appropriate adjustments to the polar axis to eliminate any drift. Unfortunately, the latter adjustments interact with the prior adjustments ever so slightly. So, repeat the process again to improve the accuracy checking both axes for minimal drift. Once the drift has been eliminated, the telescope is very accurately aligned. You will now be able to do prime focus deep-sky astrophotography for long periods.

NOTE: If the eastern horizon is blocked, you may choose a star near the western horizon. However, you will have to reverse the polar high/low error directions. If using this method in the southern hemisphere, the procedure is the same as described above. However, the direction of drift is reversed.

Polar Alignment Finders

There are two finders specifically designed for polar alignment that can be used with the G-8 telescopes. These finders can be purchased as optional accessories for the G-8. The first finder, known as the 7x50 Polaris finder (#93785-8P), is used as a regular finder.

The second finder is the polar axis finderscope (#94221). Its sole purpose is polar alignment and can NOT be used to find objects in the telescope. Both these finders work on the same principle, but their methods of operation are slightly different. These methods are generally easier than those already described and they are fairly accurate. For more information on both these finderscopes, refer to the Optional Accessories section of this manual or ask for the Celestron accessory catalog (#93685).

Aligning the R.A. Setting Circle

Before you can use the setting circles to find objects in the sky you need to align the R.A. setting circle. The declination setting circle is aligned during the polar alignment process. In order to align the R.A. setting circle you will need to know the names of a few of the brightest stars in the sky . If you don't, they can be learned by using the Celestron Sky Maps (#93722) or consulting a current astronomy magazine. To align the R.A. setting circle:

1. Locate a bright star near the celestial equator. The farther you are from the celestial pole the better your reading on the R.A. setting circle will be. The star you choose to align the setting circle with should be a bright one whose coordinates are known and easy to look up. (For a list of bright stars to align the R.A. setting circle, see the list at the back of this manual.)

2. Center the star in the finder.

3. Look through the main telescope and see if the star is in the field. If not, find it and center it.

4. Start the optional motor drive so that it will track the star. If you are not using a motor drive the star will start to drift out of the field and you will need to center it again before setting the R.A. circle.

5. Look up the coordinates of the star.

6. Rotate the circle until the proper coordinates line up with the R.A. indicator (the zero mark on the vernier scale). The R.A. setting circle should rotate freely.

As mentioned above, the declination setting circle is aligned during the process of polar alignment. There is no need to align it in the same manner as the R.A. setting circle.

Once you have finished this process you are ready to use the setting circles to locate objects in the night sky. See the section on "Using the Setting Circles" for specific information.

CELESTIAL OBSERVING

With your telescope set up, you are ready to use it for celestial observing. This section covers visual observing of both solar system and deep-sky objects.

Observing the Moon

In the night sky, the Moon is a prime target for your first look because it is extremely bright and easy to find. Often, it is a temptation to look at the Moon when it is full. At this time, the face we see is fully illuminated and its light can be overpowering. In addition, little or no contrast can be seen during this phase.

One of the best times to observe the Moon is during its partial phases (around the time of first or third quarter). Long shadows reveal a great amount of detail on the lunar surface. At low power you will be able to see most of the lunar disk at one time. Change to higher power (magnification) to focus in on a smaller area. Keep in mind that if you are not using an optional motor drive, the rotation of the Earth will cause the Moon to drift out of your field of view. You will have to manually adjust the telescope to keep the Moon centered. This effect is more noticeable at higher power.

If you are using a motor drive and have polar aligned, the Moon will remain centered. Consult your local newspaper or a current astronomy magazine to find out when the Moon will be visible. Try using filters to increase contrast and bring out more detail on the lunar surface.

Observing the Planets

Other easy targets in the night sky include the five naked eye planets. You can see Venus go through its lunar-like phases. Mars can reveal a host of surface detail and one, if not both, of its polar caps. You will be able to see the cloud belts of Jupiter and the great Red Spot (if it is visible at the time you are observing). In addition, you will also be able to see the moons of Jupiter as they orbit this gas giant. Saturn with its beautiful ring system and Cassini's division are easily visible at moderate power. All you need to know is where to look. Most astronomy publications tell where the planets can be found in the sky each month.

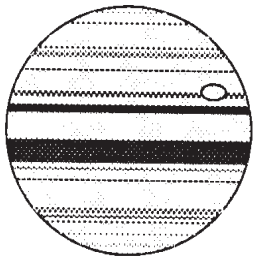


Figure 6-1

This scanned drawing of Jupiter provides a good representation of what you can expect to see with moderate magnification during good seeing conditions. The large, bright cloud belts should be immediately obvious. Smaller, faint belts become visible with practice and experience.

Observing the Sun

Although overlooked by many amateur astronomers, solar observation is both rewarding and fun. However, because the Sun is so bright, special precautions must be taken when observing our star so as not to damage your eyes or your telescope.

WARNING:

Never project an image of the Sun through the telescope. Because of the folded optical design, tremendous heat build-up will result inside the optical tube. This can damage the telescope and/or any accessories attached to the telescope.

For safe solar viewing, use a Celestron solar filter (#94162). This filter reduces the intensity of the Sun's light, making it safe to view. With this filter you can see sunspots as they move across the solar disk and faculae, which are bright patches seen near the Sun's edge. **Be sure to cover the objective lens of the finder or completely remove the finder when observing the Sun. This will ensure that the finder itself is not damaged and that no one looks through it inadvertently.**

SOLAR OBSERVING HINTS

- The best time to observe the Sun is in the early morning or late afternoon when the air is cooler.
- To locate the Sun without a finder, watch the shadow of the telescope tube until it forms a circular shadow.

Observing Deep-Sky Objects

Deep-sky objects are simply those objects outside the boundaries of our solar system. They include star clusters, planetary nebulae, diffuse nebulae, double stars, and other galaxies outside our own Milky Way. The Celestron Sky Maps (#93722) can help you locate the brightest deep-sky objects.

Most deep-sky objects have a large angular size. Therefore, low-to-moderate power is all you need to see them. Visually, they are too faint to reveal any color seen in long exposure photographs. Instead, they have a black and white appearance. And, because of their low surface brightness, they should be observed from a dark sky location. Light pollution around large urban areas washes out most nebulae making them difficult, if not impossible, to observe. Light Pollution Reduction filters help reduce the background sky brightness, thus increasing contrast.

Using the Setting Circles

Once the setting circles are aligned you can use them to find any object with known coordinates.

1. Select an object to observe. Use a seasonal star chart or planisphere to make sure the object you chose is above the horizon. As you become more familiar with the night sky, this will no longer be necessary.

2. Look up the coordinates in an atlas or reference book.

3. Move the telescope in declination until the indicator is pointing at the correct declination coordinate.

4. Move the telescope in R.A. until the indicator points to the correct coordinate (do NOT move the R.A. circle). The telescope will track in R.A. as long as a motor drive is operating and the R.A. clamp is in the locked position.

5. Look through the finder to see if you have located the object.

6. Center the object in the finder.

7. Look in the main optics using a low power eyepiece; the object should be there. The telescope will track in R.A. as long as the motor drive is operating.

8. Repeat the process for each object observed throughout the observing session.

You may not be able to see fainter objects in the finder. When this happens, gradually sweep the telescope around until the object is visible.

The declination setting circle is scaled in degrees while the R.A. setting circle is incremented in minutes with a marker every fifth minute. As a result, the setting circles will get you close to your target, but not directly on it. Also, the accuracy of your polar alignment will also affect how accurately your setting circles read.

At the end of this manual there is a list of deep-sky objects well within reach of your Celestron telescope.

Star Hopping

You can use your setting circles to find these objects (as described earlier in this manual) or try star hopping. Star hopping is done by using bright stars to guide you to an object. Here are directions for two popular objects.

The Andromeda Galaxy, M31, is an easy first target. To find M31:

1. Locate the constellation of Pegasus, a large square visible in the fall and winter months.

2. Start at the star in the northeast corner. The star is Alpha (α) Andromedae.

3. Move northeast approximately 7°. There you will find two stars of equal brightness — Delta (δ) and Pi (π) Andromedae — about 3° apart.

4. Continue in the same direction another 8°. There you will find two stars — Beta (β) and Mu (μ) Andromedae — about 3° apart.

5. Move 3° northwest — the same distance between the two stars— to the Andromeda galaxy. It is easily visible in the finder.

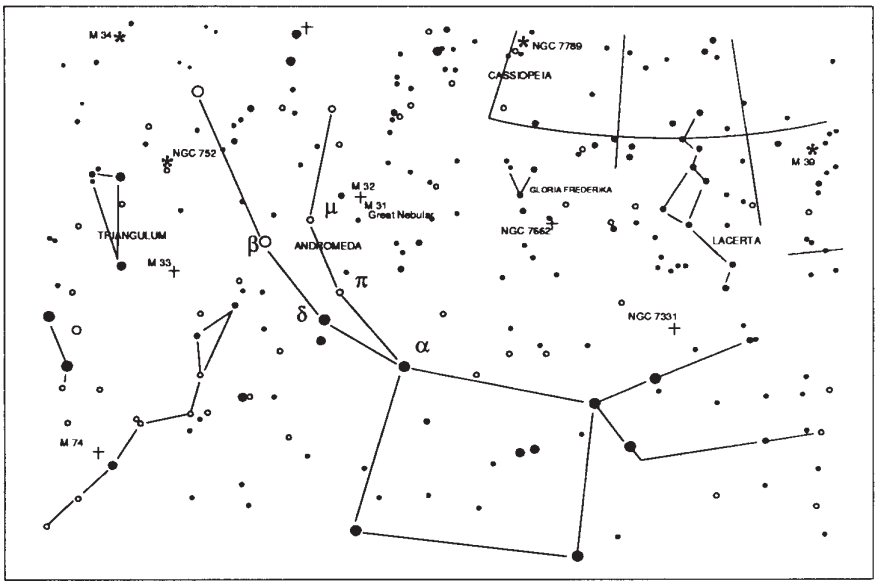


Figure 6-2

Star hopping to the Andromeda Galaxy is a snap to find since all the stars needed to do so are visible to the naked eye. Note that the scale for this star chart is different from the one on the following page which shows the constellation Lyra.

Star hopping may take some getting used to since you can see more stars through the finder than you can see with the naked eye. And, some objects are not visible in the finder. One such object is M57, the famed Ring Nebula. Here's how to find it:

1. Find the constellation of Lyra, a small parallelogram visible in the summer and fall months. Lyra is easy to pick out because it contains the bright star Vega.

2. Start at the star Vega — Alpha (α) Lyrae — and move a few degrees southeast to find the parallelogram. The four stars that make up this geometric shape are all similar in brightness, making them easy to see.

3. Locate the two southern most stars that make up the parallelogram — Beta (β) and Gamma (γ) Lyrae (see figure 6-3).

4. Point the finder half way between these two stars.

5. Move about 1/2° toward Beta (β) Lyrae, but remaining on a line that connects the two stars.

6. Look through the telescope and the Ring Nebula should be in the telescope. Its angular size is quite small and, therefore, not visible in the finder.

These two examples should give you an idea of how to star hop to deep sky objects. To use this method on other objects, consult any of the star atlases listed at the end of this book.

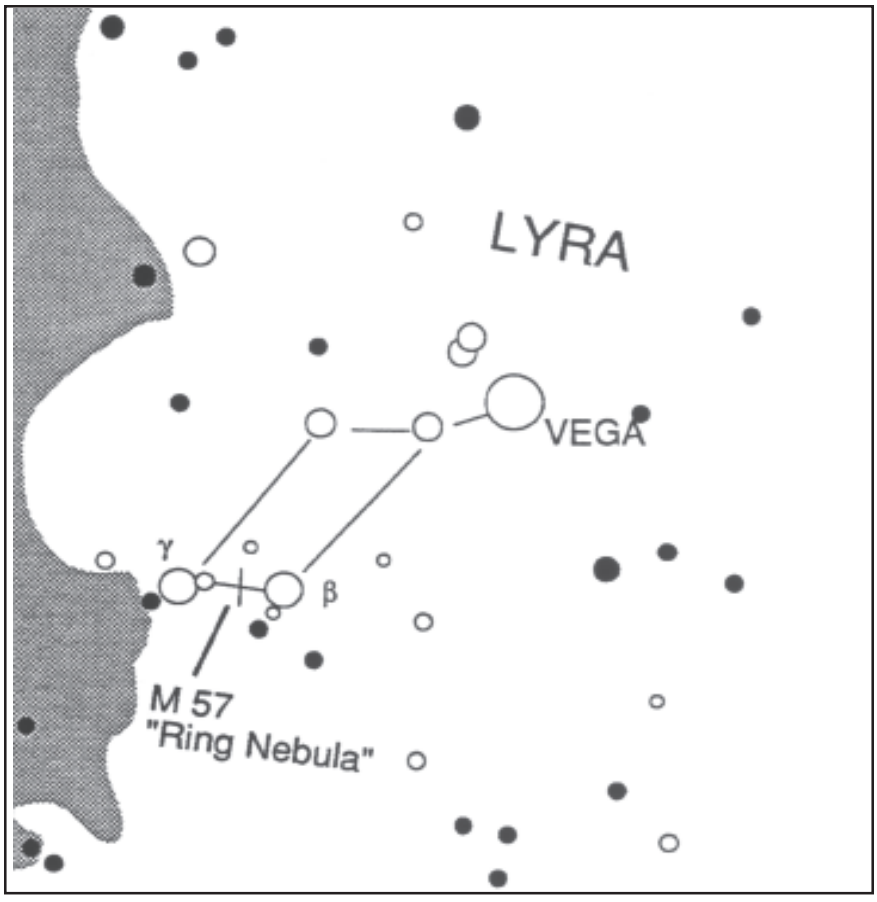


Figure 6-3

Although the Ring Nebula lies between two naked eye stars, it may take a little time to locate since it is not visible in the finder. Note that the scale for this star chart is different from the one on the previous page which shows several constellations including Pegasus, Triangulum, and Andromeda.

Viewing Conditions

Viewing conditions affect what you can see through your G-8 telescope during an observing session. Conditions include transparency, sky illumination, and seeing. Understanding viewing conditions and the affect they have on observing will help you get the most out of your telescope.

Transparency

Transparency is the clarity of the atmosphere and is affected by clouds, moisture, and other airborne particles. Thick cumulus clouds are completely opaque while cirrus can be thin, allowing the light from the brightest stars through. Hazy skies absorb more light than clear skies making fainter objects harder to see and reducing contrast on brighter objects. Aerosols ejected into the upper atmosphere from volcanic eruptions also affect transparency. Ideal conditions are when the night sky is inky black.

Sky Illumination

General sky brightening caused by the Moon, aurorae, natural airglow, and light pollution greatly affect transparency. While not a problem for the Moon, planets, and brighter stars, bright skies reduce the contrast of extended nebulae making them difficult, if not impossible, to see. To maximize your observing, limit deep-sky viewing to moonless nights far from the light polluted skies found around major urban areas. LPR filters enhance deep-sky viewing from light polluted areas by blocking unwanted light while transmitting light from certain deep-sky objects. You can, on the other hand, observe planets and stars from light polluted areas or when the Moon is out.

Seeing

Seeing conditions refer to the stability of the atmosphere and directly effects the clarity of star images and the amount of fine detail seen in extended objects like the planets. The air in our atmosphere acts as a lens which bends and distorts incoming light rays. The amount of bending depends on air density. Varying temperature layers have different densities and therefore bend light differently. Light rays from the same object arrive slightly displaced creating an imperfect or smeared image. These atmospheric disturbances vary from time-to-time and place-to-place. The size of the air parcels compared to your aperture determines the “seeing” quality. Under good seeing conditions, fine detail is visible on the brighter planets like Jupiter and Mars, and stars are pinpoint images. Under poor seeing conditions, images are blurred and stars appear as blobs. Seeing conditions are rated on a five-point scale where one is the worst and five is the best (see figure 6-4). Seeing conditions can be classified in one of three categories which are based on the cause.

Type 1 seeing conditions are characterized by rapid changes in the image seen through the telescope. Extended objects, like the Moon, appear to shimmer while point sources (i.e., stars) appear double. Type 1 seeing is caused by currents within or very close to the telescope tube. These currents could be caused by a telescope that has not reached thermal equilibrium with the outdoor surroundings, heat waves from people standing near the telescope, or heated dew caps. To avoid the problems associated with Type 1 seeing, allow your telescope approximately 20 to 30 minutes to reach thermal equilib-

rium. Once adjusted to the outdoor temperature, don't touch the telescope tube with your hands. When pointing the telescope, hold the telescope by the star diagonal. If observing with others, make sure no one stands in front of or directly below the telescope tube.

The images produced by Type 2 seeing conditions don't move as quickly as those produced by Type 1 conditions, but the images are quite blurry. Fine detail is lost and the contrast is low for extended objects. Stars are spread out and not sharp. The source of Type 2 seeing is the lower atmosphere, most likely heat waves from the ground or buildings. To avoid the problems associated with Type 2 seeing, select a good observing site. Specifically, avoid sites that overlook asphalt parking lots or ploughed fields. Stay away from valleys and shorelines. Instead, look for broad hilltops or open grassy fields. Stable thermal conditions found near lakes and atmospheric inversions also tend to produce good seeing. If you can't get a better location, wait until the early morning hours when the surroundings are uniformly cool and the seeing is generally better.

Type 3 seeing conditions are characterized by fast ripples, but sharp images. In extended objects fine detail is visible, but the images shift around the field. Stars are crisp points, but they shift small distances rapidly around the field. The cause of Type 3 seeing is turbulence in the upper atmosphere which means the observer has less control over it. However, the effects of Type 3 seeing are generally less pronounced than the other two types. You can never really avoid Type 3 seeing. Your best bet is to wait until moments of steadiness. If the seeing is extremely bad, pack up and wait for a better night.

The conditions described here apply to both visual and photographic observations.

Figure 6-4

Seeing conditions directly affect image quality. These drawings represent a point source (i.e., star) under bad seeing conditions (left) to excellent conditions (right). Most often, seeing conditions produce images that lie somewhere between these two extremes.

CELESTIAL PHOTOGRAPHY

After looking at the night sky for awhile you may want to try photographing it. Several forms of celestial photography are possible with your Celestron G-8N telescope. The most common forms of celestial photography, in order of difficulty are: short exposure prime focus, piggyback, eyepiece projection, and long exposure deep sky. Each of these is discussed in moderate detail with enough information to get you started. Topics include the accessories required and some simple techniques. More information is available in some of the publications listed at the end of this manual.

In addition to the specific accessories required for each type of celestial photography, there is the need for a camera — but not just any camera. The camera does not have to have many of the features offered on today's state-of-the-art equipment. For example, you don't need auto focus capability or mirror lock up. Here are the mandatory features a camera needs for celestial photography. First, a 'B' setting which allows for time exposures. This excludes point and shoot cameras and limits the selection to 35mm SLR cameras.

Second, the 'B' or manual setting should not run off the battery. Many new electronic cameras use the battery to keep the shutter open during time exposures. Once the batteries are drained, usually after a few minutes, the shutter closes, whether you have finished with the exposure or not. Look for a camera that has a manual shutter when operating in the time exposure mode. Olympus, Nikon, Minolta, Pentax, Canon and others have made such camera bodies.

The camera should have interchangeable lenses so you can attach it to the telescope and use a variety of lenses for piggyback photography. If you can't find a new camera, you can purchase a used camera body that is not 100-percent functional. The light meter does not have to be operational since you will be determining the exposure length manually.

Use a cable release with a locking function to hold the shutter open while you do other things. Mechanical and air releases are available at most camera stores.

Short Exposure Prime Focus

Short exposure prime focus photography is the best way to begin recording celestial objects. It is done with the camera attached to the telescope without an eyepiece or camera lens in place. To attach your camera, you need the T-adapter and a T-Ring for your specific camera (i.e., Minolta, Nikon, Pentax, etc.). The G-8N focuser has a built-in T-adapter and is ready to accept a 35mm cammera body. The T-Ring replaces the 35mm SLR camera's normal lens. Prime focus photography allows you to capture the entire solar disk (if using the proper filter) as well as the entire lunar disk. To attach your camera to your telescope:

1 Remove the eyepiece from the 1 $^1/_4$" eyepiece holder.

2 Unthread the 1 $^1/_4$" eyepiece holder from the focuser assembly. This will expose the male thread of the built-in T-adapter.

3 Thread the T-ring onto the exposed T-adapter threads.

4 Mount your camera body onto the T-Ring the same as you would any other lens.

With your camera attached to the telescope, you are ready for prime focus photography. Start with an easy object like the Moon. Here's how to do it:

1. Load your camera with film that has a moderate-to-fast speed (i.e., ISO rating). Faster films are more desirable when the Moon is a crescent. When the Moon is near full, and at its brightest, slower films are more desirable. Here are some film recommendations:

    - T-Max 100
    - T-Max 400
    - Any 100 to 400 ISO color slide film
    - Fuji Super HG 400

2. Center the Moon in the field of your telescope.

3. Focus the telescope by turning the focus knob until the image is sharp.

4. Set the shutter speed to the appropriate setting (see table 6-1).

5. Trip the shutter using a cable release.

6. Advance the film and repeat the process.

Lunar Phase	ISO 50	ISO 100	ISO 200	ISO 400
Crescent	1/2	1/4	1/8	1/15
Quarter	1/15	1/30	1/60	1/125
Full	1/30	1/60	1/125	1/250

Table 6-1

Above is a listing of recommended exposure times when photographing the Moon at the prime focus of your Celestron G-8N.

The exposure times listed here should be used as a starting point. Always make exposures that are longer and shorter than the recommended time. Also, try bracketing your exposures, taking a few photos at each shutter speed. This will ensure that you will get a good photo. If using black and white film, try a yellow filter to reduce the light intensity and to increase contrast.

Keep accurate records of your exposures. This information is useful if you want to repeat your results or if you want to submit some of your photos to various astronomy magazines for possible publication!

This technique is also used for photographing the Sun with the proper Celestron solar filter.

Piggyback

The easiest way to enter the realm of deep-sky, long exposure astrophotography is via the piggyback method. Piggyback photography is done with a camera and its normal lens riding on top of the telescope. Through piggyback photography you can capture entire constellations and record large scale nebulae that are too big for prime focus photography. Because you are photographing with a low power lens and guiding with a high power telescope, the margin for error is very large. Small mistakes made while guiding the telescope will not show up on film. To attach the camera to the telescope, use the optional piggyback mount (#93598). In order to guide the exposure, you will need an optional motor drive (#93518 or #93820-C).

As with any form of deep-sky photography, it should be done from a dark sky observing site. Light pollution around major urban areas washes out the faint light of deep-sky objects. You can still practice from less ideal skies.

1. Polar align the telescope (using one of the methods described earlier) and start the motor drive.

2. Load your camera with slide film, ISO 100 or faster, or print film, ISO 400 or faster!

3. Set the f/ratio of your camera lens so that it is a half stop to one full stop down from completely open.

4. Set the shutter speed to the "B" setting and focus the lens to the infinity setting.

5. Locate the area of the sky that you want to photograph and move the telescope so that it points in that direction.

6. Find a suitable guide star in the telescope eyepiece field of view. This is relatively easy since you can search a wide area without affecting the area covered by your camera lens. If you do not have an illuminated cross hair eyepiece for guiding, simply defocus your guide star until it fills most of the field of view. This makes it easy to detect any drift.

7. Release the shutter using a cable release.

8. Monitor your guide star for the duration of the exposure making the neccessary corrections needed to keep the star centered.

9. Close the camera's shutter.

As for lenses, use good ones that produce sharp images near the edge of the field. The lenses should have a resolving power of at least 40 lines per millimeter. A good focal length range is 50 to 500mm for lenses designed for 35mm cameras.

The exposure time depends on the film being used. However, five minutes is usually a good starting point. With slower films, like 100 ISO, you can expose as long as 45 minutes. With faster films, like 1600 ISO, you really shouldn't expose more than 5 to 10 minutes. When getting started, use fast films to record as much detail in the shortest possible time. Here are proven recommendations:

- Ektar 1000 (color print)
- Konica 3200 (color print)
- Fujichrome 1600D (color slide)
- 3M 1000 (color slide)
- T-Max 3200 (black and white print)
- T-Max 400 (black and white print)

As you perfect your technique, try specialized films, that is films that are designed or specially treated for celestial photography. Here are some popular choices:

- Ektar 125 (color print)
- Fujichrome 100D (color slide)
- Tech Pan, gas hypered (black and white print)

As with all forms of photography, keep accurate records of your work. This information can be used later if you want to reproduce certain results or if you want to submit photos for possible publication.

Once you have mastered piggyback photography with wide angle and normal lenses, try longer focal length lenses. The longer the focal length, the more accurate your guiding must be. You can continue to increase the focal length of the lens until you are ready for prime focus photography with your Celestron G-8N.

Eyepiece Projection

This form of celestial photography is designed for objects with small angular sizes, primarily the planets and individual lunar features. Planets, although physically quite large, appear small in angular size because of their great distances. Moderate to high magnification is, therefore, required to make the image large enough to see any detail. Unfortunately, the camera/telescope combination alone does not provide enough magnification to produce a usable image size on film. In order to get the image large enough, you must attach your camera to the telescope with the eyepiece in place. To do so, you need two additional accessories; a tele-extender (#93643), which attaches onto the visual back, and a T-ring for your particular camera make (i.e., Minolta, Nikon, Pentax, etc.).

Because of the high magnifications during eyepiece projection, the field of view is quite small which makes it difficult to find and center objects. To make the job a little easier, align the finder as accurately as possible. This allows you to get the object in the field based on the finder's view alone.

Another problem introduced by the high magnification is vibration. Simply tripping the shutter — even with a cable release — produces enough vibration to smear the image. To get around this, use the camera's self-timer if the exposure time is less than one second — a common occurrence when photographing the Moon. For exposures over one second, use the "hat trick." This technique incorporates a hand-held black card placed over the aperture of the telescope to act as a shutter. The card prevents light from entering the telescope while the shutter is released. Once the shutter has been released and the vibration has diminished (a few seconds), move the black card out of the way to expose the film. After the exposure is complete, place the card over the front of the telescope and close the shutter. Advance the film and you're ready for your next shot. Keep in mind that the card should be held a few inches in front of the telescope, and not touching it. It is easier if you use two people for this process; one to release the camera shutter and one to hold the card. Here's the process for making the exposure.

1. Find and center the desired target in the view finder of your camera.

2. Turn the focus knob until the image is as sharp as possible.

3. Place the black card over the front of the telescope.

4. Release the shutter using a cable release.

5. Wait for the vibration caused by releasing the shutter to diminish. Also, wait for a moment of good seeing.

6. Remove the black card from in front of the telescope for the duration of the exposure (see table 7-2).

7. Replace the black card over the front of the telescope.

8. Close the camera's shutter.

Advance the film and you are ready for your next exposure. Don't forget to take photos of varying duration and keep accurate records of what you have done. Record the date, telescope, exposure duration, eyepiece, f/ratio, film, and some comments on the seeing conditions.
The following table lists exposures for eyepiece projection with a 10mm eyepiece. All exposure times are listed in seconds or fractions of a second.

Planet	ISO 50	ISO 100	ISO 200	ISO 400
Moon	4	2	1	1/2
Mercury	16	8	4	2
Venus	1/2	1/4	1/8	1/15
Mars	16	8	4	2
Jupiter	8	4	2	1
Saturn	16	4	4	2

Table 7-2

The exposure times listed here should be used as a starting point. Always make exposures that are longer and shorter than the recommended time. Also, try bracketing your exposures, taking a few photos at each shutter speed. This will ensure that you will get a good photo. It is not uncommon to go through an entire roll of 36 exposures and have only one shot turn out. Also, don't expect to record more detail than you can see visually in the eyepiece at the time you are photographing.

Once you have mastered the technique, experiment with different films, different focal length eyepieces, and even different filters.

This is the last form of celestial photography to be attempted after others have been mastered. It is intended primarily for deep-sky objects, that is objects outside our

Long Exposure Prime Focus

solar system which includes star clusters, nebulae, and galaxies. While it may seem that high magnification is required for these objects, just the opposite is true. Most of these objects cover large angular areas and fit nicely into the prime focus field of your Celestron G-8 telescope. The brightness of these objects, however, requires long exposure times and, as a result, are rather difficult.

There are several techniques for this type of photography, and the one chosen will determine the standard accessories needed. If, for example, you use a separate guidescope, the camera attaches to the telescope with a T-Adapter (#93633-A) and a T-Ring for your specific camera. However, the best method for long exposure deep-sky astrophotography is with an off-axis guider. This devise allows you to photograph and guide through the telescope simultaneously. Celestron offers a very special and advanced off-axis guider, called the Radial Guider (#94176). In addition, you will need a T-Ring to attach your camera to the Radial Guider.

Other equipment needs include a guiding eyepiece. Unlike piggyback photography which allows for fairly loose guiding, prime focus requires meticulous guiding for long periods. To accomplish this you need a guiding ocular with an illuminated reticle to monitor your guide star. For this purpose, Celestron offers the Micro Guide Eyepiece (#94171). Here is a brief summary of the technique.

1. Polar align the telescope using the declination drift method.
2. Remove all visual accessories.
3. Thread the Radial Guider onto your Celestron G-8N.
4. Thread the T-Ring onto the Radial Guider.
5. Mount your camera body onto the T-Ring the same as you would any other lens.
6. Set the shutter speed to the “B” setting.
7. Focus the telescope on a star while looking through the camera viewfinder or by using alternative focusing aids
8. Center your subject in the field of your camera.
9. Find a suitable guide star in the telescope field. This can be the most time consuming process.
10. Open the shutter using a cable release.
11. Monitor your guide star for the duration of the exposure using the buttons on the hand controller to make the needed corrections.
12. Close the camera’s shutter.

When getting started, use fast films to record as much detail in the shortest possible time. Here are proven recommendations:

- Ektar 1000 (color print)
- Konica 3200 (color print)
- Fujichrome 1600D (color slide)
- 3M 1000 (color slide)
- T-Max 3200 (black and white print)
- T-Max 400 (black and white print)

As you perfect your technique, try specialized films, that is films that are designed or specially treated for celestial photography. Here are some popular choices:

- Ektar 125 (color print)
- Fujichrome 100D (color slide)
- Tech Pan, gas hypered (black and white print)

There is no exposure determination table to help you get started. The best way to determine exposure length is look at previously published photos to see what film/exposure combinations were used. Or take unguided sample photos of various parts of the sky while the drive is running. Always take exposures of various lengths to determine the best exposure time.

CCD IMAGING

Fastar Lens Assembly Option – Using your G-8 telescope at f/1.95 with optional PixCel CCD Camera

Your G-8 telescope is equipped with a removable secondary mirror that allows you to convert your f/10 telescope into an f/1.95 imaging system capable of exposure times 25 times shorter than those needed with a f/10 system! Used with Celestron's PixCel CCD System, objects will be easily found due to the ultra wide 2/3° by 1/2° field of view provided. With the optional Fastar lens assembly you can easily convert your Fastar compatible telescope to f/1.95 prime focus use in a matter of seconds. Your telescope can now be used in many different f-number's for CCD imaging. It can be used at f/1.95 (with optional Fastar Lens Assembly – #94180), f/6.3 (with the optional Reducer/Corrector– #94175), f/10, and f/20 (with the optional 2x barlow – #93507) making it the most versatile imaging system available today. This makes the system ideal for imaging deep-sky objects as well as planetary detail. The key to the Fastar's versatility is the variety of different F-numbers in which it can be used. Described below is the significance of each F-number and the type of object best suited to that kind of imaging.

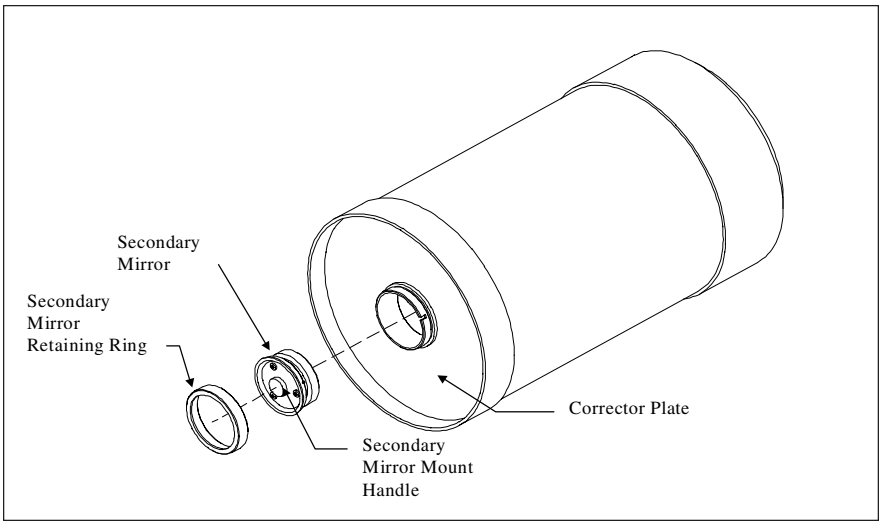


Figure 7-1

The above figure shows how the secondary mirror is removed when using the optional PixCel CCD camera at f/1.95 and the Fastar Lens Assembly (#94180).

Warning: The secondary mirror should never be removed unless installing the optional Fastar Lens Assembly. Adjustments to collimation can easily be made by turning the screws on the top of the secondary mirror mount without ever having to remove the secondary mirror (see Telescope Maintenance section of this manual).

Description of F-numbers

The F/# stands for the ratio between the focal length and the diameter of the light gathering element. A C8 optical tube has a focal length of 80 inches and a diameter of 8 inches. This makes the system an f/10, (focal length divided by diameter). When the secondary is removed and the CCD is placed at the Fastar position, the system becomes f/1.95, this is unique to Celestron telescopes (see figures below).

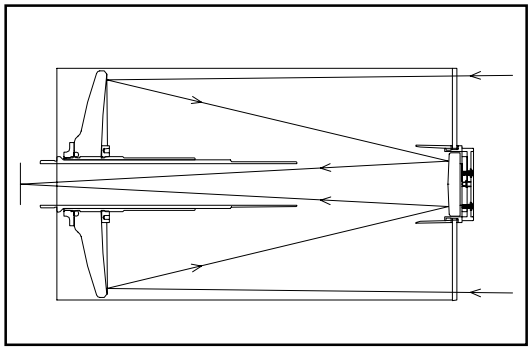


Figure 7-2 -- Light path at f/10 focus

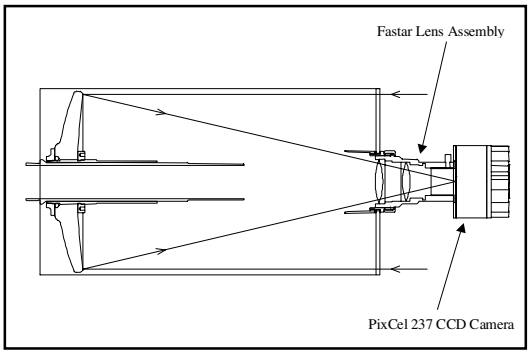


Figure 7-3 -- Light path at Fastar f/1.95 focus

The key factors for good CCD imaging are; exposure time, field-of-view, image size, and pixel resolution. As the F/# goes down (or gets faster), the exposure times needed decreases, the field-of-view-increases, but the image scale of the object gets smaller. What is the difference between f/1.95 and f/10? F/1.95 has 1/5 the focal length of f/10. That makes the exposure time needed about 25 times shorter than at f/10, the field of view 5 times larger and the object size 1/5 compared to that of f/10. (see Table below)

	Standard Cassegrain	With Reducer/Corrector Accessory	**With Fastar Lens Accessory**
Focal Length & Speed	80"(2032mm) @ f/10	50" (1280mm) @ f/7	**16" (406mm) @ f/1.95**
PixCel 237 F.O.V.	8.1 x 6.2 (arc min) .13 x .10 (degrees)	13 x 10 (arc min) .21 x .16 (degrees)	**41 x 31 (arc min)** **.68 x .52 (degrees)**
PixCel Sampling (arc sec/pixel)	.75 (arc sec)	1.2 (arc sec)	**3.8 (arc sec)**

Table 7-3

Fastar Configuration

The following is a brief description of the advantages of imaging at each f-number configuration and the proper equipment needed to use the telescope in any of its many settings. Refer to Figure 7-6 for a more detailed description of the accessories offered for each configuration.

Imaging at f/1.95

As stated above, the exposure times are much shorter at f/1.95 than at f/6.3 or f/10. The field-of-view is wider, so it is easier to find and center objects. Also with a wider field-of-view you can fit larger objects (such as M51, The Whirlpool Galaxy) in the frame. Typical exposure times can be 20-30 seconds for many objects. With the Track and Accumulate function on the PixCel software (see the PixCel Operating Manual for more details about its software features), the camera can shoot and stack several images automatically without ever having to guide the exposure. Under dark skies you can get an excellent image of the Dumbbell Nebula (M27) with only a few 30 second exposures (see figure 7-4 below). The spiral arms of the Whirlpool galaxy (Figure 7-5) can be captured with a 30 second exposure and can be improved upon dramatically if several 30-60 second exposures are added together using the Track and Accumulate™ feature.

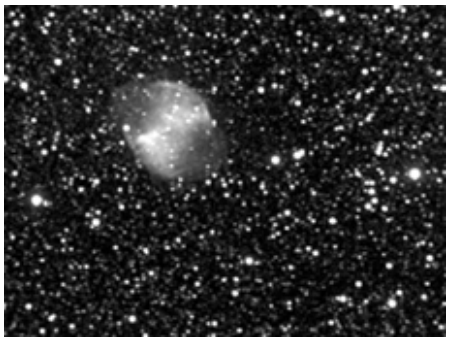


Figure 7-4 M27 -- The Dumbbell Nebula
4 exposures of 30 seconds each!

Figure 7-5 M51 -- The Whirlpool Nebula
9 exposures of 60 seconds each.

When imaging some objects like planetary nebula (for example M57, the Ring Nebula) and small galaxies (M104, the Sombrero Galaxy), larger image scale is needed to resolve finer detail. These objects are better shot at f/6.3 or even f/10.

Imaging at f/6.3

Medium size to small galaxies --
f/6.3 imaging gives you finer resolution then at f/1.95, but the slower f-number will usually require you to guide the image while you are taking longer exposures. Guiding can be accomplished by using an optional Radial Guider or a piggyback guidescope. The exposure times are about 10 times longer but the results can be worth the extra effort. There are some objects that are small enough and bright enough that they work great at f/6.3. M104 (the Sombrero Galaxy) can be imaged under dark skies with a series of short exposures using Track and Accumulate. Ten exposures at 15 seconds each will yield a nice image and is short enough that you may not need to guide the exposure at all. For f/6.3 imaging the optional Reducer/Corrector is needed. (See Optional Accessory section at the end of this manual).

Imaging at f/10

Lunar or small planetary nebulae--
f/10 imaging is more challenging for long exposure, deep-sky imaging. Guiding needs to be very accurate and the exposure times need to be much longer, about 25 times longer than f/1.95. There are only a select few objects that work well at f/10. The moon images fine because it is so bright, but planets are still a bit small and should be shot at f/20. The Ring nebula is a good candidate because it is small and bright. The Ring Nebula (M57) can be imaged in about 30-50 seconds at f/10. The longer the exposure the better.

Imaging at f/20

Planetary or Lunar--
f/20 is a great way to image the planets and features on the moon. With the PixCel CCD camera and optional Color Filter Wheel, it is easy to take tri-color images of planets also. When imaging the planets, very short exposures are needed. Many cameras have trouble taking images under .1 seconds. The PixCel camera can image at .01 seconds exposures due to the design of the CCD array. The exposure lengths range from .03 to .1 seconds on planetary images. Focus is critical as is good atmospheric conditions. Generally you will take one image after another until one looks good (see AutoGrab feature in the PixCel Operating Manual). This is due to the atmospheric "seeing" conditions. For every 10 exposures you might save 1. To image at f/20 you need to purchase a 2x Barlow and a T-adapter or Radial Guider.

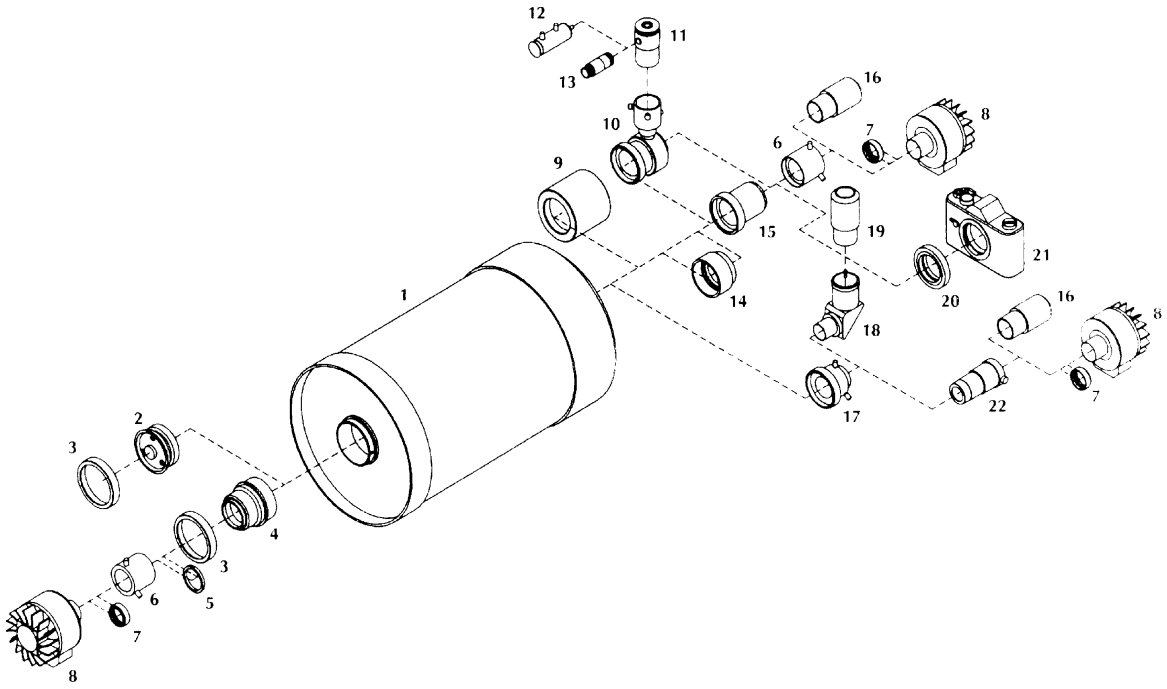


Figure 7-6 -- This figure shows the many accessories that can be used with the Fastar compatible G-8N telescope in its various optical configurations.

1	Optical Tube Assembly	12	Pulstar Illuminator
2	Secondary Mirror	13	Illuminator (Microguide Eyepiece only)
3	Secondary Mirror Retaining Ring	14	Reducer/Corrector f/6.3
4	Fastar Lens Assembly	15	T-Adapter
5	Tricolor Spacer Ring	16	Cross Hair Eyepiece
6	T-1 ¼" Adapter	17	Visual Back 1 ¼"
7	IR Cutoff Filter (for use with Color Filter Wheel)	18	Star Diagonal
8	PixCel CCD Camera	19	26mm Plossl Eyepiece
9	Rear Cell Counterweight	20	T-Ring (for 35mm SLR Camera)
10	Radial Guider	21	35mm SLR Camera
11	Microguide Eyepiece	22	2X Barlow Lens

For more information about the above accessories refer to the Optional Accessories section at the end of this manual

TELESCOPE MAINTENANCE

While the G-8 telescope requires little maintenance, there are a few things to remember that will ensure your telescope performs at its best.

Care and Cleaning of the Optics

Occasionally, dust and/or moisture may build up on the corrector plate of your telescope. Special care should be taken when cleaning any instrument so as not to damage the optics.

If dust has built up on the corrector plate, remove it with a brush (made of camel's hair) or a can of pressurized air. Spray at an angle to the lens for approximately two to four seconds. Then, use an optical cleaning solution and white tissue paper to remove any remaining debris. Apply the solution to the tissue and then apply the tissue paper to the lens. Low pressure strokes should go from the center of the corrector to the outer portion. **Do NOT rub in circles!**

You can use a commercially made lens cleaner or mix your own. A good cleaning solution is isopropyl alcohol mixed with distilled water. The solution should be 60% isopropyl alcohol and 40% distilled water. Or, liquid dish soap diluted with water (a couple of drops per one quart of water) can be used.

Occasionally, you may experience dew build-up on the corrector plate of your G-8 during an observing session. If you want to continue observing, the dew must be removed, either with a Celestron Dew Eliminator (# 94122) or by pointing the telescope at the ground until the dew has evaporated. The optional Dew Cap/Lens Shade (#94017) helps reduce the amount of dew build-up on the corrector plate.

If moisture condenses on the inside of the corrector, place the telescope in a dust-free environment and point it down. Remove the accessories from the rear cell of the telescope or spotting scope to allow the moisture to evaporate from the optical tube.

To minimize the need to clean your telescope, replace all lens covers once you have finished using it. Since the rear cell is **NOT** sealed, the cover should be placed over the opening when not in use. This will prevent contaminants from entering the optical tube.

Internal adjustments and cleaning should be done only by the Celestron repair department. If your G-8 is in need of internal cleaning, please call the factory for a return authorization number and price quote.

Collimation

The optical performance of your Celestron telescope is directly related to its collimation, that is the alignment of its optical system. Your G-8 was collimated at the factory after it was completely assembled. However, if the telescope is dropped or jarred severely during transport, it may have to be recollimated. The only optical element that can be adjusted by you is the tilt of the secondary mirror.

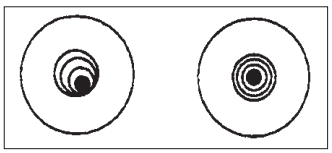


Figure 8-1

Left: With an out-of-focus star image at the center of the field, the secondary mirror shadow is off center indicating the telescope is out of collimation Right: The out-of-focus star image showing good collimation.

To check the collimation of your telescope you will need a light source. A bright star near the zenith is ideal since there is a minimal amount of atmospheric distortion. Turn your telescope motor drive on so that you don't have to manually track the star. Or, if you are not using the motor drive, use Polaris. Its position relative to the celestial pole means that it moves very little thus eliminating the need to track it.

Before you begin the collimation process, be sure that your telescope is in thermal equilibrium with the surroundings. Allow 45 minutes for the telescope to reach equilibrium if you move it between large temperature extremes.

To verify collimation, view a star near the zenith. Use a medium to high power ocular — 12mm to 6mm focal length. It is important to center a star in the center of the field to judge collimation. Slowly cross in and out of focus and judge the symmetry of the star. If you see a systematic skewing of the star to one side, then recollimation is needed.

To accomplish this, you need to adjust the secondary collimation screw(s) that move the star across the field toward the direction of the skewed light (see figure 8-1). Make only small corrections, approximately 1/6 to 1/8 of the field. Recenter the star by moving the telescope before making further adjustments.

When using higher power, 6mm and above, collimation is best accomplished with the telescope in focus. In this instance, you are observing the Airy disk (see figure 8-2), not the shadow of the secondary housing. This (stellar) image appears as a bright point of light with a diffraction ring around it. When the point of light is perfectly centered within the diffraction ring, your telescope is in collimation. Keep in mind that to use high power, the seeing conditions must be very good.

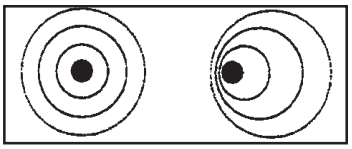


Figure 8-2

In focus images show the C8 in collimation (left) and out of collimation (right).

Perfect collimation yields a star or planetary image very symmetrical just inside and outside of focus. Also, perfect collimation delivers the optimal optical performance specifications that your telescope is built to achieve.

If seeing (i.e., air steadiness) is turbulent, collimation is difficult to judge. Wait until a better night if it is turbulent or aim to a steadier part of the sky. A steadier part of the sky is judged by steady versus twinkling stars.

NOTE: **THE ADJUSTMENT SCREWS ON THE SECONDARY MIRROR ARE VERY SENSITIVE. USUALLY A TENTH OF A TURN WILL COMPLETELY CHANGE THE COLLIMATION OF THE TELESCOPE. DO NOT FORCE THESE SCREWS IF THEY WILL NOT TURN. IF TIGHTENING ONE SCREW IN THE DIRECTION YOU NEED TO GO IS DIFFICULT, SIMPLY LOOSEN THE OTHER TWO SCREWS BY EQUAL AMOUNTS TO BRING ABOUT THE SAME CHANGE. DO NOT BE INTIMIDATED BY TOUCHING UP COLLIMATION AS NEEDED TO ACHIEVE OPTIMAL HIGH-RESOLUTION VIEWS. IT IS WORTH THE TROUBLE!!!!**

OPTIONAL ACCESSORIES

The following is a partial list of optional accessories available for your Celestron G-8.

Barlow Lens - A Barlow lens is a negative lens that increases the focal length of a telescope. Used with any eyepiece, it doubles the magnification of that eyepiece. Celestron offers two Barlow lens in the 1-1/4" size for the G-8. The 2x Ultima Barlow (#93506) is a compact triplet design that is fully multicoated for maximum light transmission and parfocal when used with the Ultima eyepieces. Model #93507 is a compact achromatic Barlow lens that is under three inches long and weighs only 4 oz. It works very well with all Celestron eyepieces.

Carrying Case (#302070) - This rugged case (for the G-8 optical tube assembly only and accessories) is constructed of space age resin, making it waterproof, unbreakable, airtight and extremely durable. It's designed so that the optical tube of the telescope can be packed with the standard finderscope in place, a convenience you'll be sure to appreciate. The case is lined with die cut foam for custom fitting. It features large handles and is equipped with wheels, for easy transportation. Weight: 17 lbs. (31.5"x 21.75"x 11.5").

CD-ROM (93700) - Celestron and Software Bisque have joined together to present this comprehensive CD-ROM called *The Sky™ Level 1 - for Celestron.* It features a 10,000 object database, 75 color images, horizontal projection, custom sky chart printing, zoom capability, Comet Hale-Bopp coordinates and more! A fun, useful and educational product. PC format.

Dew Cap/Lens Shade (#94017) - The dew cap is a tube (about the same diameter as the telescope) that fits on the front end of the telescope to reduce the amount of dew that can build up on the corrector plate at night. The dew cap also acts as a lens shade by preventing stray light from falling on the corrector plate and into the tube possibly reducing contrast. The dew cap/lens shade uses a bayonet mounting system for a snug fit.

Dew Eliminator - (#94122)
Celestron's 12 volt Dew Eliminator means viewing sessions can go longer. It blows warm air to keep your corrector plate and any optional accessories dew-free. Just plug it into your car's cigarette lighter receptacle for trouble-free observing. 156 watts. Weight: 9 ounces.

Dual Axis Drive System - #93820-C
This drive motor, with drive corrector capabilities, is designed for Celestron's CG-5 Equatorial telescope mount. It precisely controls the telescope's tracking speed during long, timed exposures of celestial objects, producing the best possible image sharpness. Drive correctors are a must for those with serious interest in astrophotography or CCD imaging.This precision, state-of-the-art DC motor drive operates on a 9 volt battery. The hand controller module is very compact and fits easily in the palm of your hand. Motors for both axes are included, along with brackets, clutches and hardware.

Erect Image Diagonal (#94112-A) - This accessory is an Amici prism arrangement that allows you to look into the telescope at a 45° angle with images that are oriented properly (upright and correct from left-to-right). It is useful for daytime, terrestrial viewing.

Eyepieces - Like telescopes, eyepieces come in a variety of designs. Each design has its own advantages and disadvantages. For the 1-1/4" barrel diameter there are four different eyepiece designs available.

- **Super Modified Achromatic (SMA) Eyepieces:**
  The SMA design is an improved version of the Kellner eyepiece. SMAs are very good, economical, general purpose eyepieces that deliver a wide apparent field, good color correction and an excellent image at the center of the field of view. Celestron offers SMA eyepieces in the following focal lengths: 6mm, 10mm, 12mm,17mm and 25mm.

- **Plössl -** Plössl eyepieces have a 4-element lens designed for low-to-high power observing. The Plössls offer razor sharp views across the entire field, even at the edges! In the 1-1/4" barrel diameter, they are available in the following focal lengths: 6.3mm, 7.5mm, 10mm, 12.5mm, 17mm, 20mm, 26mm, 32mm and 40mm.

- **Ultima -** Ultima is not really a design, but a trade name for our 5-element, wide field eyepieces. They are available in the following focal lengths: 5mm, 7.5mm, 12.5mm, 18mm, 24mm, 30mm, 35mm, and 42mm. These eyepieces are all parfocal. The 35mm Ultima gives the widest possible field of view with a 1-1/4" diagonal and is ideal for use with or without the Reducer/Corrector.

- **Lanthanum Eyepieces (LV Series) -** Lanthanum is a unique rare earth glass used in one of the field lenses of this new eyepiece. The Lanthanum glass reduces aberrations to a minimum. All are fully multicoated and have an astounding 20mm of eye relief — perfect for eyeglass wearers! They are available in the following focal lengths: 2.5mm, 4mm, 5mm, 6mm, 9mm, 10mm, 12mm, 15mm, 20mm and 25mm. Celestron also offers the LV Zoom eyepiece (#3777) with a focal length of 8mm to 24mm. It offers an apparent field of 40º at 24mm and 60º at 8mm. Eye relief ranges from 15mm to 19mm.

In addition to the previously mentioned, there is also a deluxe compact zoom ocular (#93306) that has a variable focal length of 6.5 to 18mm. This provides 113 to 313 power on the G-8.

Eyepiece Filters - To enhance your visual observations of solar system objects, Celestron offers a wide range of colored filters that thread into the 1-1/4" oculars. Available individually are: #12 deep yellow, #21 orange, #25 red, #58 green, #80A light blue, #96 neutral density - 25%T, #96 neutral density - 13%T, and polarizing. These and other filters are also sold in sets.

Finderscopes - Finderscopes are used to help you locate objects in the main telescope. The larger the finder, the more you will see, making it easier to locate objects. One option for finders is the illuminated Polaris 7x50 Finder

(#93785-8P). It comes with the bracket, finderscope, illuminator and Polaris setting plate. Another option is the 9x50 finder **(93783-8)**. This includes the finder, and the finder bracket. There is also a Quick Release Finder bracket **(#51149-A)** which allows you to easily remove and replace the finderscope without loosing alignment. The Quick Release Bracket is only available for the 9x50 and 7x50 Finderscopes.

Another tool for finding objects in the sky is the **Star Pointer (#51630)**. The Star Pointer is different from a finderscope in that you can use both eyes when pointing the telescope at an object. A partially reflective surface projects the image of an LED illuminated pinpoint into the line of sight. Just align the illuminated pinpoint with the object you are interested in and the object will be in the main telescope.

LED Flashlight (#93592) - The LED flashlight uses a red light emitting diode (LED) to allow reading star maps and locating telescope accessories and functions without ruining your night vision. The LED flashlight is small, only 6 inches long, and weighs in at a mere 3 ounces. Operates on two AA batteries (included).

Night Vision Flashlight - (#93588) - Celestron's premium model for astronomy, using two red LEDs to preserve night vision better than red filters or other devices. Brightness is adjustable. Operates on a single 9 volt battery (included). Made in the U.S.A.

Light Pollution Reduction (LPR) Filters - These filters are designed to enhance your views of deep sky astronomical objects when viewed from urban areas. LPR Filters selectively reduce the transmission of certain wavelengths of light, specifically those produced by artificial lights. This includes mercury and high and low pressure sodium vapor lights. In addition, they also block unwanted natural light (sky glow) caused by neutral oxygen emission in our atmosphere. Celestron offers a model for 1-1/4" eyepieces (#94126A) and a model that attaches to the rear cell ahead of the star diagonal and visual back (#94127A).

Micro Guide Eyepiece (#94171) - This multipurpose 12.5mm illuminated reticle can be used for guiding deep-sky astrophotos, measuring position angles, angular separations, and more. The laser etched reticle provides razor sharp lines and the variable brightness illuminator is completely cordless. The micro guide eyepiece produces 163 power when used with the C8 at f/10.

Moon Filter (94119-A) - Celestron's Moon Filter is an economical eyepiece filter for reducing the brightness of the moon and improving contrast, so greater detail can be observed on the lunar surface. The clear aperture is 21mm and the transmission is about 18%.

Motor Drive System - #93518
By adding the MDCG-5 Drive System to your mount, you add the capacity to *automatically* track objects in the sky, a convenience you'll be sure to enjoy during long viewing or astrophotography sessions, when manual tracking can become tiring. Furthermore, the Drive System will enhance high-power visual observing. It attaches to the R.A. (east/west) drive axis of your CG-5 Mount and will drive the telescope at the normal sidereal rate as well as allowing you to guide at 2x and 4x sidereal. Power is supplied via a DC battery pack.

Piggyback Mount (#93598) - Celestron's Piggyback Mount is a great accessory for all observers interested in deep-sky astrophotography, particularly beginners. This mount allows you to attach your camera, with its lens, to either the top or side of the telescope, making it possible to shoot with a normal or wide angle lens while guiding through the telescope.

Planisphere (93720) - A simple and inexpensive tool for all levels of observers, from naked eye viewers to users of highly sophisticated telescopes. The Celestron Planisphere makes it easy to locate stars for observing and is a great planet finder as well. A map of the night sky, oriented by month and day, rotates within a depiction of the 24 hours of the day, to display exactly which stars and planets will be visible at any given time. Ingeniously simple to use, yet quite effective. Made of durable materials and coated for added protection. Celestron Planispheres come in three different models, to match the latitude from which you're observing:

For 20 to 40 degrees of latitude	93720-30
For 30 to 50 degrees of latitude	93720-40
For 40 to 60 degrees of latitude	93720-50

Polarizing Filter Set (#93608) - The polarizing filter set limits the transmission of light to a specific plane, thus increasing contrast between various objects. This is used primarily for terrestrial, lunar and planetary observing.

Polar Axis Finderscope (#94221) - This useful accessory speeds accurate polar alignment by providing a means of visually aligning your German equatorial mount with Polaris and true north. The finderscope has an eyepiece with etched reticle for quick polar alignment.

Radial Guider (#94176) - The Celestron® Radial Guider is specifically designed for use in prime focus, deep sky astrophotography and takes the place of the T-Adapter. This device allows you to photograph and guide simultaneously through the optical tube assembly of your telescope. This type of guiding produces the best results since what you see through the guiding eyepiece is exactly reproduced on the processed film. The Radial Guider is a "T"-shaped assembly that attaches to the rear cell of the telescope. As light from the telescope enters the guider, most passes straight through to the camera. A small portion, however, is diverted by a prism at an adjustable angle up to the guiding eyepiece. This guider has two features not found on other off-axis guiders; first, the prism and eyepiece housing rotate independently of the camera orientation making the acquisition of a guide star quite easy. Second, the prism angle is tunable allowing you to look at guide stars on-axis. This accessory works especially well with the Reducer/Corrector.

Reducer/Corrector (#94175) - This lens reduces the focal length of the telescope by 37%, making your G-8 a 1280mm f/6.3 instrument. In addition, this unique lens also corrects inherent aberrations to produce crisp images all the way across the field when used visually. When used photographically, there is some vignetting that produces a 26mm circular image on the processed film. It also increases the field of view significantly and is ideal for wide-field, deep-space viewing. It is also perfect for beginning prime focus, long-exposure astrophotography when used with the Radial Guider. It makes guiding easier and exposures much shorter.

Sky Maps (#93722) - Celestron Sky Maps are the ideal teaching guide for learning the night sky. You wouldn't set off on a road trip without a road map, and you don't need to try to navigate the night sky without a map either. Even if you already know your way around the major constellations, these maps can help you locate all kinds of fascinating objects.

Skylight Filter (#93621) - The Skylight Filter is used on the Celestron G-8 telescope as a dust seal. The filter threads onto the rear cell of your telescope. All other accessories, both visual and photographic (with the exception of Barlow lenses), thread onto the Skylight Filter. The light loss caused by this filter is minimal

Solar Filter (#94162) - Celestron Solar Skreen® solar filter permits direct observation of the Sun in complete safety. This filter, which transmits .001% of visible light, allows you to see sunspots as they move across the solar disk. In addition to reducing the intensity of the Sun's visible light, it also blocks 99.999% of invisible infrared light. The Celestron Solar Skreen® solar filter is made of precision engineered Mylar polyester film. A layer of aluminum is vacuum-deposited on one surface of each of the dual sheets of Mylar used to make each filter. The aluminum coating produces a cool, comfortable pale blue image of the Sun. (A #21 orange eyepiece filter works well in conjunction with this filter to produce a more natural colored Sun with greater contrast.) This filter can be used for both visual observation and photography of the Sun.

NOTE: **NEVER LOOK DIRECTLY AT THE SUN WITH THE NAKED EYE OR WITH A TELESCOPE. NEVER POINT YOUR TELESCOPE AT THE SUN UNLESS YOU HAVE THE PROPER FILTER. ALWAYS COVER YOUR FINDER OBJECTIVE WITH AN OPAQUE COVER.**

T-Adapter (#93633-A) - T-Adapter (with additional T-Ring) allows you to attach your 35mm SLR camera to the rear cell of your Celestron G-8. This turns your G-8 into a 2032mm telephoto lens perfect for terrestrial photography and short exposure lunar and filtered solar photography.

T-C Adapter (#93636) - This adapter allows you to couple a video or movie camera to a telescope. The camera must have a removable lens with a standard "C" thread. The T-C adapter threads into the camera and then onto the T-Adapter.

T-Ring - The T-Ring couples your 35mm SLR camera body to the T-Adapter, radial guider, or tele-extender. This accessory is mandatory if you want to do photography through the telescope. Each camera make (i.e., Minolta, Nikon, Pentax, etc.) has its own unique mount and therefore, its own T-Ring. Celestron has 9 different models for 35mm cameras.

Tele-Extender, Deluxe (#93643) - The tele-extender is a hollow tube that allows you to attach a camera to the telescope when the eyepiece is installed. This accessory is used for eyepiece projection photography which allows you to capture very high power views of the Sun, Moon, and planets on film. The Tele-Extender fits over the eyepiece onto the visual back. This tele-extender works with eyepieces that have large housings, like the Celestron Ultima series.

A full description of all Celestron accessories can be found in the Celestron accessory catalog (#93685).

THE MESSIER CATALOG

The Messier Catalog, compiled by Charles Messier, was the first extensive listing of star clusters and nebulae. Messier's primary observational purpose was to discover comets. He compiled this list so that others searching for comets would not be confused by these objects. His list still remains popular today because all of these objects are easily visible in amateur telescopes.

M#	NGC#	Const.	R.A. H M S	DEC ° '	Mag	Type	Proper Name
M1	NGC 1952	Tau	5 34.5	22 01	8.4	P. Neb.	Crab Nebula
M2	NGC 7089	Aqr	21 33.5	-00 49	6.5	Gl. Cl.	
M3	NGC 5272	CVn	13 42.2	28 23	6.4	Gl. Cl.	
M4	NGC 6121	Sco	16 23.6	-26 32	5.9	Gl. Cl.	
M5	NGC 5904	Ser	15 18.5	2 05	5.8	Gl. Cl.	
M6	NGC 6405	Sco	17 40.0	-32 13	4.2	Op. Cl.	Butterfly Cluster
M7	NGC 6475	Sco	17 54.0	-34 49	3.3	Op. Cl.	
M8	NGC 6523	Sgr	18 03.7	-24 23	5.8	D. Neb.	Lagoon Nebula
M9	NGC 6333	Oph	17 19.2	-18 31	7.9	Gl. Cl.	
M10	NGC 6254	Oph	16 57.2	-4 06	6.6	Gl. Cl.	
M11	NGC 6705	Sct	18 51.1	-6 16	5.8	Op. Cl.	Wild Duck Cluster
M12	NGC 6218	Oph	16 47.2	-1 57	6.6	Gl. Cl.	
M13	NGC 6205	Her	16 41.7	36 28	5.9	Gl. Cl.	Hercules Cluster
M14	NGC 6402	Oph	17 37.6	-3 15	7.6	Gl. Cl.	
M15	NGC 7078	Peg	21 30.0	12 10	6.4	Gl. Cl.	
M16	NGC 6611	Ser	18 18.9	-13 47	6.0	D. Neb.	Eagle Nebula
M17	NGC 6618	Sgr	18 20.8	-16 11	7.0	D. Neb.	Omega Nebula
M18	NGC 6613	Sgr	18 19.9	-17 08	6.9	Op. Cl.	
M19	NGC 6273	Oph	17 02.6	-26 16	7.2	Gl. Cl.	
M20	NGC 6514	Sgr	18 02.4	-23 02	8.5	D. Neb.	Trifid Nebula
M21	NGC 6531	Sgr	18 04.7	-22 30	5.9	Op. Cl.	
M22	NGC 6656	Sgr	18 36.4	-23 54	5.1	Gl. Cl.	
M23	NGC 6494	Sgr	17 56.9	-19 01	5.5	Op. Cl.	
M24	NGC 6603	Sgr	18 16.4	-18 29	4.5	Op. Cl.	
M25	IC 4725	Sgr	18 31.7	-19 15	4.6	Op. Cl.	
M26	NGC 6694	Sct	18 45.2	-9 24	8.0	Op. Cl.	
M27	NGC 6853	Vul	19 59.6	22 43	8.1	P. Neb.	Dumbbell Nebula
M28	NGC 6626	Sgr	18 24.6	-24 52	6.9	Gl. Cl.	
M29	NGC 6913	Cyg	20 23.0	38 32	6.6	Op. Cl.	
M30	NGC 7099	Cap	21 40.4	-23 11	7.5	Gl. Cl.	
M31	NGC 224	And	0 42.7	41 16	3.4	Sp. Gx.	Andromeda Galaxy
M32	NGC 221	And	0 42.7	40 52	8.2	El. Gx.	
M33	NGC 598	Tri	1 33.8	30 39	5.7	Sp. Gx.	Pinwheel Galaxy
M34	NGC 1039	Per	2 42.0	42 47	5.2	Op. Cl.	
M35	NGC 2168	Gem	6 08.8	24 20	5.1	Op. Cl.	

M#	NGC#	Const.	R.A. H M S	DEC ° ‘	Mag	Type	Proper Name
M36	NGC 1960	Aur	5 36.3	34 08	6.0	Op. Cl.	
M37	NGC 2099	Aur	5 52.0	32 33	5.6	Op. Cl.	
M38	NGC 1912	Aur	5 28.7	35 50	6.4	Op. Cl.	
M39	NGC 7092	Cyg	21 32.3	48 26	4.6	Op. Cl.	
M40		UMa	12 22.2	58 05	8.0	dbl	
M41	NGC 2287	CMa	6 47.0	-20 44	4.5	Op. Cl.	
M42	NGC 1976	Ori	5 35.3	-5 27	4.0	D. Neb.	Great Orion Nebula
M43	NGC 1982	Ori	5 35.5	-5 16	9.0	D. Neb.	
M44	NGC 2632	Cnc	8 40.0	19 59	3.1	Op. Cl.	Beehive Cluster
M45		Tau	3 47.5	24 07	1.2	Op. Cl.	Pleiades
M46	NGC 2437	Pup	7 41.8	-14 49	6.1	Op. Cl.	
M47	NGC 2422	Pup	7 36.6	-14 30	4.4	Op. Cl.	
M48	NGC 2548	Hya	8 13.8	-5 48	5.8	Op. Cl.	
M49	NGC 4472	Vir	12 29.8	8 00	8.4	El. Gx.	
M50	NGC 2323	Mon	7 03.0	-8 20	5.9	Op. Cl.	
M51	NGC 5194-5	CVn	13 29.9	47 12	8.1	Sp. Gx.	Whirlpool Galaxy
M52	NGC 7654	Cas	23 24.2	61 35	6.9	Op. Gx.	
M53	NGC 5024	Com	13 12.9	18 10	7.7	Gl. Cl.	
M54	NGC 6715	Sgr	18 55.1	-30 29	7.7	Gl. Cl.	
M55	NGC 6809	Sgr	19 40 .0	-30 58	7.0	Gl. Cl.	
M56	NGC 6779	Lyr	19 16.6	30 11	8.2	Gl. Cl.	
M57	NGC 6720	Lyr	18 53.6	33 02	9.0	P. Neb.	Ring Nebula
M58	NGC 4579	Vir	12 37.7	11 49	9.8	Sp. Gx.	
M59	NGC 4621	Vir	12 42.0	11 39	9.8	El. Gx.	
M60	NGC 4649	Vir	12 43.7	11 33	8.8	El. Gx.	
M61	NGC 4303	Vir	12 21.9	4 28	9.7	Sp. Gx.	
M62	NGC 6266	Oph	17 01.2	-30 07	6.6	Gl. Cl.	
M63	NGC 5055	CVn	13 15.8	42 02	8.6	Sp. Gx.	Sunflower Galaxy
M64	NGC 4826	Com	12 56.7	21 41	8.5	Sp. Gx.	Black Eye Galaxy
M65	NGC 3623	Leo	11 18.9	13 05	9.3	Sp. Gx.	Leo’s Triplet
M66	NGC 3627	Leo	11 20.3	12 59	9.0	Sp. Gx.	Leo’s Triplet
M67	NGC 2682	Cnc	8 50.3	11 49	6.9	Op. Cl.	
M68	NGC 4590	Hya	12 39.5	-26 45	8.2	Gl. Cl.	
M69	NGC 6637	Sgr	18 31.4	-32 21	7.7	Gl. Cl.	
M70	NGC 6681	Sgr	18 43.2	-32 18	8.1	Gl. Cl.	
M71	NGC 6838	Sge	19 53.7	18 47	8.3	Gl. Cl.	
M72	NGC 6981	Aqr	20 53.5	-12 32	9.4	Gl. Cl.	
M73	NGC 6994	Aqr	20 58.0	-12 38		ast	
M74	NGC 628	Psc	1 36.7	15 47	9.2	S	
M75	NGC 6864	Sgr	20 06.1	-21 55	8.6	Gl Cl.	
M76	NGC 650-1	Per	1 42.2	51 34	11.5	P. Neb.	Cork Nebula
M77	NGC 1068	Cet	2 42.7	0 01	8.8	Sp. Gx.	
M78	NGC 2068	Ori	5 46.7	0 03	8.0	D. Neb.	
M79	NGC 1904	Lep	5 24.2	-24 33	8.0	Gl. Cl.	
M80	NGC 6093	Sco	16 17.0	-22 59	7.2	Gl. Cl.	

M#	NGC#	Const.	R.A. H M S	DEC ° ‘	Mag	Type	Proper Name
M81	NGC 3031	UMa	9 55.8	69 04	6.8	Sp. Gx.	Bodes Nebula
M82	NGC 3034	UMa	9 56.2	69 41	8.4	Ir. Gx.	
M83	NGC 5236	Hya	13 37.7	-29 52	7.6	Sp. Gx.	
M84	NGC 4374	Vir	12 25.1	12 53	9.3	El. Gx.	
M85	NGC 4382	Com	12 25.4	18 11	9.2	El. Gx.	
M86	NGC 4406	Vir	12 26.2	12 57	9.2	El. Gx.	
M87	NGC 4486	Vir	12 30.8	12 24	8.6	El. Gx.	Virgo A
M88	NGC 4501	Com	12 32.0	14 25	9.5	Sp. Gx.	
M89	NGC 4552	Vir	12 35.7	12 33	9.8	El. Gx.	
M90	NGC 4569	Vir	12 36.8	13 10	9.5	Sp. Gx.	
M91	NGC 4548	Com	12 35.4	14 30	10.2	Sp. Gx.	
M92	NGC 6341	Her	17 17.1	43 08	6.5	Gl. Cl.	
M93	NGC 2447	Pup	7 44.6	-23 52	6.2	Op. Cl.	
M94	NGC 4736	CVn	12 50.9	41 07	8.1	Sp. Gx.	
M95	NGC 3351	Leo	10 44.0	11 42	9.7	Sp. Gx.	
M96	NGC 3368	Leo	10 46.8	11 49	9.2	Sp. Gx.	
M97	NGC 3587	UMa	11 14.9	55 01	11.2	P. Neb.	Owl Nebula
M98	NGC 4192	Com	12 13.8	14 54	10.1	Sp. Gx.	
M99	NGC 4254	Com	12 18.8	14 25	9.8	Sp. Gx.	Pin Wheel Nebula
M100	NGC 4321	Com	12 22.9	15 49	9.4	Sp. Gx.	
M101	NGC 5457	UMa	14 03.2	54 21	7.7	Sp. Gx.	
M102	NGC 5457	UMa	14 03.2	54 21	7.7	dup	
M103	NGC 581	Cas	1 33.1	60 42	7.4	Op. Cl.	
M104	NGC 4594	Vir	12 40.0	-11 37	8.3	Sp. Gx.	Sombrero Galaxy
M105	NGC 3379	Leo	10 47.9	12 35	9.3	El. Gx..	
M106	NGC 4258	CVn	12 19.0	47 18	8.3	Sp. Gx.	
M107	NGC 6171	Oph	16 32.5	-13 03	8.1	Gl. Cl.	
M108	NGC 3556	UMa	11 11.6	55 40	10.0	Sp. Gx.	
M109	NGC 3992	UMa	11 57.7	53 23	9.8	Sp. Gx.	
M110	NGC 205	And	0 40.3	41 41	8.0	El. Gx.	

Object Abbreviations:

- Sp. Gx. ..... Spiral Galaxy
- El. Gx. ..... Elliptical Galaxy
- Ir. Gx. ..... Irregular Galaxy
- Op. Cl. ..... Open Cluster
- Gl. Cl. ..... Globular Cluster
- D. Neb. ..... Diffuse Nebula
- P. Neb. ..... Planetary Nebula

NOTE: All coordinates for the objects in the Messier catalog are listed in epoch 2000.00.

LIST OF BRIGHT STARS

The following is a list of bright stars that can be used to align the R.A. setting circle. All coordinates are in epoch 2000.0.

Star Name	Constellation	Epoch 2000.0 R.A. H M S	DEC ° ‘ “	Magnitude
Sirius	CMa	06 45 09	-16 42 58	-1.47
Canopus	Car	06 23 57	-52 41 44	-0.72
Arcturus	Boo	14 15 40	+19 10 57	-0.72
Rigel Kent.	Cen	14 39 37	-60 50 02	+0.01
Vega	Lyr	18 36 56	+38 47 01	+0.04
Capella	Aur	05 16 41	+45 59 53	+0.05
Rigel	Ori	05 14 32	-08 12 06	+0.14
Procyon	CMi	07 38 18	+05 13 30	+0.37
Betelgeuse	Ori	05 55 10	+07 24 26	+0.41
Achernar	Eri	01 37 43	-57 14 12	+0.60
Hadar	Cen	14 03 49	-60 22 22	+0.63
Altair	Aqi	19 50 47	+08 52 06	+0.77
Aldebaran	Tau	04 35 55	+16 30 33	+0.86
Spica	Vir	13 25 12	-11 09 41	+0.91
Antares	Sco	16 29 24	-26 25 55	+0.92
Fomalhaut	PsA	22 57 39	-29 37 20	+1.15
Pollux	Gem	07 45 19	+28 01 34	+1.16
Deneb	Cyg	20 41 26	+45 16 49	+1.28
Beta Crucis	Cru	12 47 43	-59 41 19	+1.28
Regulus	Leo	10 08 22	+11 58 02	+1.36

FOR FURTHER READING

The following is a list of astronomy books that will further enhance your understanding of the night sky. The books are broken down by classification for easy reference.

Astronomy Texts

Astronomy Now	Pasachoff & Kutner
Cambridge Atlas Of Astronomy	Audouze & Israel
McGraw-Hill Encyclopedia Of Astronomy	Parker
Astronomy-The Evolving Universe	Zeilik

Atlases

Atlas Of Deep Sky Splendors	Vehrenberg
Sky Atlas 2000.0	Tirion
Sky Catalog 2000.0 Vol 1 & 2	Hirshfeld & Sinnott
Uranometria Vol. 1 & 2	Tirion, Rappaport, Lovi
Magnitude 6 Star Atlas	Dickinson, Costanzo, Chaple
NGC 2000.0	Sinnott

General Observational Astronomy

The Cambridge Astronomy Guide	Liller & Mayer
A Complete Manual Of Amateur Astronomy	Sherrod
The Guide To Amateur Astronomy	Newton & Teece

Visual Observation

Observational Astronomy For Amateurs	Sidgwick
Astronomical Calendar	Ottewell
Burnham's Celestial Handbook Vols. 1, 2 & 3	Burnham
The Planet Jupiter	Peek
Field Guide To The Stars & Planets	Menzel & Pasachoff
Observe Comets	Edberg & Levy

Astrophotography

Skyshooting	Mayall & Mayall
Astrophotography A Step-by-Step Approach	Little
Astrophotography For The Amateur	Covington
Astrophotography	Gordon
Astrophotography II	Martinez
A Manual Of Celestial Photography	King
Manual Of Advanced Celestial Photography	Wallis & Provin
Colours Of The Stars	Malin & Muirden

CELESTRON ONE YEAR WARRANTY

A. Celestron International (CI) warrants this telescope to be free from defects in materials and workmanship for one year. CI will repair or replace such product or part thereof which, upon inspection by CI, is found to be defective in materials or workmanship. As a condition to the obligation of CI to repair or replace such product, the product must be returned to CI together with proof-of-purchase satisfactory to CI.

B. The Proper Return Authorization Number must be obtained from CI in advance of return. Call Celestron at (310) 328-9560 to receive the number to be displayed on the outside of your shipping container.

All returns must be accompanied by a written statement setting forth the name, address, and daytime telephone number of the owner, together with a brief description of any claimed defects. Parts or product for which replacement is made shall become the property of CI.

The customer shall be responsible for all costs of transportation and insurance, both to and from the factory of CI, and shall be required to prepay such costs.

CI shall use reasonable efforts to repair or replace any telescope covered by this warranty within thirty days of receipt. In the event repair or replacement shall require more than thirty days, CI shall notify the customer accordingly. CI reserves the right to replace any product which has been discontinued from its product line with a new product of comparable value and function.

This warranty shall be void and of no force of effect in the event a covered product has been modified in design or function, or subjected to abuse, misuse, mishandling or unauthorized repair. Further, product malfunction or deterioration due to normal wear is not covered by this warranty.

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Some states do not allow the exclusion or limitation of incidental or consequential damages or limitation on how long an implied warranty lasts, so the above limitations and exclusions may not apply to you.

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CI reserves the right to modify or discontinue, without prior notice to you, any model or style telescope.

If warranty problems arise, or if you need assistance in using your telescope contact:

Celestron International
Customer Service Department
2835 Columbia Street
Torrance, CA 90503
Tel. (310) 328-9560
Fax. (310) 212-5835
Monday-Friday 8AM-4PM PST

This warranty supersedes all other product warranties.

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NOTE: This warranty is valid to U.S.A. and Canadian customers who have purchased this product from an Authorized CI Dealer in the U.S.A. or Canada. Warranty outside the U.S.A. and Canada is valid only to customers who purchased from a CI International Distributor or Authorized CI Dealer in the specific country and please contact them for any warranty service.

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Web site: http://www.celestron.com

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