



# **CELESTAR**

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## **INSTRUCTION MANUAL**

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# INTRODUCTION

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 Celestar line of telescopes continue in this proud tradition combining large aperture optics with ease of use and portability. With a mirror diameter of 8 inches, your Celestar telescope has a light gathering power of 841 times that of the unaided human eye. Yet despite its large aperture, the Celestar optical system is extremely compact and portable because it utilizes the Schmidt-Cassegrain design. This means you can take your Celestar telescope to the mountains or desert or wherever you observe.

The Celestar telescope 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. And, your Celestar telescope is versatile – it grows as your interest in astronomy grows.

Your Celestar telescope however, is not limited to astronomical usage alone. It can also be used for terrestrial viewing to study the world around you. All you need to do is take the time to familiarize yourself with your Celestron telescope and its operation.

## HOW TO USE THIS MANUAL

This manual is designed to instruct you in the proper use of your Celestar telescope. The instructions are for assembly, initial use, long term operation, and maintenance. There are seven major sections to the manual. The first section covers the proper procedure for setting up your Celestar telescope. This includes setting up the tripod, attaching the telescope to the mount, balancing the telescope, etc.

The second section deals with the basics of telescope use. Topics include focusing, aligning the finder, and taking your first look. The third section deals with the basics of astronomy which includes the celestial coordinate system, the motions of the stars, and polar alignment. The fourth section deals with celestial observing covering visual observations of the planets and deep-sky objects. Using both the setting circles and star hopping are discussed. The fifth section covers celestial photography working from the easiest to the most difficult. The last major section is on telescope maintenance, specifically on cleaning and collimation. Keeping your Celestar telescope in proper collimation is the single most important thing you can do to ensure it performs well.

In addition to the major sections mentioned previously, there is a list of optional accessories for your Celestar telescope that include a brief description of its purpose. This is the section to consult when you've mastered the basics and ready for new, more challenging observations. The final part of this manual contains a list of objects that can be observed through your Celestar telescope. Included are the coordinates for each object, its brightness, and a code which indicates what type of an object it is. In addition, there is a list of bright stars used for aligning the setting circles.

Read the assembly instructions through completely before you attempt to set up your Celestar telescope. Then, once you've set up your Celestar telescope read the section on 'Telescope Basics' before you take it outside and use it. This will ensure that you are familiar with your telescope before you try to use it under a dark sky. Since it will take a few observing sessions to familiarize yourself with your Celestar telescope you should keep this manual handy until you have fully mastered your telescope's operation. After that, save the manual for future reference.

### **A WORD OF CAUTION**

Your Celestar telescope is designed to give you hours of fun and rewarding observations. There are, however, a few things to consider before using your telescope that will ensure your safety and protect your equipment.

**WARNING ! 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.**

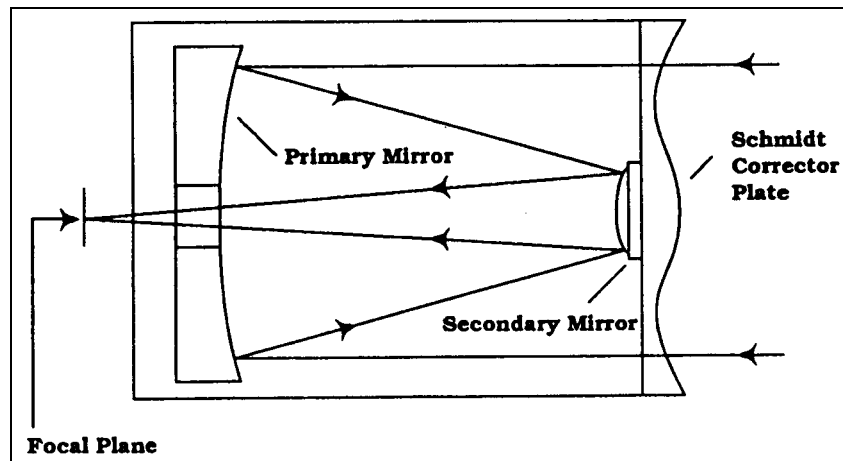
**NEVER LEAVE THE TELESCOPE UNSUPERVISED, EITHER WHEN CHILDREN ARE PRESENT OR WITH ADULTS WHO MAY NOT BE FAMILIAR WITH THE CORRECT OPERATING PROCEDURES OF YOUR TELESCOPE.**

**NEVER POINT YOUR TELESCOPE AT THE SUN UNLESS YOU HAVE THE PROPER 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 nothing more than 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 (or Schmidt-Cass for short) system 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. This makes them extremely popular among amateur astronomers. 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 which prevents stray light from passing through to the eyepiece or camera without striking the primary or secondary mirrors.



**Figure 1-1.** This cross-section 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 design. Note that the curve of the corrector plate is greatly exaggerated.

# ASSEMBLING YOUR CELESTAR

The complete line of Celestar models are fork mounted telescopes with built-in single motor gear drives. The Celestar 8 and Celestar 8 computerized have a spur gear drive powered by a single 9-volt battery while the Celestar Deluxe 8 and Celestar Deluxe 8 computerized are worm gear driven powered by two 9-volt batteries. All models can also run off external AC or DC power. All come standard with the Starbright™ coating, an enhanced multilayer aluminum coating on the primary and secondary mirrors for increased reflectivity. Also, the corrector is fully coated to allow maximum light transmission.

The Celestar 8's are shipped in two boxes. One contains the standard Wedgpod, a combination wedge and tripod. One contains the telescope with all the standard accessories, which are:

- 25mm SMA Ocular 1-1/4"
- Visual Back 1-1/4"
- Star Diagonal 1-1/4"
- 6x30mm Finder With Bracket
- Lens Cap
- 9-volt Alkaline Battery
- Bolt Pack

The Celestar Deluxe 8's are shipped in four boxes. The telescope, the standard wedge, and the standard adjustable height tripod each are contained in its own box. And one box contains all the standard accessories, which are:

- 26mm Plössl Ocular 1-1/4"
- Visual Back 1-1/4"
- Star Diagonal 1-1/4"
- 9x50mm Finder with Bracket
- Hand Controller with cable
- Car Battery Adapter
- Two 9-volt Alkaline Batteries (packaged with telescope)
- Lens Cap (packaged with telescope)
- Declination motor with cable (packaged with telescope)

In addition to the above listed accessories, the computerized models also come with standard optical encoders and an Advanced Astro Master®. This unit is installed on the fork mount and is virtually ready to use.

## UNPACKING YOUR CELESTAR 8/CELESTAR DELUXE 8

Remove the Wedgpod (or the wedge and tripod), the telescope, and the standard accessories from their respective boxes. Save the boxes since you may want to ship your telescope via a common carrier at some time in the future. To assemble the Celestar 8, you will need a 3/16" and a 5/16" Allen wrench and a Phillips screw driver.

Use the diagram on the following page (Figure 2-1, Figure 2-2) to familiarize yourself with the various parts of your Celestar telescope.

The Computerized models are identical with the exception that the Advanced Astro Master comes installed.



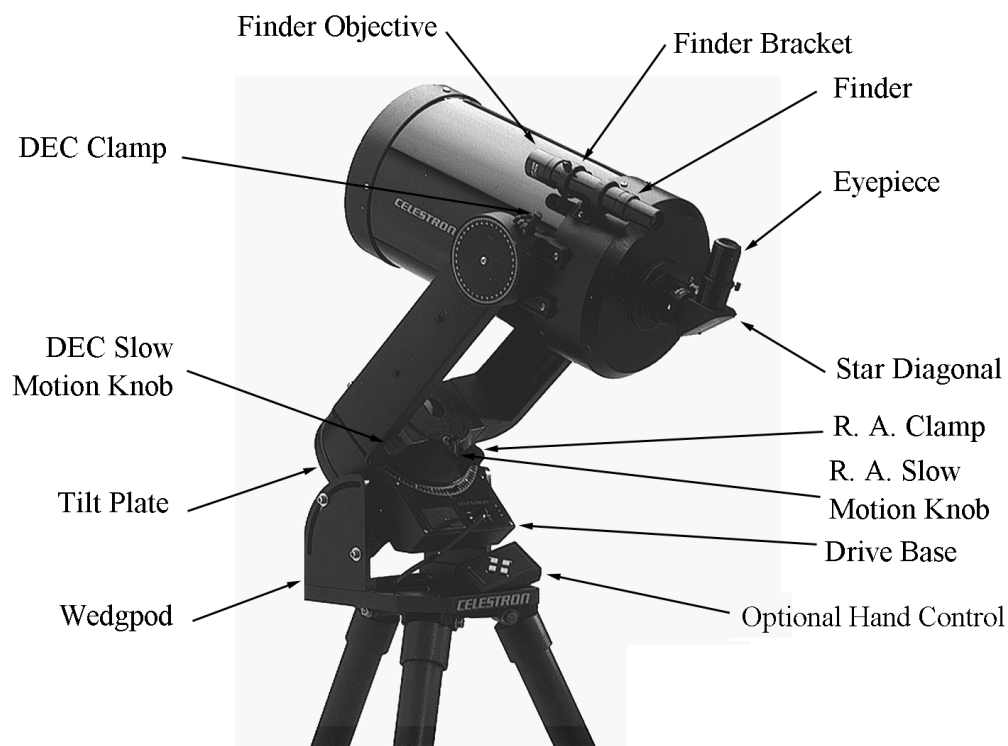


Figure 2-1 -- Celestar 8

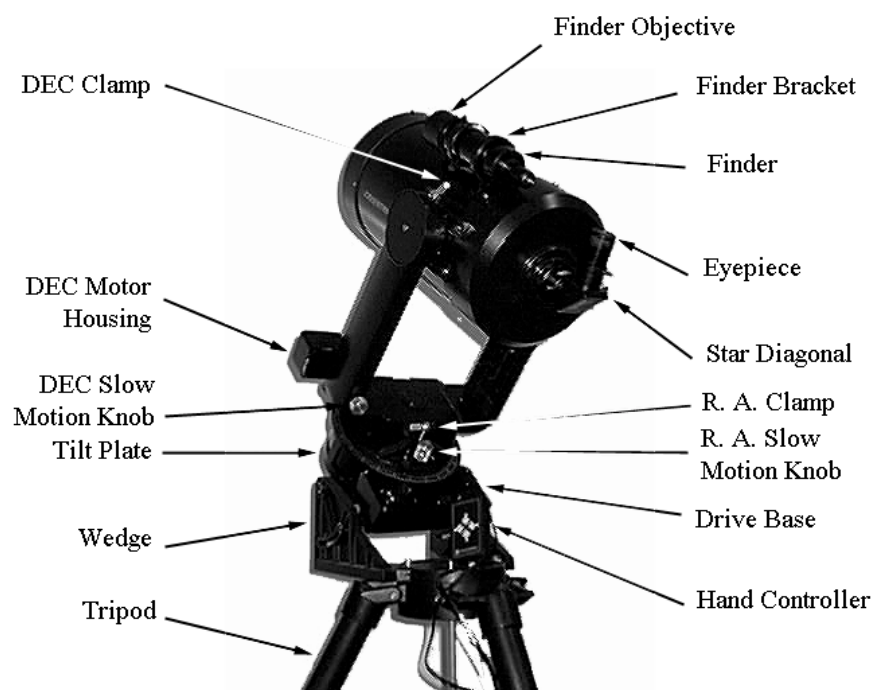


Figure 2-2 -- Celestar8 Deluxe

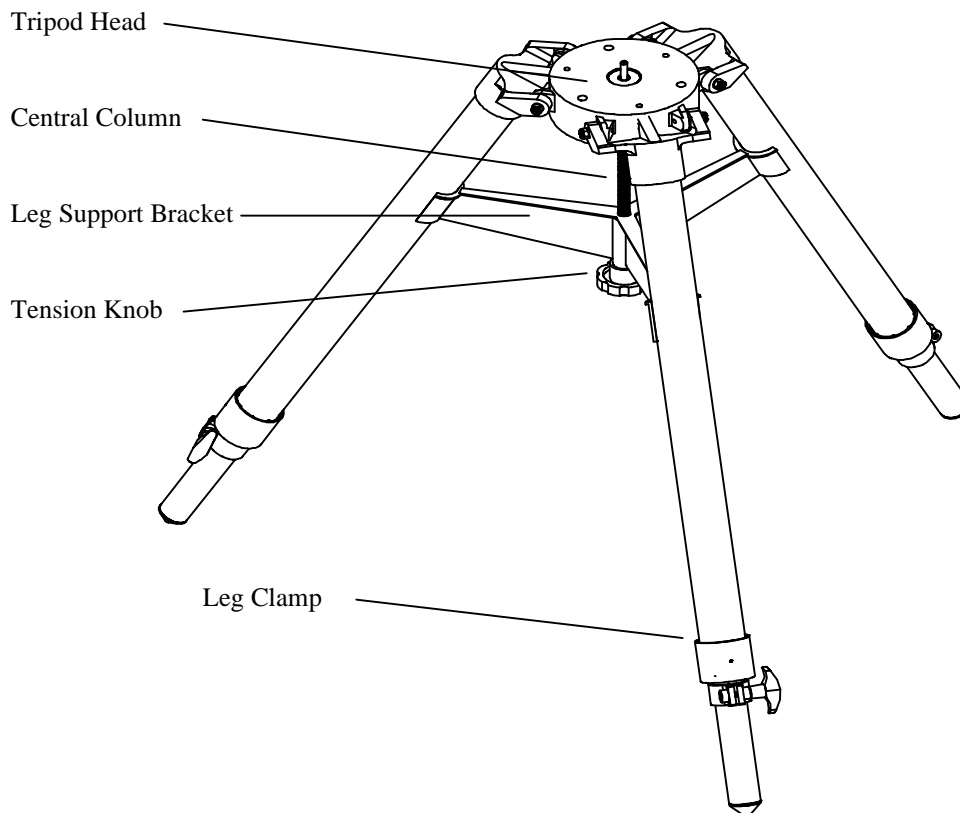
### **SETTING UP THE TRIPOD**

(For Celestar Deluxe 8 And Celestar Deluxe 8 Computerized Only)

For maximum rigidity, the Celestron field tripod has a leg support bracket. This bracket fits snugly against the tripod legs, increasing stability while reducing vibration and flexure. However, the tripod is shipped with each arm of the leg support bracket in between the legs so the tripod legs can collapse. To set up the tripod:

1. Hold the tripod with the head up and the legs pointed toward the ground.
2. Pull the legs away from the central column until they will not separate any further. A small stop on the top of each tripod leg presses against the tripod head to indicate maximum separation.
3. Rotate the tension knob (located underneath the support bracket on the central column) clockwise until it is close to the bottom of the central column.
4. Turn the leg support bracket until the cups on the end of each bracket are directly underneath each leg.
5. Rotate the tension knob counterclockwise until the bracket is secure against the tripod legs. **Do not over tighten.**

The tripod will now stand by itself. Once the wedge and telescope are attached to the tripod, readjust the tension knob to ensure that the leg support bracket is snug. Once again, do not over tighten!



**Figure 2-3**

### **ADJUSTING THE TRIPOD HEIGHT**

(For Celestar Deluxe 8 And Celestar Deluxe 8 Computerized Only)

The tripod that comes with your Celestar Deluxe 8 telescope is adjustable. To adjust the height at which the tripod stands:

1. Loosen the extension clamp on one of the tripod legs (see figure 2-3).
2. Extend the leg to the desired height.
3. Tighten the extension clamp to hold the leg in place.
4. Repeat this process for each of the remaining legs.

You can do this while the tripod legs are still folded together.

Remember that the higher the tripod legs are extended, the less stable it is. For casual observing, this may not pose a problem. However, if you plan on doing photography, the tripod should be set low to ensure stability. A recommended height is to set the tripod in such a manner that you can look directly into the eyepiece on the telescope with a diagonal while seated.

### **ATTACHING THE WEDGE TO THE TRIPOD**

(For Celestar Deluxe 8 And Celestar Deluxe 8 Computerized Only)

Your Celestar Deluxe 8 telescope has a clock drive built into the base to track the stars as they move across the sky from east to west. However, for this drive to be useful, the telescope's axis of rotation should be made parallel to the Earth's axis. The wedge, which comes standard with both telescopes, allows you to tilt the telescope's axis of rotation. This process is known as polar alignment and is described in the section by the same name. The wedge, like the tripod, is fully assembled and only needs to be attached to the tripod.

The tripod has six holes on its base for mounting equipment. Three of the holes are threaded with 5/16-18 threads and three of the holes are open. The three open holes are for mounting a different telescope in the Celestron line. To mount a wedge to the tripod, the three threaded holes are used.

To attach the wedge to the tripod:

1. Place the three slots on the wedge over the three threaded holes in the tripod head.
2. Thread the three 5/16-18x1" socket head cap screws and washers into the holes until tight (see figure 2-5)
3. Tighten the screws until the wedge cannot be moved side to side. These can be loosened later for polar alignment.

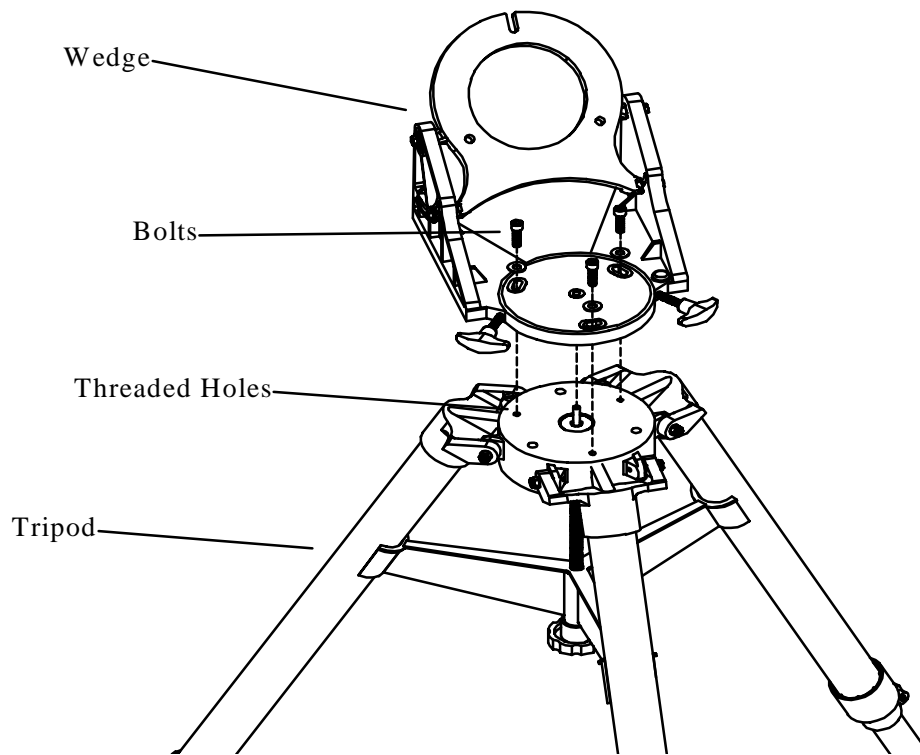


Figure 2-4

### SETTING UP THE WEDGPOD (For Celestar 8 And Celestar 8 Computerized Only)

The Wedgpod comes pre-assembled. Just remove it from the box, stand it up, and separate the tripod legs. There are stops that set the proper angle of the legs.

### LATITUDE ADJUSTMENT

Before attaching the telescope to the wedge/Wedgpod, you must adjust the wedge/Wedgpod to the proper latitude. To do so:

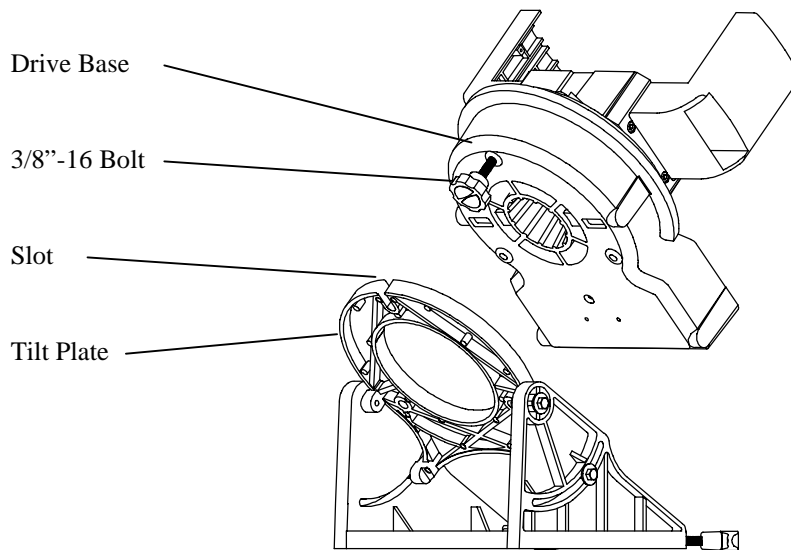
1. Loosen the four socket head screws that hold the tilt plate in place. They are located on the side plates of the wedge (two on each side). You'll need a 3/16" Allen wrench.
2. Move the tilt plate until the latitude scale indicates the latitude of your observing site. The latitude scale is on the side plate. The center of the bolt serves as the marker.
3. Tighten the socket head screws on the side plates to hold the tilt plate in place.

You are now ready to attach the telescope to the wedge/Wedgpod.

### ATTACHING THE CELESTAR TO THE WEDGE / WEDGPOD

For astronomical viewing, you should mount the telescope on the wedge/wedgpod. This will allow you to polar align the telescope, use the setting circles and the clock drive. To mount the telescope on the wedge:

1. Lay the telescope on its side and locate the three threaded holes in the bottom of the drive base.
2. Partially thread one of the three 3/8"-16 bolts (supplied in the bolt pack) into the hole that is opposite the rectangular portion of the base.
3. Pick the telescope up by the fork tines and position it above the tripod. It should be oriented so that the telescope is over the tripod with the base pointing toward the tilt plate.
4. Slide the bolt into the slot on the top of the tilt plate.



**Figure 2-5**

1. Tighten the bolt slightly so that the bottom of the drive base is flush to the tilt plate. Do not tighten it fully or you will not be able to move the base enough to insert the two remaining bolts. If you do not tighten the bolt at all, the drive base may be tilted slightly preventing the remaining two bolts from threading straight in.
2. Move the base of the telescope until the two remaining holes in the drive base line up with the holes in the tilt plate on the wedge.
3. Insert the screws and tighten all three completely.
4. There is no need to loosen these until you are ready to remove the telescope from the wedge/wedgpod.

### **INSTALLING THE FINDER**

The Celestar 8 comes with a 6x30 finderscope which has an 7° field-of-view. The Celestar Deluxe 8 comes with a 9x50 finder, which has a 5.8° field of view. The specifications for a finderscope, 6x30 or

9x50, stand for the magnification and the aperture, in millimeters, of the scope. So, a 6x30 finder magnifies six times and has a 30mm objective lens.

To ensure that the finder and bracket are not damaged during shipping, they are not attached to the telescope at the factory. Start by removing the finder and hardware from the plastic wrapper. Included are the following:

#### **Celestar 8**

- 6x30mm Finderscope
- Rubber O-Ring
- Three Nylon Thumbscrews (10-24x1/2)
- Two Phillips Pan Head Screws (10-24x5/8)

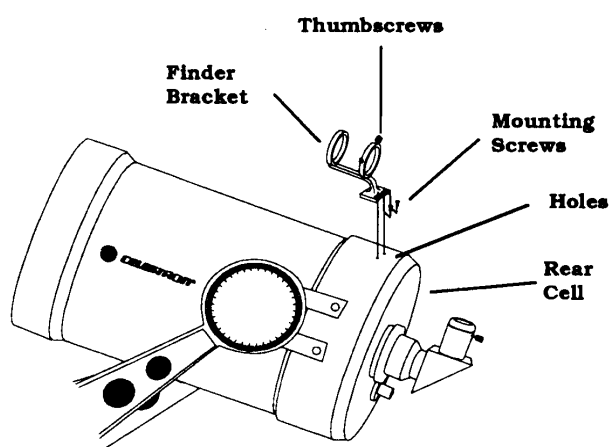
#### **Celestar Deluxe 8**

- 9x50mm Finderscope
- Rubber O-Ring
- Three Nylon Thumbscrews (10-24x1/2)
- Two Phillips Pan Head Screws (10-24x5/8")

Mounting the finder is a two-step process and is the same for the Celestar 8 and the Celestar Deluxe 8. First you mount the bracket to the telescope, then mount the finder in the bracket.

### **ATTACHING THE FINDER BRACKET**

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 before installing the finder.
3. Place the finder bracket over the holes. Orient the bracket so that the ring with the holes for the adjustment screws is closer to the rear cell of the telescope (see Figure 2-6).
4. Thread the screws in by hand and then tighten with a Phillips screw driver.



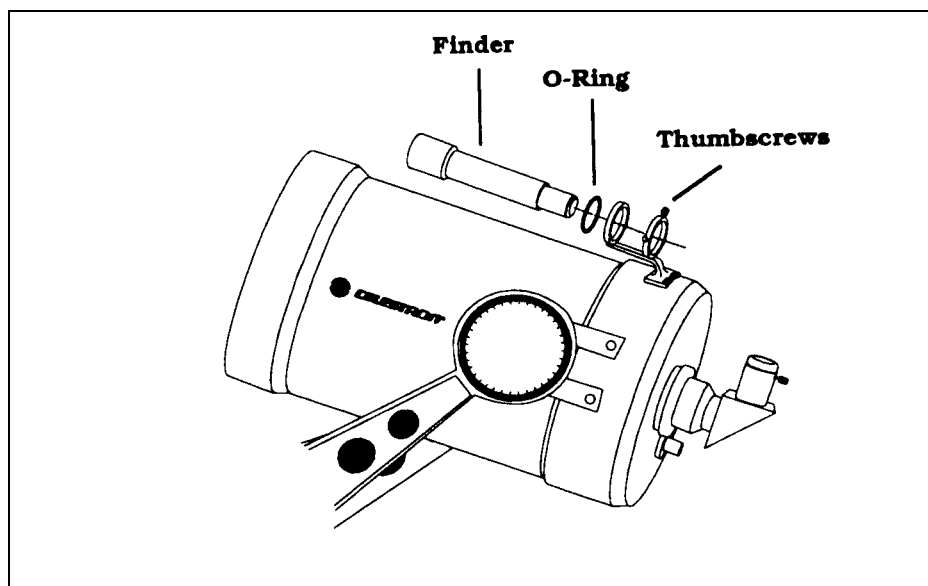
**Figure 2-6**

## **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 nylon thumbscrews into the finder bracket. Tighten the screws until the heads are flush with the inner diameter of the bracket ring. Do not thread them in completely or they will interfere with the placement of the finder.
2. Slide the rubber O-ring onto the back (i.e., eyepiece 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 end of the finder where the eyepiece mounts into the front of the bracket. Push it back until the end of the finder, where the eyepiece attaches, is past the back ring of the bracket, but NOT so far that the O-Ring is snug inside the back ring.
5. Slide the O-Ring toward the back(i.e., eyepiece end) of the finder.
6. Push the finder back until the O-Ring is snug inside the back ring of the finder bracket.
7. Hand tighten the three nylon-tipped thumbscrews until snug.

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



**Figure 2-7**

## **REMOVING THE LENS CAP**

The Celestar 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.

## INSTALLING THE VISUAL ACCESSORIES

Installing the ocular and other visual accessories is the same for both the Celestar 8 and Celestar Deluxe 8.

### *The Visual Back*

The visual back allows you to attach most visual accessories to the telescope. If you use a 1-1/4" star diagonal or if you want to insert the eyepiece into the telescope without a diagonal, then attach the visual back to the rear cell on the back of the telescope (see Figure 2-8). To attach the visual back:

1. Remove the protective cap from the back of your telescope. It is pressed onto the rear cell.
2. Place the slip ring on the visual back over the threads on the rear cell.
3. Tighten by rotating the slip ring clockwise until tight.

Once this is done, you are ready to attach other accessories such as eyepieces, and diagonal prisms. If you want to remove the visual back, rotate the slip ring counterclockwise until it is free of the rear cell.

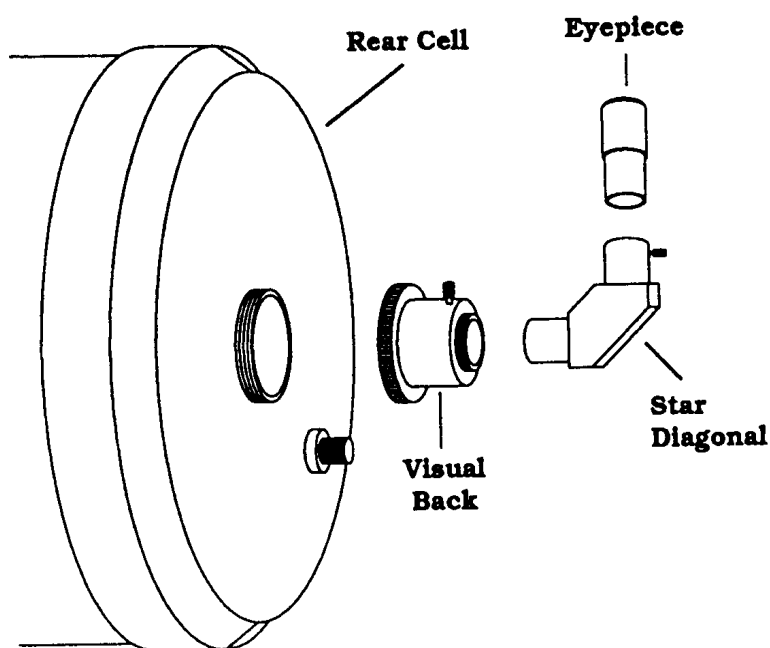


Figure 2-8

### *The Star Diagonal*

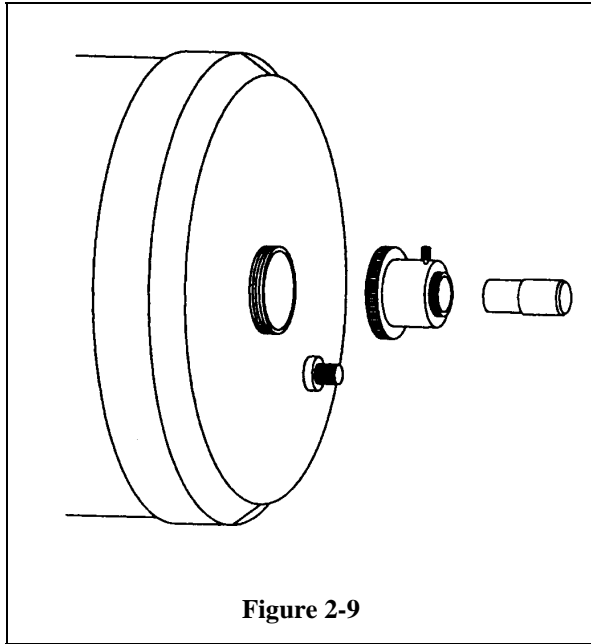
The star diagonal is a prism that diverts the light at a right angle from the light path of the telescope. For astronomical observing, this allows you to observe in positions that are more comfortable than if you were to look straight through. To attach the star diagonal:

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

2. Slide the chrome portion of the star diagonal into the visual back.
3. Tighten the thumbscrew on the visual back to hold the star diagonal in place.

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





### ***The Eyepieces***

The eyepiece, or ocular, is the optical element that magnifies the image focused by the telescope. The eyepiece fits either into the visual back directly or into the star diagonal. To install an eyepiece:

1. Loosen the thumbscrew 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.
3. Tighten the thumbscrew on the diagonal to hold the eyepiece in place.

To remove the eyepiece, loosen the thumbscrew on the star diagonal and slide the eyepiece out.

In addition to barrel diameter, eyepieces are also referred to in terms of their focal length. 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 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. Standard barrel diameters are .96”, 1.25”, and 2”. The Celestar 8 and Celestar Deluxe 8 come standard for use with 1.25” barrel eyepieces.

## MOVING THE TELESCOPE IN R.A. AND DEC

Pointing the telescope is done by moving the telescope in right ascension, or R.A. for short, and declination, or DEC for short (see Figure 2-11). Right ascension corresponds to east/west movement while declination corresponds to north/south movement. To make considerable directional changes:

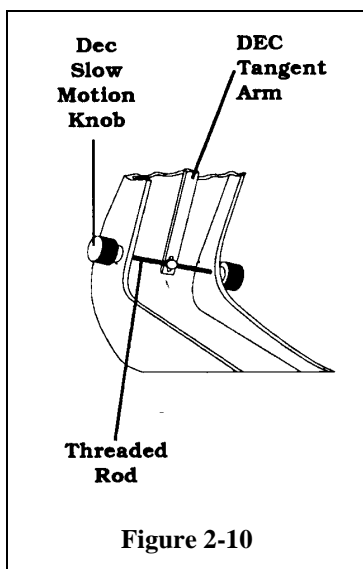


Figure 2-10

1. Loosen the R.A. and DEC clamps on the mount.
2. Move the telescope until pointing in the desired direction.
3. Lock the R.A. and DEC clamps to hold the telescope in place.

For fine adjustment in declination, simply turn the declination slow motion knob. The DEC clamp does NOT have to be loosened. Once you have the desired target, stop rotating the DEC slow motion knob. If the DEC slow motion knob will not turn, the DEC travel arm may have reached the end of the threaded rod. To correct this, rotate the DEC slow motion knob in the opposite direction until the travel arm is in the center of the fork tine (see figure 2-10). Release the DEC clamp and manually center the object you were looking at. Tighten the DEC clamp and the DEC slow motion knob will again allow fine adjustments in both directions. The Celestar Deluxe is equipped with a standard DEC motor for vibration free fine adjustment. Refer to the section "Using The Celestar Deluxe Drive" in this manual for information on

operation and maintenance of the DEC motor.

For fine adjustments in right ascension, release the R.A. clamp until the R.A. slow motion knob rotates freely. Turn the R.A. slow motion knob until the desired object is centered. Once centered, tighten the R.A. clamp by turning it clockwise. The clamp must be sufficiently locked for the drive motors to engage and move the telescope.

**WARNING: DO NOT TURN THE R.A. SLOW MOTION KNOB WHEN THE R.A. CLAMP IS IN THE FULLY LOCKED POSITION. DO NOT FORCE THE FORK MOUNT TO SWIVEL WHEN THE R.A. CLAMP IS FULLY ENGAGED.**

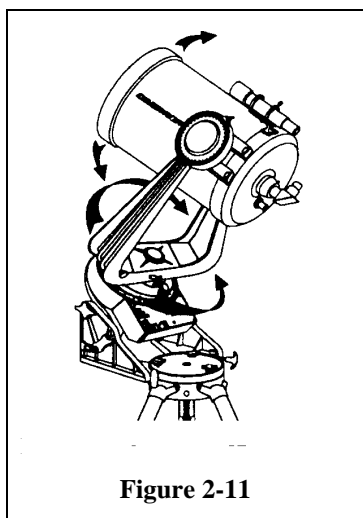


Figure 2-11

The telescope comes equipped with setting circles to help you locate objects in the night sky. The DEC setting circle is in degree increments while the R.A. setting circle is in hour and minute increments with a marker every five minutes. The numbers on the inner circle are for the northern hemisphere while those on the outer circle are for the southern hemisphere.

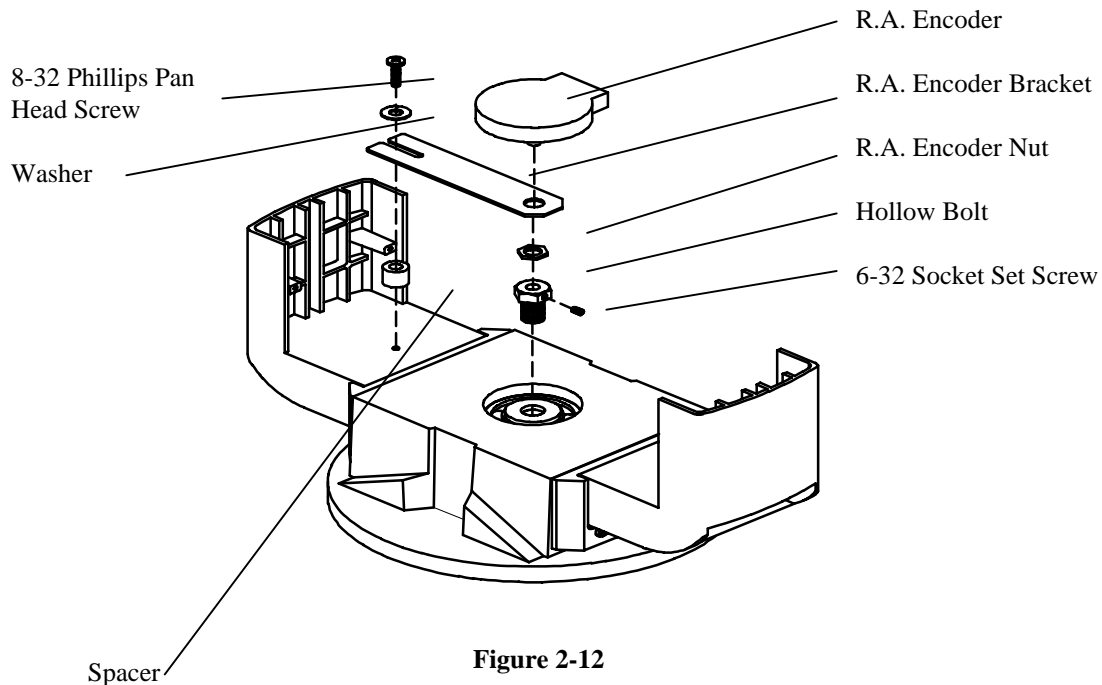
### INSTALLING THE R.A. ENCODER

(Celestar 8 Computerized and  
Celestar Deluxe 8 Computerized Only)

The Celestar 8 Computerized and the Celestar Deluxe 8 Computerized are identical to the Celestar 8 and the Celestar Deluxe 8 with the exception that they come with the Advanced Astro Master attached. The Advanced Astro Master is fully installed and tested at the factory. The R.A. encoder is removed in order for the telescope to be placed in

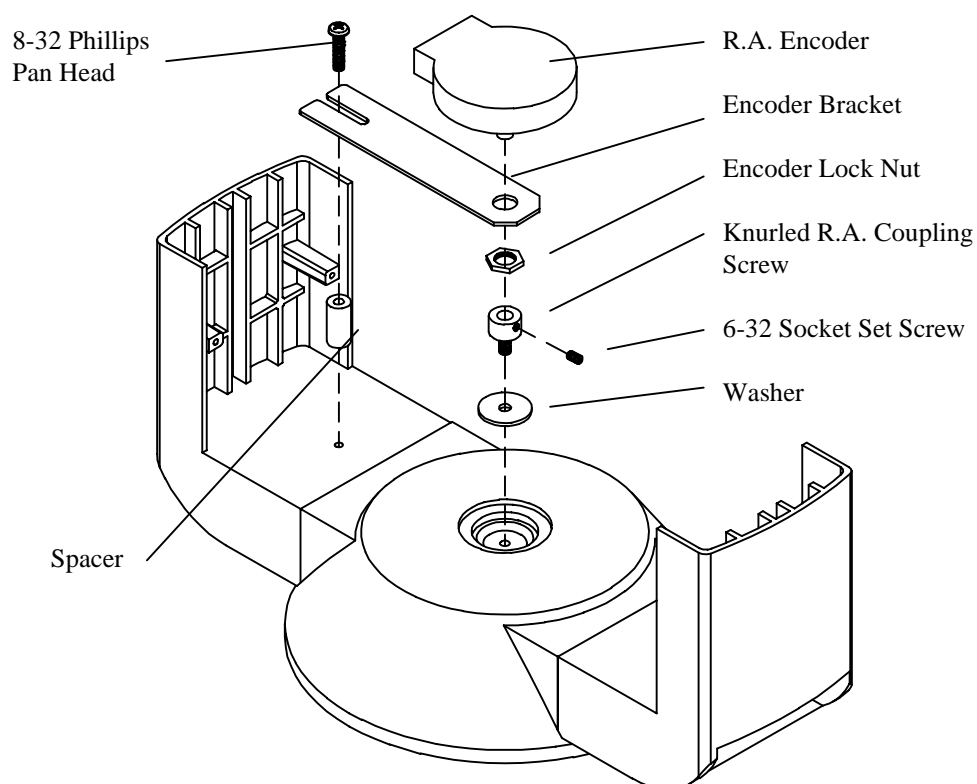
the storage position. Here is how to install the R.A. encoder (please refer to Figure 2-12 and Figure 2-13 for all installation procedures):

1. Swing the telescope through the fork tines so that it is pointing straight up.
2. Slide the R.A. encoder shaft through the hole in the R.A. encoder bracket (i.e., the long, flat bracket).
3. Place the lock washer and nut over the encoder shaft and tighten fully. This will hold the encoder to the bracket.
4. Slide the R.A. encoder shaft into the R.A. encoder coupling screw (Celestar 8) or the hollow bolt (Celestar Deluxe 8). Tighten the #6-32x5/16" socket set screw on the side of the R.A. encoder coupling screw/hollow bolt to hold the R.A. encoder shaft in place.
5. For the Celestar Deluxe 8, place the slotted end of the R.A. bracket over the threaded cylindrical spacer and insert the 8-32x1/4" screw into the threaded cylindrical spacer. Tighten the screw to hold the bracket in place (refer to figure 2-12).



**Figure 2-12**

6. For the Celestar 8, place the slotted end of the R.A. bracket over the hollow cylindrical spacer and insert the 8-32x1" screw through the spacer and thread it into the threaded hole on the fork. Tighten the screw to hold the bracket in place (refer to Figure 2-13).



**Figure 2-13**

The installation of the R.A. encoder of the Advanced Astro Master is now complete. Keep in mind that the R.A. encoder must be removed when returning the telescope to the storage position. Now connect the blue connector on the cable to the five pins on the R.A. encoder, plug the phone jack type connector to the Advanced Astro Master module, and the telescope is ready for hours of observing fun.

Please see the Advanced Astro Master instruction manual for complete operational information.

### **ADVANCED ASTRO MASTER SETUP**

(For Celestar 8 Computerized and Celestar Deluxe 8 Computerized Only)

(See the Advanced Astro Master manual for complete directions)

Once the Advanced Astro Master (AAM) is attached to the telescope, there are a few steps that need to be taken to make sure the AAM is set up for the Celestar 8. Although the AAM should already be set up for the Celestar 8, it is good practice to check and to familiarize yourself with the navigation process of the AAM.

To setup the AAM, follow these steps:

1. Roughly polar align the telescope as explained in “Latitude Scale Polar Alignment Method” of the “Polar Alignment” section of the chapter, “Astronomy Basics”.
2. Attach the AAM to the telescope.
3. Turn on the AAM.
4. The screen should read, “SET DEC = 0”. Set the telescope’s declination to 0° (see the section, “Telescope Basics”). Hit enter.
5. The AAM screen should read “MODE ALIGN STAR”. Press the down arrow once to scroll to the “MODE SETUP” screen.
6. Press enter. Use the up/down arrow to scroll to the appropriate mount. For a roughly aligned fork mount, (i.e., the Celestar 8 Computerized) set the mount type to “EQ”. Press enter. (If you are accurately polar aligned then set the mount as “EP”.)
7. Press enter at the “SCROLL 5” window.
8. At the Chart screen, select SA or UA. This defines what reference numbers will be applied to the stars. The star reference numbers will either match those of the Star Atlas 2000 (SA) or Uranometria 2000 (UA). Hit enter.
9. In the next screen, you will set the encoder ratios and polarities. AZ should be set at -4000. Hit enter to scroll the cursor through each number and use the up/down arrows to set the numbers. AL should be set to +2160.

The AAM is now set up for the telescope. Steps 5 through 8 should already be set by the factory, so you may not have had to change anything. To use the AAM, you need to align the computer to the sky by using the “MODE ALIGN STAR” screen. Refer to the AAM manual for complete instructions.

### **TRANSPORTING YOUR CELESTAR/CELESTAR DELUXE 8**

You may leave your Celestar/Celestar Deluxe 8 fully set up in the house and carry it outside for a casual observing session. However, since the telescope is large and somewhat heavy on the tripod, you may want to remove the telescope and drive from the Wedgpod or tripod/wedge when moving it. To do so:

1. Remove the two lower bolts that hold the drive base to the tilt plate of the wedge or Wedgpod.
2. Partially loosen the top bolt that holds the drive base to the tilt plate by rotating it approximately half a turn.
3. Hold the telescope by the fork arms and slide it up, off the wedge/Wedgpod.

The Wedgpod can now be carried outside and the telescope reattached. For the Celestar Deluxe, since the wedge does not interfere with the tripod at all, it can be left in place once firmly attached. This holds true even if you are transporting your telescope to a remote dark site observing location. The tripod legs can be collapsed and folded back together with the wedge in place.

However, if you are planning a trip to a remote site, you should remove the telescope from the wedgpod or tripod/wedge, and return it to its box. The tripod/wedgpod legs can be transported with its legs folded back together.

### **STORING YOUR CELESTAR/CELESTAR DELUXE 8**

When not in use, all lens and eyepiece covers should be put back in place. This will reduce the amount of dust build-up on all optical surfaces and reduce the number of times you need to clean your instrument. You may want to return everything to its original shipping container and store it there. If this is the case, all optical surfaces should be covered to prevent dust build-up.

# TELESCOPE BASICS

Once your telescope is fully assembled, you are ready for your first look. This section deals with some of the basics of telescope operation.

## IMAGE ORIENTATION

The image orientation changes depending on how the eyepiece is inserted into the telescope. When using the star diagonal, the image is right-side-up, but reversed from left-to-right (i.e., reverted). If inserting the eyepiece directly into the visual back (i.e., without the star diagonal), the image is upside-down and reversed from left-to-right (i.e., inverted). These orientations apply to the telescope's finder as well.

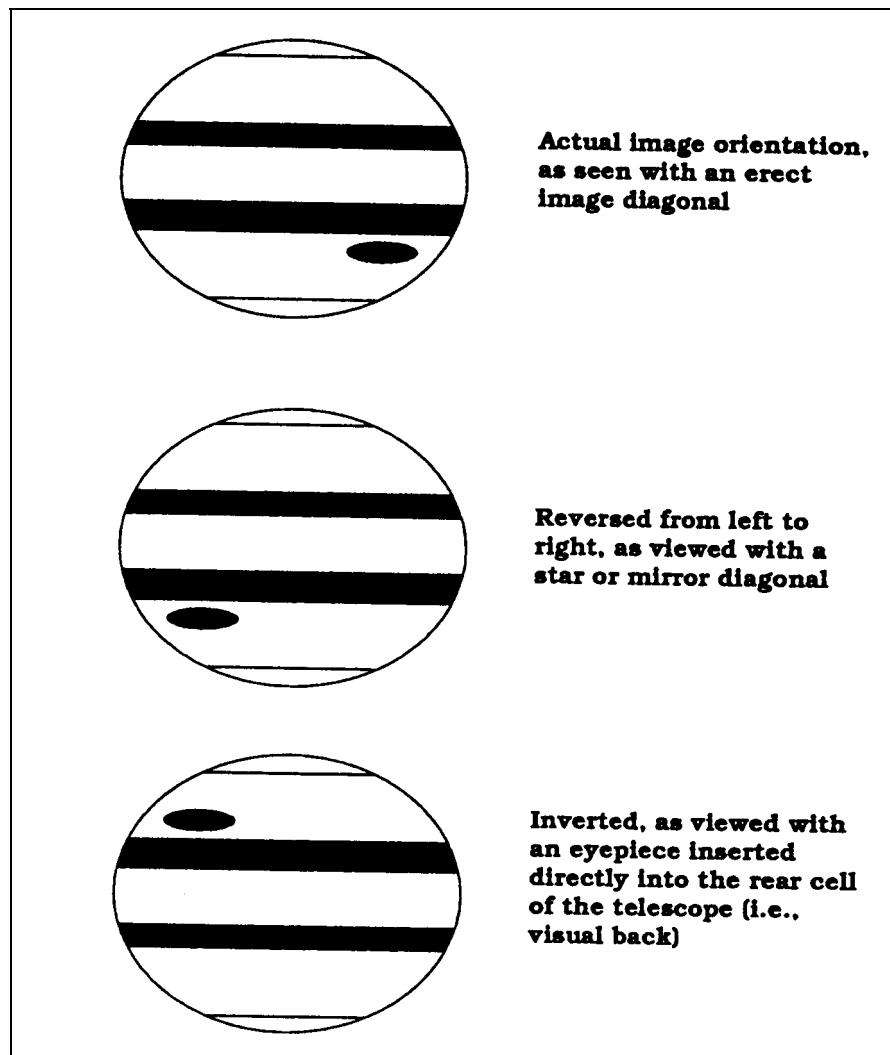


Figure 3-1

## FOCUSING

The Celestar 8 focusing mechanism controls the primary mirror which is mounted on a ring that slides back and forth on the primary baffle tube. The focusing knob, which moves the primary mirror, is on the rear cell of the telescope just right of the star diagonal and eyepiece. 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. 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 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.

## ALIGNING THE FINDER

The Celestar 8 comes with a 6x30mm finder (9x50mm for Celestar Deluxe 8) which helps you aim the main telescope at distant objects that would be hard to find in the narrow field of the main optics. The first number used to describe the finder is the power or magnification while the second number is the diameter of the objective lens in millimeters. For example, the Celestar 8 finder is a 6x30. This 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 the alignment process a little easier, you should perform this task in the daytime when it is easier to locate objects in the telescope without the finder. To align the finder:

1. Choose a conspicuous object that is in excess of one mile away. This will eliminate any possible parallax effect between the telescope and the finder.
2. Point your telescope at the object you selected 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 black thumb screws on the finder bracket, tightening one while loosening another, until the cross hairs are centered on the target.
6. Tighten each black thumb screw a quarter of a turn to ensure that they will not come loose easily.

The image orientation through the finder is inverted (i.e., upside down and reversed from left-to-right). Because of this, it may take a few minutes to familiarize yourself with the directional change each screw has on the finder.



## 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 is easier to locate the locking clamps and slow motion knobs. This will help to familiarize you with your Celestar 8, thus making it easier to use at night.

### *Daytime Observing*

As mentioned in the introduction, your Celestron Celestar 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 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. Find a distant object that is fairly bright.
2. Insert a low power eyepiece (i.e. one with a long focal length 25mm) into the telescope.
3. Release the R.A. and DEC clamps and point the telescope in the direction of the object you selected.
4. Locate the object in your finder.
5. Move the telescope by hand until the object is centered in the finder.
6. Lock the R.A. and DEC clamps to hold the telescope in place.
7. Look through the main optics and the object will be there (if you aligned the finder first).
8. Use the slow motion knobs to center the object if needed. Remember, you should not use the drive for terrestrial viewing.

Try using different optional eyepieces to see how the field changes with various magnifications.

### *Nighttime Observing*

Looking at objects in the sky is quite different from looking at objects on Earth. For example, many objects seen in the daytime are easy to see with the naked eye and can be located in the telescope by using landmarks. In the night sky, many objects are not visible to the naked eye. To make things easier, you are better off starting with a bright object like the Moon or one of the planets. Here is a quick description to get you started. A more detailed description is found under the section on "Visual Observing."

1. Orient the telescope so that the polar axis is pointing as close to true north as possible. (The fork arms indicate which direction the polar axis is pointing.) You can use a land mark that you know faces north to get you in the general direction.
2. If you are observing with the Celestar 8, shim the Wedgpad legs until the mount is leveled. If you are using the Celestar Deluxe 8, extend or retract each of the three tripod legs until it is at your preferred height and the mount is leveled.

3. Adjust the wedge in altitude until the latitude indicator points to the latitude of the site from which you are observing.
4. Insert a low power eyepiece (i.e., one with a long focal length 25mm) into the telescope to give you the widest field possible.
5. Turn the clock drive on.
6. Loosen 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.
7. Locate the object in the finder, center it, and then look through the telescope.
8. Turn the focus knob until the image is sharp.
9. Take your time and study your subject. If observing the Moon, look for small details in the craters.

That's all there is to using your Celestar telescope. However, do not limit your view of an object to a single eyepiece. If you purchase other eyepieces of varying focal lengths, you can view at different magnifications.

NOTE: If not using the clock drive, the stars will appear to drift out of the field of view. This is due to the Earth's rotation. In fact, any celestial object, day or night, will drift out of the field unless the telescope has been polar aligned and the clock drive is running. More on this in the section on "Polar Alignment."

### CALCULATING MAGNIFICATION

You can change the power of your Celestron telescope just by changing the eyepiece (ocular). To determine the magnification of your Celestron telescope, simply divide the focal length of the telescope by the focal length of the eyepiece used. In equation format, the formula looks like this:

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

Let's say, for example, that you are using a 25mm eyepiece. To determine the magnification you simply divide the focal length of your Celestron Telescope (let us use the Celestar telescope which has a focal length of 2032mm) by the focal length of the eyepieces (25mm for the Celestar 8 and 26mm for the Celestar Deluxe). Dividing 2032 by 25 yields a magnification of 81 power. A 26mm Plössl yields a magnification of 78 power with the Celestar telescope.

Although the power is variable, each instrument under average skies 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 Celestar telescope is 8" in diameter. Multiplying 8 by 60 gives a maximum useful magnification of 480 power. Although this is the maximum useful magnification, most observing is done in the range of 20 to 35 power for every inch of aperture which is 160 to 280 times for the Celestar telescope.

## DETERMINING FIELD OF VIEW

Determining the field of view is important if you want to get an idea of the angular 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:

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

As you can see, before determining the field of view, you must calculate the magnification. Using the example in the previous section, we can determine the field of view using the same 25mm eyepiece. The 25mm SMA eyepiece has an apparent field of view of 52°. Divide the 52° by the magnification, which is 81 power. This yields an actual field of .64°, or a little under two-thirds of a degree. The 26mm Plössl eyepiece has an apparent field of view of 50°. This yields an actual field of .62°.

To convert degrees to feet at 1,000 yards, which is more useful for terrestrial observing, simply multiply by 52.5. Continuing with our example, multiply the angular field .64° by 52.5. This produces a linear field width of 33.6 feet at a distance of one thousand yards.

The apparent field of each eyepiece that Celestron manufactures 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, while 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 and underexposed.
- When using your telescope 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 you may consider using a focusing magnifier. (These are 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 the telescope. When using a camera, however, you should always wear corrective lenses to ensure the sharpest possible focus. If you have astigmatism, corrective lenses must be worn at all times.

### **GENERAL PHOTOGRAPHY HINTS**

Your Celestar telescope can be used for both terrestrial and astronomical photography. Your Celestar telescope 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 which lets you know if your picture is under or overexposed. This is more of a consideration when doing terrestrial photography, where exposure times are measured in fractions of a second. This also applies to lunar photography and filtered solar photography. In deep-sky 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.

To reduce vibration when tripping the shutter, use a cable release. Releasing the shutter manually can cause vibration, which 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 cable releases can be used, though air type releases are best.

# ASTRONOMY BASICS

Up to this point, this manual covered the assembly and basic operation of your Celestron telescope. However, to use your telescope effectively, you need to know a little about the night sky. This section deals with observational astronomy in general and includes information on the night sky and polar alignment.

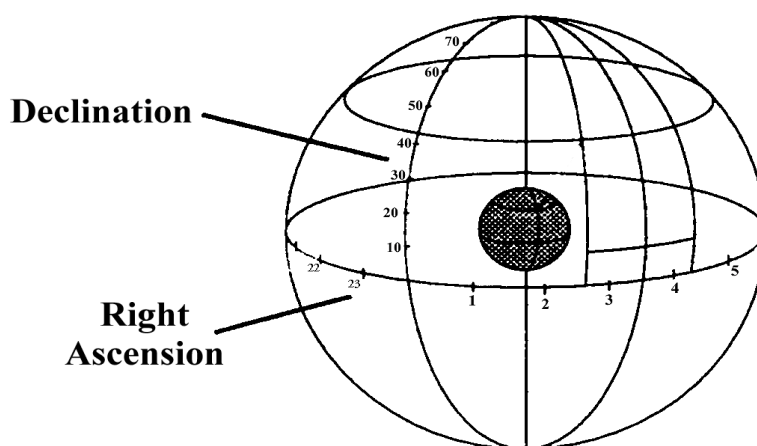
## THE CELESTIAL COORDINATE SYSTEM

To help find objects in the sky, astronomers use a celestial coordinate system that 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 referred to as declination, or DEC for short. Lines of declination are named for their angular distance above and below the celestial equator. The lines are broken down into degrees, minutes of arc, and seconds of arc. Declination readings south of the equator carry a minus sign (-) in front of the coordinate and those north of the celestial equator are either blank (i.e., no designation) or 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. As a result, 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.

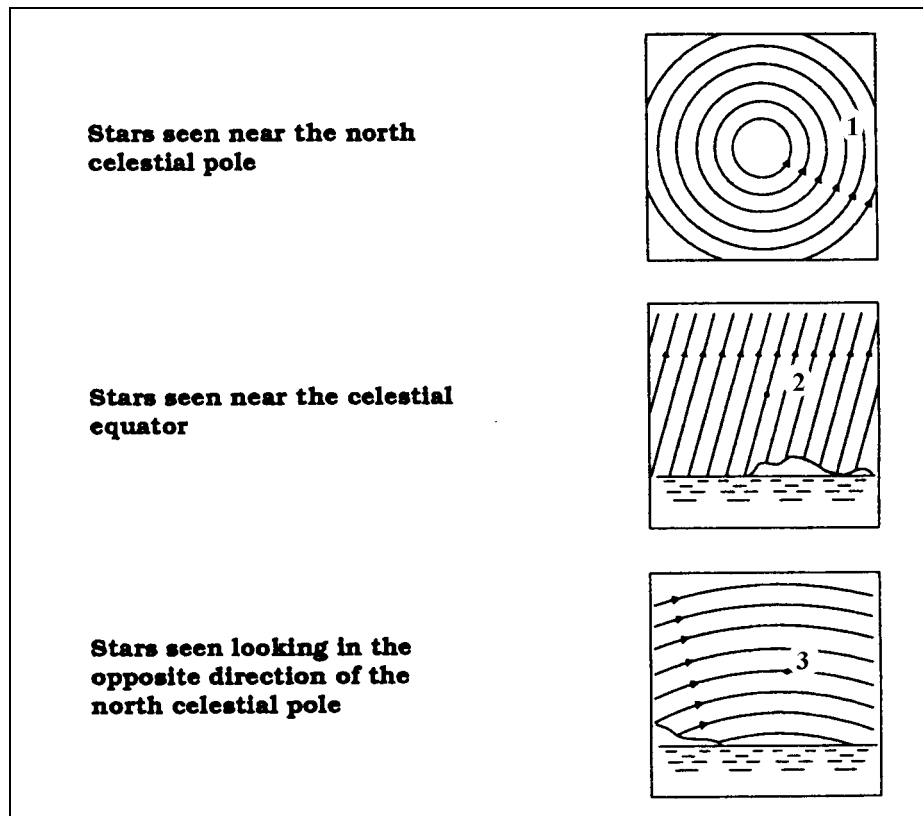
Your Celestron telescope comes equipped with setting circles that translate the celestial coordinates into a precise location for the telescope to point. The setting circles will not work properly until you have polar aligned the telescope and aligned the R.A. setting circle.



**Figure 4-1**  
The celestial sphere seen from the outside showing R.A. and DEC.

## MOTION OF THE STARS

The daily motion of the Sun across the sky is familiar to even the most casual observer. This daily trek is not the Sun moving as early astronomers thought, but the result of the Earth's rotation. The Earth's rotation also causes the stars to do the same, scribing out a large circle as the Earth completes one rotation. The size of the circular path a star follows depends on where it is in the sky. Stars near the celestial equator form the largest circles rising in the east and setting in the west. Moving toward the north celestial pole, the point around which the stars in the northern hemisphere appear to rotate, these circles become smaller. Stars in the mid-celestial latitudes rise in the northeast and set in the northwest. Stars at high celestial latitudes are always above the horizon, and are said to be circumpolar because they never rise and never 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 hours. The processed film will reveal semicircles that revolve around the pole. (This description of stellar motions also applies to the southern hemisphere except all stars south of the celestial equator move around the south celestial pole.)



**Figure 4-2**

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, you must meet two criteria. First, you need a drive motor that moves at the same rate as the stars. The Celestron telescope comes standard with a built-in drive motor designed specifically for this purpose. 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.

Polar alignment is the process by which the telescope's axis of rotation (called the polar axis) 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 appear stationary (i.e., they will not drift out of the field of view). If not using the clock drive, all objects in the sky (day or night) will slowly drift out of the field. This motion is caused by the Earth's rotation. Even if you are not using the clock drive, polar alignment is still desirable since it will reduce the number of corrections needed to follow an object and limit all corrections to one axis (R.A.). There are several methods of polar alignment, all work on a similar principle, but performed somewhat differently. Each method is considered separately, beginning with the easier methods and working to the more difficult.

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, you may use two methods; one for rough alignment followed by a more accurate method if you plan on doing astrophotography.

**Definition:** The polar axis is the axis around which the telescope rotates when moved in right ascension. This axis points the same direction even when the telescope moves in right ascension and declination.

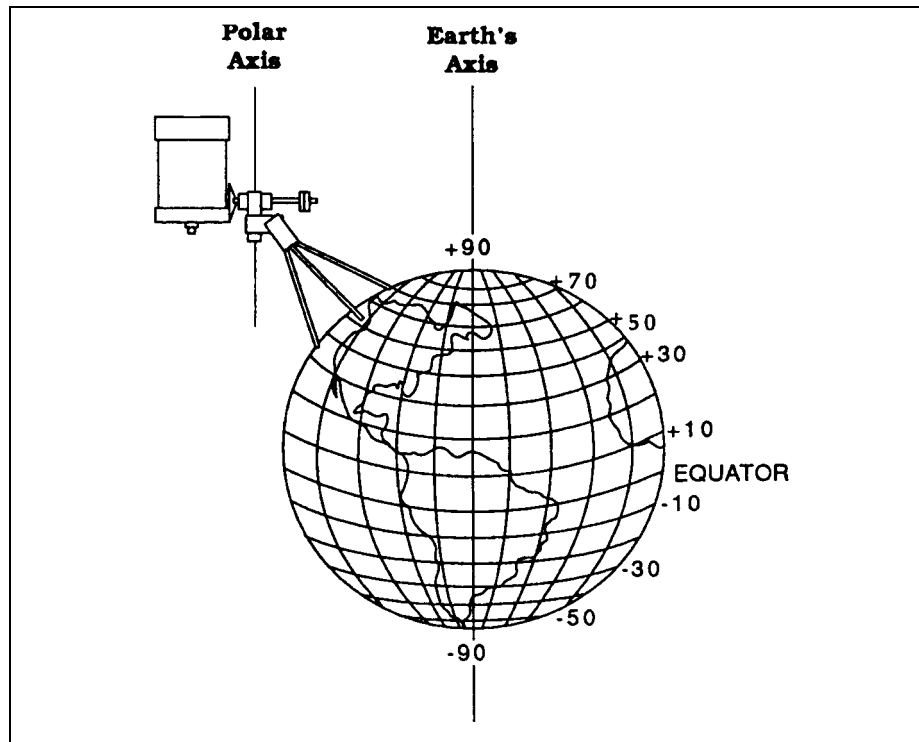
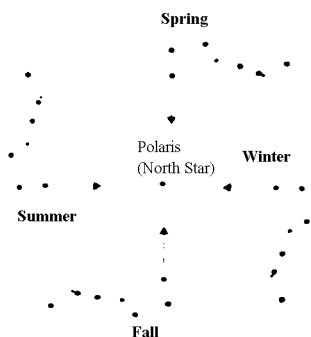


Figure 4-3

### Finding the Pole

In 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.

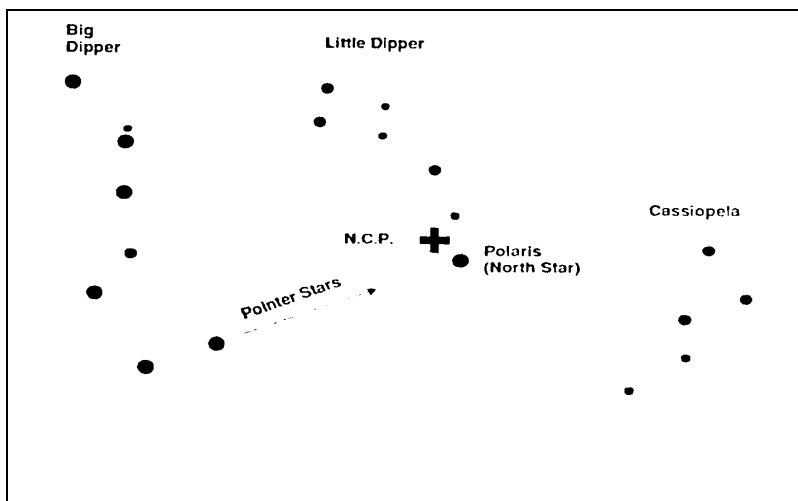


**Figure 4-4.**

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

Many 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 not too difficult. 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. Since the Little Dipper (technically called Ursa Minor) is not one of the brightest constellations in the sky, it may be difficult to locate from urban areas. If this is the case, use the two end stars in the bowl of the Big Dipper (the pointer stars). Draw an imaginary line through them toward the Little Dipper. They point to Polaris (see Figure 4-5). The position of the Big Dipper changes during the year and throughout the course of the night (see Figure 4-4). When the Big Dipper is low in the sky (i.e., near the horizon), it may be difficult to locate. During these times, look for Cassiopeia (see Figure 4-5). 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 about 59 arc minutes from the pole. For more information about stars around the south celestial pole, please consult a star atlas.

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



**Figure 4-5**

**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. Cassiopeia, 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 Scale Polar Alignment Method***

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, latitude, to determine how high the polar axis should be pointed. The latitude range for the Celestar telescope is 0° to 90°.

**NOTE: If the altitude of the scope needs a minor adjustment for polar alignment, be aware that the telescope tends to fall toward the observer when the four screws, that hold the tilt plate, are loosened. Be sure you are holding the telescope!**

If you know the latitude of your observing site then you can determine the altitude the tilt plate needs to be set at. There is a relationship between your latitude and the angular distance (altitude) 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. In other words, the altitude you need to set your tilt plate at is the same as the latitude of your observing site.

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. Set the Wedgpod on a level surface with legs fully separated.
3. Adjust the Wedgpod's tilt plate in altitude until the latitude indicator (the hex head bolt serves as the 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.

***Pointing at Polaris Method of Polar Alignment***

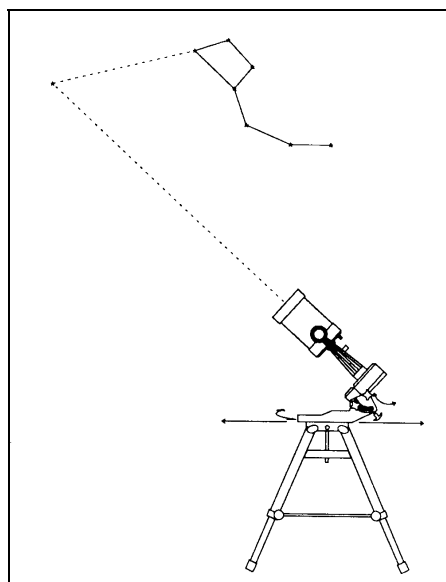
This method uses Polaris as a guidepost to the celestial pole. Since Polaris is less than a degree from the celestial pole, you can simply point the polar axis of your telescope at Polaris. Although this is by no means perfect alignment, it does get you within one degree. Unlike the previous method, this must be done in the dark when Polaris is visible.

1. Set the telescope up so that the polar axis is pointing north.

2. Loosen the DEC clamp and move the telescope so that the tube is parallel to the polar axis. When this is done, the declination setting circle will indicate  $+90^\circ$ . If the declination setting circle is not aligned, move the telescope so that the tube is parallel to the polar axis (see figure 4-6).
3. Adjust the mount in altitude and/or azimuth until Polaris is in the field of view of the finder.
4. Center Polaris in the field of the telescope using the altitude and azimuth adjustment knobs.

**Remember, while polar aligning, do NOT move the telescope in R.A. or DEC. You do not want to move the telescope itself, but the polar axis. The telescope is used simply to see where the polar axis is pointing. You adjust the telescope by moving the wedge and/or tripod.**

Once Polaris is in the finder it should also be centered in the telescope. This, of course, presumes you aligned the finderscope with the main optical tube. If not, use the fine adjustment controls to center Polaris in the telescope field.



**Figure 4-6**

**This is how the telescope is to be set up for polar alignment. The tube should be parallel to the forks and the mount should point to Polaris.**

### ***Declination Drift Method of Polar Alignment***

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 stars. The drift of each star tells you how far away the polar axis is pointing from the true celestial pole and in what direction. Although declination drift is simple and straight-forward, 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.,  $0^\circ$  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 is revealed. While monitoring a star near the east/west horizon, any misalignment in the north-south direction is 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, insert the diagonal so the eyepiece points straight up. Insert the cross hair ocular and align the cross hairs so that one is parallel to the declination axis and the other is parallel to the right ascension axis. Move your telescope manually in R.A. and DEC to check parallelism.

First, choose your star near where the celestial equator and the meridian meet. The star should be approximately within 1/2 an hour of the meridian and within five 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 eliminated all the drift, move to the star near the eastern horizon. The star should be 20 degrees above the horizon and within five degrees 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.

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 can now 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, but you must reverse the polar high/low error directions. Also, if using this method in the southern hemisphere, the direction of drift is reversed for both R.A. and DEC.

### ALIGNING THE RA SETTING CIRCLE

In order to align the R.A. setting circle, you must first polar align the telescope mount. Second, you 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 of the R.A. setting circle. The star you choose to align the setting circle 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. Center the star in the field of view of the telescope.

4. Start the clock drive so that the mount tracks the star.
5. Look up the coordinates of the star. You can consult a star catalog or use the list at the end of this manual.
6. Rotate the R.A. circle until the proper coordinates line up with the R.A. indicator. The R.A. setting circle should rotate freely. The R.A. setting circle has a marker every five minutes with each hour labeled

The R.A. setting circle is now aligned and ready to use. The R.A. setting circle is clutched to the R.A. gear rotation. As long as the drive is operating, the circle does not need to be reset once indexed to the correct coordinate (i.e., once aligned). If the drive is ever turned off, then the R.A. setting circle must be reset once reactivated.

## USING THE CELESTAR DRIVE

The Celestar 8 comes with a built-in single motor spur gear clock drive to track objects as they move across the sky. The Celestar 8 is DC powered and operated by an internal 9-volt battery that is included with the telescope. In addition, the Celestar 8 has built-in electronics that when used in conjunction with the optional hand controller allow you to do long exposure deep-sky astrophotography.

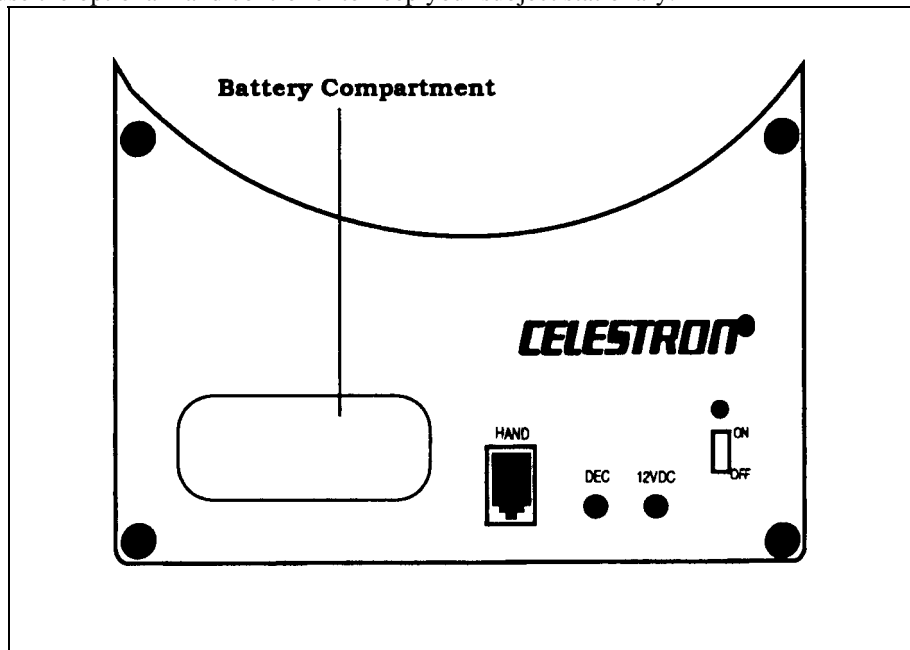
Following is a brief description of each function.

### POWERING UP THE DRIVE

The “ON/OFF” switch supplies power to the drive motor. Once on, the motor tracks at sidereal rate, that is, the rate at which the stars move across the sky. The LED above the “ON/OFF” switch illuminates when the drive is on.

In order for the clock drive to track accurately — across the sky from east to west — the telescope must be polar aligned. The process of polar alignment, which was discussed earlier in this manual, makes the telescope’s axis of rotation parallel to the Earth’s, ensuring that the telescope moves in the right direction. Keep in mind that the clock drive moves the telescope only in right ascension at a rate that is half of the hour hand on a clock. Therefore, the telescope makes one complete revolution every twenty four hours and the motion is very hard to detect simply by looking at the telescope.

The drive motor in your Celestar 8 is accurate enough to keep objects in the field for long periods. However, if you watch closely, you will notice that the object drifts slowly back and forth in right ascension. This is known as periodic error which all telescope drives have to some degree. For visual observing, periodic error does not pose a problem. If, however, you are interested in astrophotography, you must use the optional hand controller to keep your subject stationary.



**Figure 5-1**  
The cover plate for the Celestar 8 drive base.

## ***Outlets***

On the drive base cover there are three outlets, two miniature jacks and one modular telephone jack. Starting from the left, the first is labeled “Hand.” This is the outlet that the optional hand controller plugs into. To plug the hand controller into the drive base:

1. Hold the end of the cable with the modular telephone jack over the outlet in the base.
2. Orient the jack so that the plastic tab is down.
3. Slide the jack into the outlet until it clicks.

The hand controller is now installed and ready to use. Pressing the buttons on the hand controller will speed the motor up or slow it down allowing you to track accurately for long exposure astrophotography. If you are using the optional DEC motor, all corrections to the DEC axis will also be made from the hand controller.

The next outlet is for the optional DEC motor, and appropriately labeled “DEC.” Once the DEC motor is attached to the mount, the cable plugs into the cover plate allowing you to make all corrections to the DEC axis from the hand controller.

The last outlet, labeled “12VDC,” is for an external power source. Celestron offers two optional adapters for external power, one for AC (#18772) and one for DC (#18767). When plugging into an external power source, ALWAYS plug the connector into the drive base first, then the power-source outlet. Failure to do so could damage the circuit board.

## ***The Hand Controller (Optional Accessory)***

### **(Needed to operate the Celestar 8 in the Southern Hemisphere)**

The hand controller (#28983) is an optional accessory that can be purchased through your Celestron dealer. The hand controller is essential for long exposure deep sky photography. For normal observing it serves as a convenient aid for centering objects especially at high power.

On the hand controller there are four buttons used to make guiding corrections in right ascension and declination during astrophotography. The right and left buttons move the telescope in right ascension. The up and down buttons are for declination corrections. The up and down buttons only work if an optional DEC motor is being used. With the hand controller cord facing down, the default settings are as follows:

- “Right” button moves the telescope clockwise. (West\*)
- “Left” button moves the telescope counter clockwise. (East\*)
- “Up” button moves the telescope up. (North\*)
- “Down” button moves the telescope down. (South\*)

(\* These are the directions if the telescope is polar aligned)

For Right Ascension, a 3x sidereal speed is available. To make the telescope slew at 3x in the clockwise or Westerly direction, press the right button and without letting go of the right button, press the left button. The same applies for making the telescope slew in the Easterly direction. Press the left button and without letting go of the left button, simultaneously press the right button.

To change the direction of the north/south buttons, press the “Down” button while powering up the drive. Once this is done, the “Down” button will move the telescope north and the “Up” button will move the

telescope south. If you are NOT using the optional DEC motor then all corrections to the declination axis must be made manually (i.e., by turning the DEC slow motion knob).

If the drive does not respond when the correction buttons have been pressed, check to make sure that the hand controller cable is plugged into the drive base correctly.

### **NORTHERN/SOUTHERN HEMISPHERE OPERATION**

When using your Celestar 8 in the southern hemisphere, there is a need to reverse the direction of the R. A. motor. In previous telescopes this was accomplished by installing a reversed motor. Now, the direction the drive motor moves the telescope is within the control of the user. Changing from northern hemisphere to southern hemisphere requires changing the polarity of the drive motor. To do this:

1. You need to purchase the optional hand controller.
2. With the power turned off, press down and hold the up and down buttons simultaneously.
3. Turn the power switch on (keep holding the buttons down).
4. In one or two seconds the red (LED) will blink. This will indicate the telescope is set for the southern hemisphere.
5. Keep the hand controller plugged in at all times. If you unplug the unit, it will default back to northern hemisphere operation.

The direction of the drive motor is now reversed and will work in the opposite hemisphere.

### **CHANGING THE BATTERY**

Once the battery has been drained, it must be replaced. To replace the battery:

1. Locate the battery compartment cover. It is on the left side of the drive base cover next to the hand controller outlet.
2. Remove the battery compartment cover.
3. Remove the battery from the terminal.
4. Attach a new, fresh battery to the terminal.
5. Replace the battery compartment cover.

To obtain the longest possible run time, use an alkaline battery. This type of battery will power the drive for up to 50 hours of continuous use. Keep in mind that the DEC motor (if used) consumes more power than the main R.A. drive motor, thus reducing the run time.

### **TROUBLE SHOOTING**

If the battery voltage gets low, either change the battery or plug the drive into an external power source. Optional adapters allow the drive to run off AC power or 12-volt DC power.

## USING THE CELESTAR DELUXE DRIVE

The Celestar Deluxe drive system uses a combination of a precision ground worm and a 5.5" diameter, 266 tooth anodized aluminum helical gear for superior tracking accuracy. The drive system employs stepper motors on each axis for quick response to guiding corrections and extremely accurate tracking rates. The clock drive can run off the optional AC wall transformer, or the car cigarette lighter adapter or two 9-volt batteries, supplied with the Celestar Deluxe.

The Celestar Deluxe drive system is also equipped with the Periodic Error Correction function, PEC. This feature allows the drive system to "learn" the characteristics of the worm gear, and as a result, improve the tracking accuracy to an even greater degree. This typically reduces the periodic error to 30 percent of the original error. The amount of improvement varies depending on guiding skills, atmospheric stability, the characteristics of the worm gear, and the accuracy of the polar alignment.

The following is a brief discussion of each of the features:

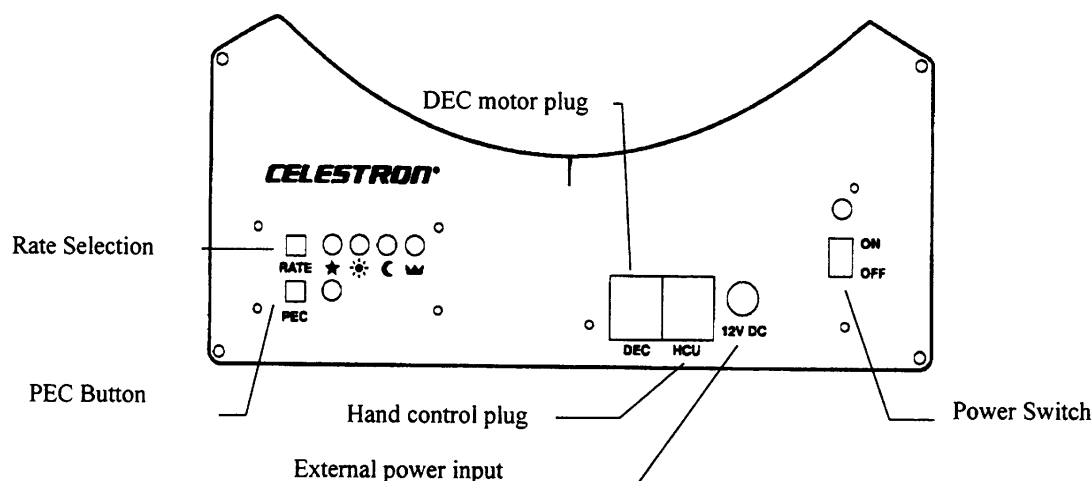


Figure 6-1

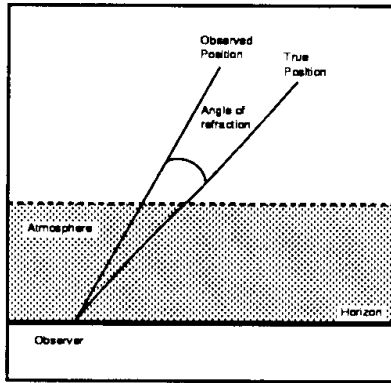
### POWERING UP THE DRIVE

The Celestar Deluxe comes equipped with two 9-volt batteries and a cigarette lighter adapter. The batteries are for convenience and are only meant to run the tracking motor. The 9-volt supplied by the batteries is not sufficient to operate the declination motor for an extended length of time. The 9-volt batteries are connected in parallel and provide about 8 hours of tracking time. The optimal way of powering the telescope is via the cigarette lighter adapter or the optional AC wall transformer.

To power up the telescope:

1. Plug the 6 conductor telephone type cable into the jack on the base board labeled DEC. Place the other end of the cable into the phone jack located on the declination motor. The declination motor is attached to the fork arm on the opposite side of the declination slow motion control.
2. Plug either the AC wall transformer into the wall or the cigarette lighter adapter into the car cigarette lighter. Plug the other end into the telescope jack marked "12V DC".
3. Turn the switch labeled "Power" to the ON position.





**Figure 6-2**

Refraction caused by the Earth's atmosphere makes celestial objects within  $45^\circ$  of the horizon appear higher in the sky than they actually are. This refraction also affects the rate at which stars rise and set. King rate takes this refraction into account.

4. The LED above the ON/OFF switch will turn on and the tracking motor will start tracking.

### TRACKING RATE SELECTION

The drive has four basic rates: sidereal, solar, lunar and King. While solar and lunar rates are obvious, sidereal and King rates require a little more explaining. Sidereal rate is based on a single rotation of the Earth which takes 1,436.5 minutes. An astronomer by the name of King discovered that atmosphere refraction affects the apparent motion of objects across the sky. The King rate takes into account this refraction caused by the earth's atmosphere and is recommended for deep sky astrophotography. For deep sky observing, either King or sidereal rate is fine.

Each of the tracking rates is represented by icons, see Figure 6-1. Sidereal rate is represented by a star, solar rate by a sun, lunar rate by a crescent moon, and King rate by a crown. Underneath each icon is an LED to indicate which rate has been selected. Once the power has been turned on, the drive tracks at sidereal rate, the default tracking rate. To change the tracking rate, press the "RATE" button. Pressing the button once changes the drive rate once. The rates are selected sequentially from left-to-right as listed above.

Note that the PEC function does NOT have to be activated for the drive to work. However, once the PEC is activated, the drive rate is locked on the one selection. You can not change the rates until PEC is turned off.

### PERIODIC ERROR CORRECTION

Periodic Error Correction, or PEC for short, is a system that improves the tracking accuracy of the drive by reducing the number of the user corrections. PEC is designed to improve photographic quality by reducing the amplitude of the worm errors. Using the PEC function is a two-step process. First, you must guide for at least 5-1/2 minutes during which time the system records the correction you make. (It takes the worm gear 5.41 minutes to make one complete revolution, hence the need to guide for 5-1/2 minutes.) This "teaches" the PEC chip the characteristics of the worm. The second step is to play back the corrections you made during the recording phase. Keep in mind, this feature is for advanced astrophotographers and requires careful guiding.

Note: All telescope drives have some periodic error.

Here's how to use the PEC function.

1. Find a bright star relatively close to the object you want to photograph.
2. Insert a high power eyepiece with illuminated cross hairs into your telescope. Orient the guiding eyepiece cross hairs so that one is parallel to the declination while the other is parallel to the R.A. axis.
3. Center the guide star on the illuminated cross hairs, focus the telescope, and study the periodic movement.

4. Take a few minutes to practice guiding. This will help you familiarize yourself with the periodic error of the drive and the operation of the hand control box.
5. Press the “PEC” button once to activate the record (REC) mode. You will have 5 seconds before the system starts to record. During this time the LED will blink once a second. When the duration of the illumination changes to a half second, it indicates the record mode is active.

**NOTE:** The star should stay centered on the cross hairs for a few seconds without using the hand controller before activating the PEC function.

6. Guide for at least 5-1/2 minutes. After this time, the PEC playback function will automatically be activated. To indicate the playback mode has started, the LED will change its blinking rate. It will blink “on” for one second and “off” for a half second.
7. Point the telescope at the object you want to photograph and you are ready to begin.

**Note: If you press the PEC button while it is in playback mode, you will lose the previously recorded information. Also, the fast slew functions are locked while the PEC functions is activated. This eliminates the possibility of shifting the focus or moving the telescope suddenly during an exposure.**

Hint: Ignore declination drift when programming the PEC.

Does the PEC function make unguided astrophotography possible? Yes and no. For solar (filtered), lunar, and piggyback (up to 200mm), the answer is yes. However, even with PEC, off-axis guiding is still mandatory for long exposure, deep sky astrophotography. The optional Reducer/Corrector lens reduces exposure times making the task of guiding a little easier. More on each of these forms of astrophotography in the section on “Celestial Photography”.

## Connectors

On the drive base cover are three electrical connectors; two modular telephone jacks and one barrel connector power source jack, tip positive. Starting from the left, the first, labeled “DEC “, is for the coiled cable that connects to the standard DEC motor, and is appropriately labeled “DEC”. The DEC motor allows you to make minor adjustments to the DEC axis using the buttons on the hand controller. Such an accessory is mandatory for deep sky astrophotography.

Next outlet, labeled “HCU”, accepts the male end of the hand controller unit. The hand controller is NOT needed for normal tracking. It is used to make corrections during long duration astrophotography or to center objects in the field of view. To plug the hand controller into the drive base:

1. Hold the end of the hand cable with the modular phone jack over the outlet in the base.
2. Orient the jack so that the plastic tab is down.
3. Slide the jack into the outlet until it clicks

The hand controller is now installed and ready to use. Pressing the buttons on the hand controller will speed the motor up or slow it down allowing you to make corrections for long exposure astrophotography. There are two speeds available for the users. For details of the hand controller operation, see the next section.

The last outlet labeled “12V DC,” is for an external power source, which will accept either the optional AC adapter or the supplied car battery adapter. The connector on the telescope is “tip positive”.

**Note: If the DEC and/or focus motors are used , the maximum operating time of the drive is reduced when using the internal 9-volt battery.**

## THE HAND CONTROLLER

The hand controller is essential for long exposure deep sky photography. For normal observing it serves as a convenient aid for centering objects especially at high power.

On the hand controller there are four buttons used to make guiding corrections in right ascension and declination during astrophotography. The right and left buttons move the telescope in right ascension. The up and down buttons are for declination corrections. With the hand controller cord facing down, the default settings are as follows:

- “Right” button moves the telescope clockwise. (West\*)
- “Left” button moves the telescope counter clockwise. (East\*)
- “Up” button moves the telescope up (North\*)
- “Down” button moves the telescope (South\*)

(\*These are the directions if the telescope is polar aligned)

A slew speed of approximately 8x sidereal rate is available for both axes. To slew the telescope, press the button that corresponds to the direction you want to move the telescope. While holding the button down, press the opposite directional button. Conversely, if you want to slew the telescope east, hold the east button down then press the west button. The slewing rate is approximately 8x sidereal rate, depending on how well your telescope is balanced. The slewing function also works in declination with the standard DEC motor.

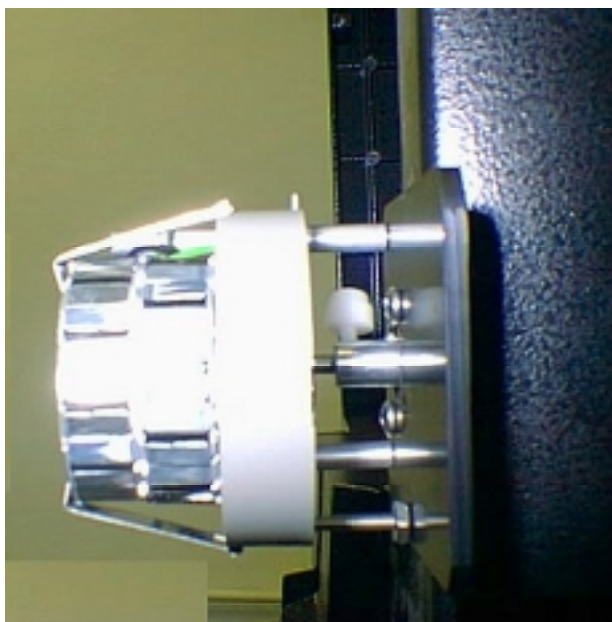
If the drive does not respond when the correction buttons have been pressed, check to make sure that the hand controller cable is plugged into the drive base correctly.

## DECLINATION MOTOR CLUTCH ADJUSTMENT

The Celestar Deluxe 8 and the Celestar Deluxe Computerized are equipped with standard declination (DEC) motors for near vibration free fine adjustment. The DEC motor assembly employs a clutch system which allows the user to have the option of using either the DEC motor or the slow motion knob for DEC adjustment. The clutch tension is preset in the factory. However, due to clutch wear, clutch tension has to be adjusted periodically. To adjust clutch tension:

1. Remove DEC motor cover (black rectangular metal can) by unscrewing the two 4-40 Phillips pan head screws on the cover.
2. Locate the white plastic thumb screw between the DEC motor and the black bottom plate.
3. Tighten the white plastic thumb screw as much as possible.
4. Check to see whether the DEC slow motion knob turns when the motor operates. If not, tighten plastic thumb screw more and check again.
5. Replace DEC motor cover with the two 4-40 Phillips pan head screws.

Dec Motor



Clutch  
Adjustment  
Knob

Figure 6-3

### REPLACING THE BATTERY

Once the batteries have been drained, they should be replaced. Replacing the alkaline batteries requires removal of the drive base cover. To do this:

1. Remove the four Phillips head screws that hold the drive base cover to the drive base.
2. Remove the cover plate by first lifting it up and then sliding it out (see Figure 6-4 and Figure 6-5). The internal components of the drive will be visible. **Caution: do not attempt to adjust setting of the drive mechanism.**

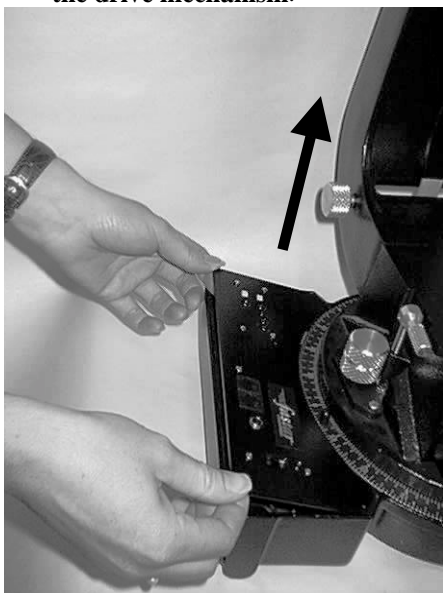


Figure 6-4

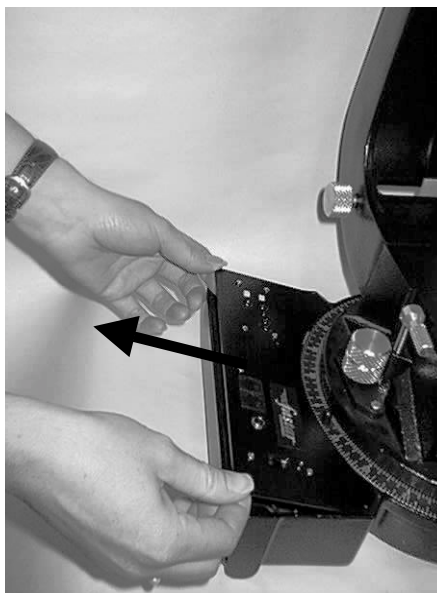


Figure 6-5

3. Unclip the batteries from the metal holders.

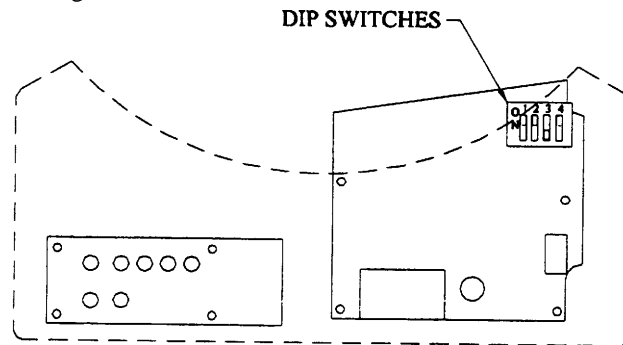
4. Remove the terminals from the batteries.
5. Install the new batteries by attaching them to the terminals and clip them into the battery holders.
6. Replace the drive base cover and secure with the four 4-40 screws.

To obtain the longest possible run time, use alkaline batteries. Alkaline batteries will power the drive for up to 8 hours of continuous use. (Nickel cadmium or standard 9-volt batteries are NOT recommended). Keep in mind that operating the declination and the optional focus motor draws more power from the batteries, thus reducing the run time of the batteries.

### NORTHERN/SOUTHERN HEMISPHERE OPERATION

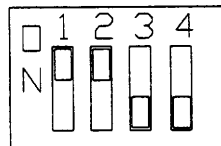
To operate the Celestar Deluxe in the Southern hemisphere, the direction of the R.A. tracking motor must be reversed. Motor direction can easily be changed by changing the settings of the dip switches on the electronic board under the drive base cover. To do this:

1. Turn off the Celestar Deluxe drive by switching the "On/Off" switch on the drive base to off and ensure that no power source is connected to the drive.
2. Remove the drive base cover and locate the dip switches as shown in Figure 6-6. They should have been set for operation in the Northern hemisphere, which is ON, ON, OFF, OFF for switches 1,2,3, and 4 respectively. See Figure 6-7.

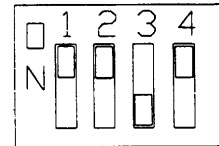


**Figure 6-6**

3. For operation in the Southern hemisphere, set switch 4 to the ON position so that the switches are set to ON, ON, OFF, ON. See Figure 6-8.



**Figure 6-7**



**Figure 6-8**

# CELESTIAL OBSERVING

With your telescope set up, you are ready to use it for observing. This section covers visual observing for 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 tempting 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. The optional Reducer/Corrector lens allows for breathtaking views of the entire lunar disk when used with a low power eyepiece. Change to higher power (magnification) to focus in on a smaller area. Keep in mind that if you are not using the clock 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 the clock 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 is visible.

### *Lunar Observing Hints*

- To increase contrast and bring out detail on the lunar surface, use filters. A yellow filter works well at improving contrast.



**This scanned drawing of Jupiter provides a good representation of what you can see with moderate magnification during good seeing conditions.**

**Figure 7-1**

## OBSERVING THE PLANETS

Other easy targets 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 the giant planet. Saturn, with its beautiful rings, is easily visible at moderate power. All you need to know is where to look. Most astronomy publications indicate where the planets are in the sky each month.

### *Planetary Observing Hints*

- To increase contrast and bring out detail on the planetary surface, try using Celestron eyepiece filters.

## 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.

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 lens of the finder or completely remove the finderscope when observing the Sun. This will ensure that the finderscope 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.
- To ensure accurate tracking, be sure to select solar tracking rate.

## 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. Unlike the Sun, Moon, and five major planets, most deep sky objects are not visible to the naked eye. Finding them requires using your setting circles or star hopping to them. 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 of the color seen in long exposure photographs. Instead, they appear black and white. 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 telescope is polar aligned (read the "Polar Alignment" section in this manual) and the R.A. setting circle is aligned, you can use the setting circles to find any object with known coordinates.

4. 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.
5. Look up the object's coordinates in an atlas or reference book.

6. Move the telescope in declination until the indicator points at the correct declination coordinate.
7. Move the telescope in R.A. until the indicator points to the correct coordinate (do NOT move the R.A. circle).
8. Look through the finder to see if you have located the object.
9. Center the object in the finder.
10. 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 clock drive is operating.
11. 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 hours and minutes with a marker every five minutes. 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 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 Celestar telescope.

## STAR HOPPING

Another way to find deep sky objects is by 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 target. To find M31:

1. Locate the constellation of Pegasus, a large square visible in the fall (in the eastern sky moving toward the point overhead) and winter months (overhead moving toward the west).
1. Start at the star in the northeast corner—Alpha ( $\alpha$ ) Andromedae.
1. Move northeast approximately  $7^\circ$ . There you will find two stars of equal brightness—Delta ( $\delta$ ) and Pi ( $\pi$ ) Andromeda—about  $3^\circ$  apart.
1. Continue in the same direction another  $8^\circ$ . There you will find two stars—Beta ( $\beta$ ) and Mu ( $\mu$ ) Andromedae—also about  $3^\circ$  apart.
1. Move  $3^\circ$  northwest—the same distance between the two star—to the Andromeda galaxy. It is easily visible in the finder.



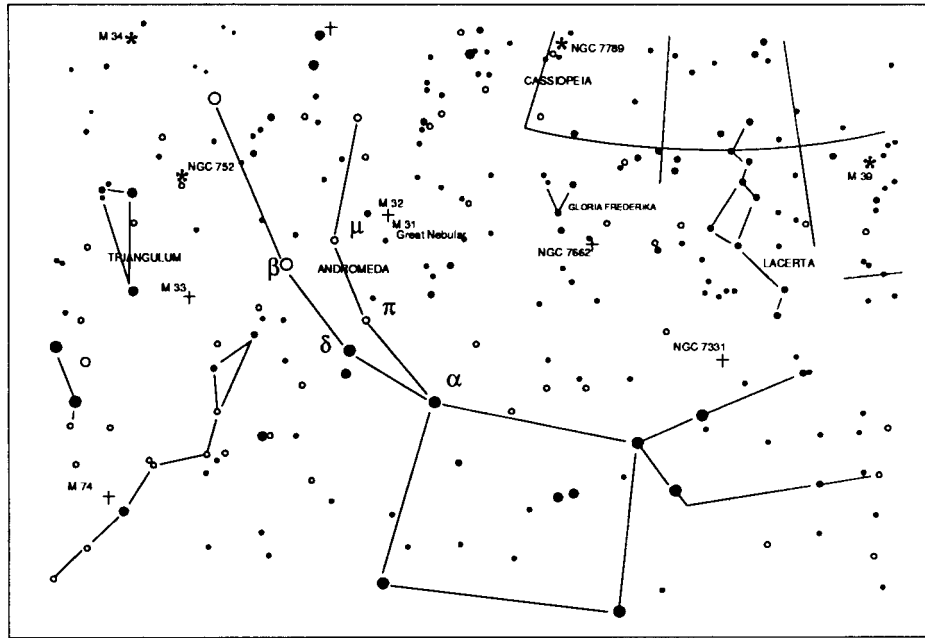


Figure 7-1

**Star hopping to the Andromeda Galaxy (M31) is a snap 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.
1. Start at the star Vega—Alpha ( $\alpha$ ) 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.
1. Locate the two southern most stars that make up the parallelogram—Beta ( $\beta$ ) and Gamma ( $\gamma$ ) Lyra.
1. Point the finder half way between these two stars.
1. Move about  $1/2^\circ$  toward Beta ( $\beta$ ) Lyra, but remaining on a line that connects the two stars.
1. 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.

Because the Ring Nebula is rather faint, you may need to use averted vision to see it. Averted vision is the act of looking slightly away from the object you are observing. So, if you are observing the Ring Nebula, center it in the field of view and then look off toward the side. In this manner, light from the object is falling on the black and white sensitive rods as opposed to the color sensitive cones of your eyes. 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 and star hop to the object of your choice using naked eye stars.

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.

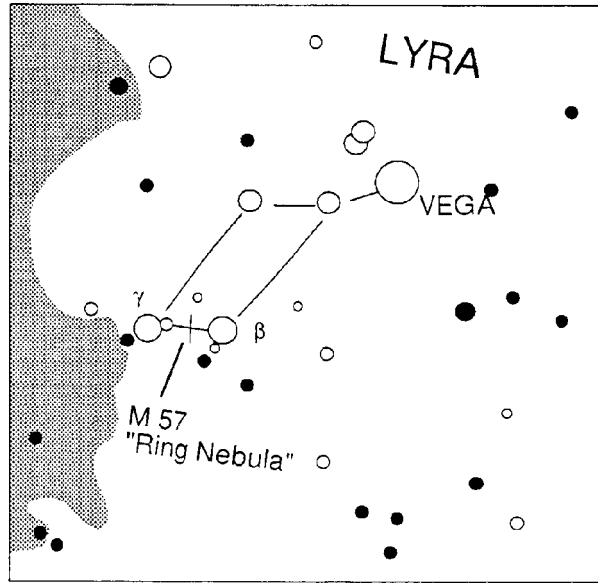


Figure 7-2

## SEEING CONDITIONS

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

### *Transparency*

Transparency is the clarity of the atmosphere which 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 effect transparency. While not a problem for the brighter stars and planets, 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*

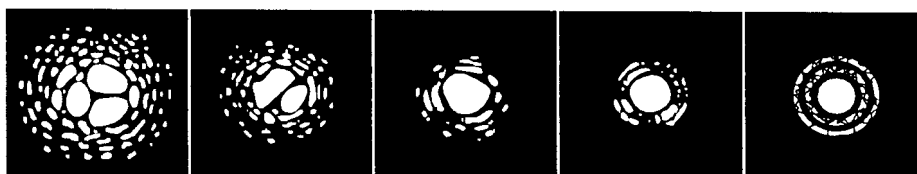
Seeing conditions refers to the stability of the atmosphere and directly effects the amount of fine detail seen in extended objects. The air in our atmosphere acts as a lens which bends and distorts incoming light rays. The amount of bending depends on air density. Varying temperature layers have different 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 7-4). 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 45 minutes to reach thermal equilibrium. Once adjusted to the outdoor temperature, don't touch the telescope tube with your hands. 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. Look for broad hill tops or open grassy fields. Stable thermal conditions found near lakes and atmospheric inversions also tend to produce good seeing. Avoid sites that overlook asphalt parking lots or plowed fields. Stay away from valleys and shorelines. 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.



**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 some where between these two extremes.**

*Figure 7-3*



# CELESTIAL PHOTOGRAPHY

After looking at the night sky for a while you may want to try photographing it. Several forms of celestial photography are possible with your Celestar 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 SLR cameras, the most common type of 35mm camera on the market today.

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 were 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 must have interchangeable lenses so you can attach it to the telescope and so you can 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, for example, does not have to be operational since you will be determining the exposure length manually.

You also need a cable release with a locking function to hold the shutter open while you do other things. Mechanical and air release models are available.

## SHORT EXPOSURE PRIME FOCUS PHOTOGRAPHY

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 Celestron T-Adapter (#93633-A) and a T-Ring for your specific camera (i.e., Minolta, Nikon, Pentax, etc.). The T-Ring replaces the 35mm SLR camera's normal lens. Prime focus photography allows you to capture the majority of the lunar disk or solar disk. To attach your camera to your Celestar telescope.

1. Remove all visual accessories.
2. Thread the T-Ring onto the T-Adapter.
3. Mount your camera body onto the T-Ring the same as you would any other lens.
4. Thread the T-Adapter onto the back of the Celestron Celestar telescope while holding the camera in the desired orientation (either vertical or horizontal).

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
  - Ektar 25 or 100
2. Center the Moon in the field of your Celestar 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 8-1).
5. Trip the shutter using a cable release.
6. Advance the film and repeat the process.

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

**Table 8-1**

**Above is a listing of recommended exposure times when photographing the Moon at the prime focus of your Celestar telescope.**

The exposure times listed in table 8-1 should be used as a starting point. Always make exposures that are longer and shorter than the recommended time. Also, take 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 PHOTOGRAPHY**

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 piggyback mount (#93598). This can be purchased as an optional accessory.

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.

1. Polar align the telescope (using one of the methods described earlier) and start the clock drive.
2. Load your camera with slide 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 field. 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 all corrections using the standard hand controller (optional on Celestar 8). If not using the optional DEC motor (standard with the Celestar 8 Deluxe), then corrections to the declination axis must be made carefully turning the DEC slow motion by hand as needed.
9. Close the camera's shutter.

As for lenses, use only those 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 35 to 200mm 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)
- Scotchchrome 400
- 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)
- T-Max 400 (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 Celestar telescope.

### EYEPiece PROJECTION

This form of celestial photography is designed for objects with small angular sizes, primarily the Moon and planets. 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 deluxe tele-extender (#93643), which attaches to 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 telescope's 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 accompanying table).
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
<b>Moon</b>	4	2	1	1/2
<b>Mercury</b>	16	8	4	2
<b>Venus</b>	1/2	1/4	1/8	1/15
<b>Mars</b>	16	8	4	2
<b>Jupiter</b>	8	4	2	1
<b>Saturn</b>	16	8	4	2

**Table 8-2**

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, take a few photos at each shutter speed. This will ensure that you get a good photo. It is not uncommon to go through an entire roll of 36 exposures and have only one good shot.

**NOTE:** 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.

### **LONG EXPOSURE PRIME FOCUS PHOTOGRAPHY**

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 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 Celestar telescope. The brightness of these objects, however, requires long exposure times and, as a result, is 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 device 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) or the 7.5mm Plössl Illuminated Reticle Ocular (#94174). 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 Celestar telescope.
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.
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)
- Scotchchrome 400
- 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)
- T-Max 400 (black and white print)

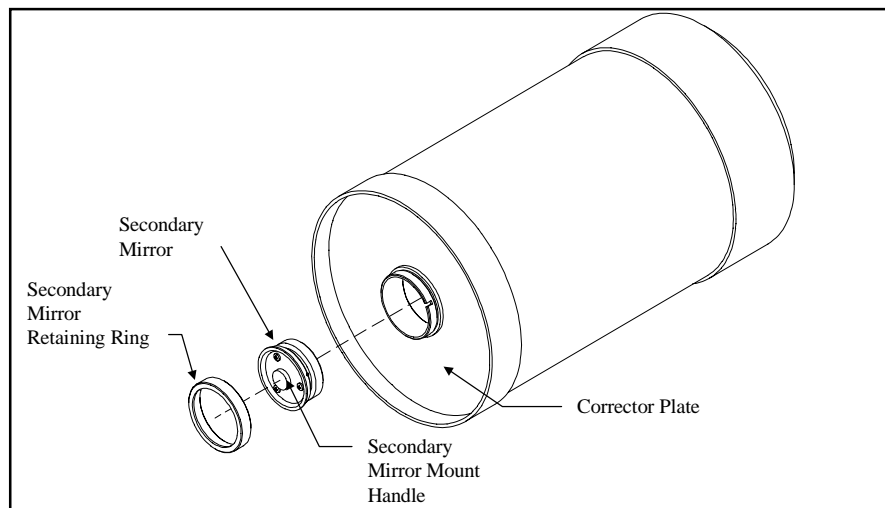
There is no exposure determination table to help you get started. The best way to determine exposure length is look at previously published photos to see what film/exposure combinations were used. Or take unguided sample photos of various parts of the sky while the drive is running. Always take exposures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

## CCD IMAGING

### Fastar Lens Assembly Option – Using your Celestar Deluxe telescope at f/1.95 with optional PixCel CCD Camera

Your Celestar Deluxe 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), f/6.3 (with the optional reducer corrector), f/10, and f/20 (with the optional 2x barlow) making it one of the most versatile imaging systems 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.

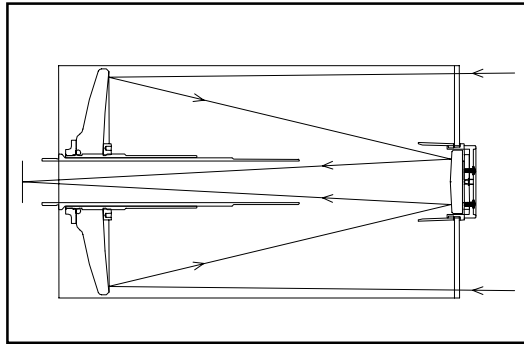
Figure 8-1



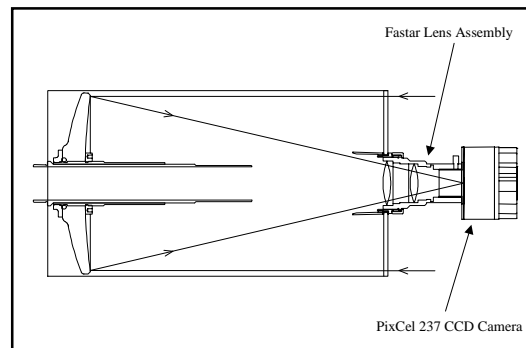
The above figure shows how the secondary mirror is removed when using the optional PixCel CCD camera at f/1.95 and the Fastar lens assembly. **Warning: The secondary mirror should never be removed unless installing the optional Fastar lens assembly.** Adjustments to collimation can easily be made by 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 standard C8 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).



• Fig 8-2 -- Light path at f/10 focus



• Fig 8-3 -- 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" (2000mm) @f/10	50" (1250mm) @f/6.3	<b>16"(400mm) @ f/1.95</b>
PixCel 237 F.O.V.	8.1 x 6.3 (arc min)	13 x 10 (arc min)	<b>.69 x .53 (degrees) 41 x 31 (arc min)</b>
PixCel Sampling (arc sec/pixel)	.75 (arc sec)	1.2 (arc sec)	<b>3.8 (arc sec)</b>

Table 8-3

## FASTAR CONFIGURATIONS

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 8-6](#) for a more detailed description of the accessories offered for each configuration.

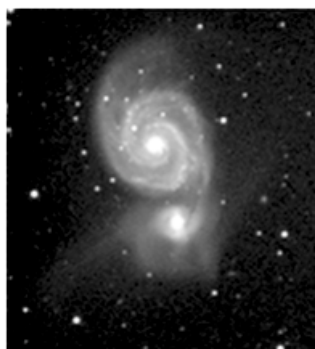
### IMAGING AT F/1.95

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 object (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 8-4 below). The spiral arms of the Whirlpool galaxy (Figure 8-5) 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 8-4** M27 – The Dumbbell Nebula  
4 exposures of 30 seconds each!



**Figure 8-5** M51 – The Whirlpool Nebula  
9 exposures of 60 second 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 than 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 f/6.3 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 do 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-adaptor or Radial Guider.

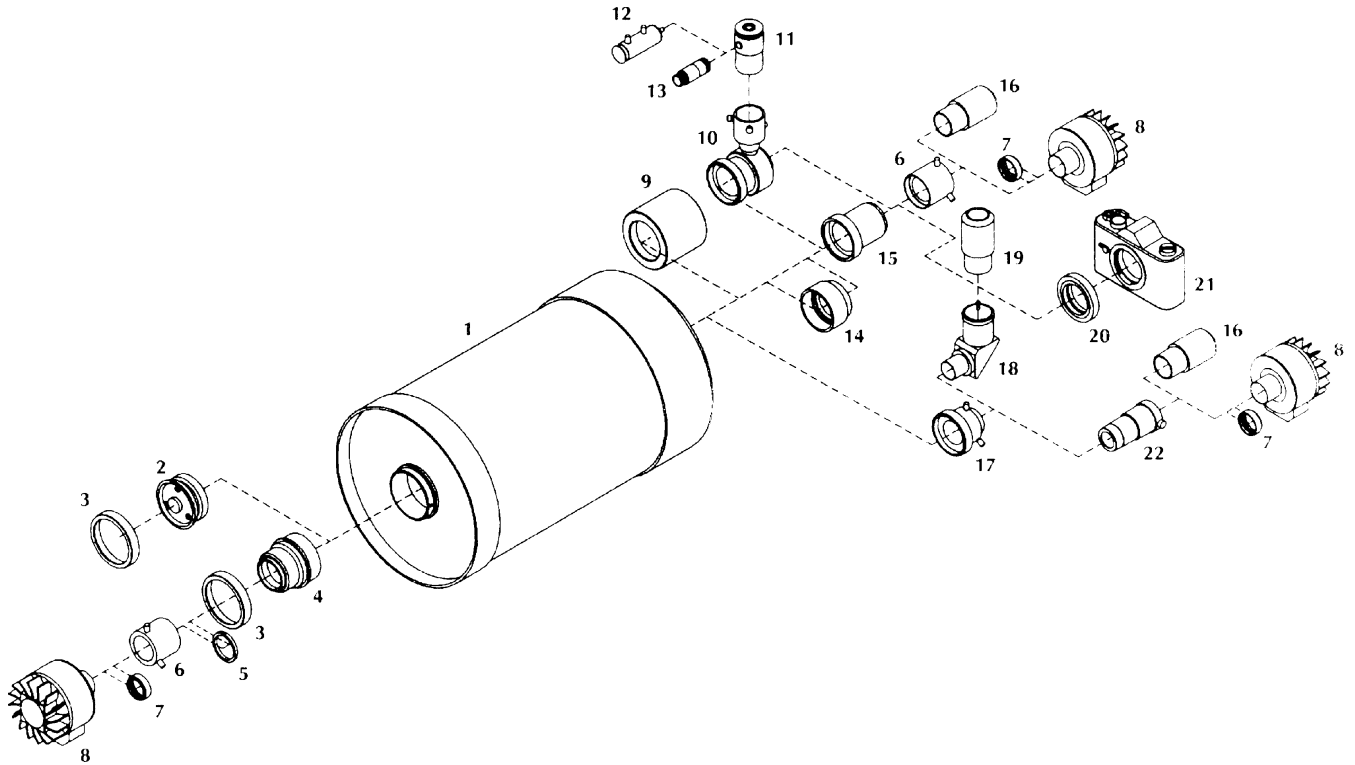


Figure 8-6 - Accessory Configurations for Fastar Compatible Telescopes

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 1/4" Adapter	17	Visual Back 1 1/4"
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 your Celestar telescope requires little maintenance, there are a few things to remember that will ensure your telescope performs optimally.

## CARE AND CLEANING OF THE OPTICS

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

If dust builds up on the corrector plate, remove it with a brush (made of camel's hair) or a can of pressurized air. When using pressurized air, spray at an angle to the corrector for approximately two to four seconds. Then, use an optical cleaning solution and white, unscented (Kleenex type) 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 edge. 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 telescope during an observing session. If you want to continue observing, the dew must be removed, either with a hair dryer or by pointing the telescope at the ground until the dew has evaporated.

If moisture condenses on the inside of the corrector, place the telescope in a dust-free environment. Remove the accessories from the rear cell and point the telescope down. This will remove the moisture from the telescope 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 prevents contaminants from entering the optical tube.

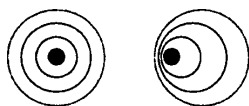
Internal adjustments and cleaning should be done only by the Celestron repair department. If your telescope is in need of internal cleaning, please call the factory for a return authorization number and price quote.

## COLLIMATION

The optical performance of your Celestron telescope is directly related to its collimation, the alignment of its optical system. Your Celestar 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 collimated. The only optical element that may need to be adjusted, or is possible, is the tilt of the secondary mirror.

Collimation is the alignment of the optical elements. In the Schmidt-Cassegrain optical system used in the Celestar, this is the alignment of the primary and secondary mirrors.





**Figure 9-1**

A collimated pattern (left) of a slightly out-of-focus star shows concentric rings. An example of an out of collimation system (right) is shown by non-symmetric rings that flare out to one side.

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 drive on so that you won't have to manually track the star. Or, if you are not using the clock drive, use Polaris. It's position relative to the celestial pole means that it moves very little thus eliminating the need to manually 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 re-collimation is needed.

To accomplish this, you need to locate the secondary alignment screws which are located on the secondary mirror housing. The secondary mirror housing is mounted in the center of the corrector plate. It will be necessary to remove the cap which covers the three secondary alignment screws. The cover just snaps off. You need to tighten the secondary collimation screw(s) that move the star across the field toward the direction of the skewed light. These screws are located in the secondary mirror holder. Make only a small 1/6 to 1/8 field correction and re-center the star by moving the scope before making any improvements or 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 9-1), not the shadow of the secondary housing. This (stellar) image will appear 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.

Perfect collimation will yield a star or planetary image very symmetrical just inside and outside of focus. In addition, 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.

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 TO TOUCH 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 that can be used with your Celestar telescope.

Accessory Name - Part Number - Description	Compatible with	
	Celestar	Celestar Deluxe
<b>AC Adapter - 110V - 60Hz (#18772)</b> - The AC Adapter allows you to run your Celestar 8 and Celestar 8 Computerized off AC rather than the standard DC battery.	X	X
<b>Accessory Case (#93500)</b> - This rugged ABS plastic case is designed for carrying a few accessories. Inside is foam padding that is die cut to 1 x 1 inch squares. These squares can be removed to accommodate accessories with a custom fit.	X	X
<b>Advanced Astro Master (#93900)</b> - Imagine observing hundreds of deep-sky objects in one night. With the Advanced Astro Master you don't have to imagine! This unique accessory contains a data base of more than 10,000 objects! Included are the Messier catalog, NGC catalog, IC catalog, portions of the ESO catalog, portions of the UGC catalog, special non-stellar catalog which contains objects not found in any of the other catalogs, a star catalog containing 241 interesting double and multiple stars, and a user definable catalog that allows you to enter 25 of your favorite objects. And, scrolling information cross references Sky Atlas 2000.0 or Uranometria . Unlike other digital setting circles, which require the use of a clock drive, the Advanced Astro Master can be used with or without a clock drive. All you have to do is align on any two of the 28 navigational alignment stars in the Advanced Astro Master's data base and you are ready to observe. Once aligned, the system keeps track of where it is pointed. And, the Advanced Astro Master has an RS 232 port for complete interface to your personal computer. The RS 232 cable (#93921) is currently available and ready for shipment. The hardware mounting kit for the Celestar 8 fork mount is #93911. This accessory is standard equipment with the Celestar 8 Computerized unit and the Celestar Deluxe 8 computerized.	X	X
<b>Barlow Lenses</b> - 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 lenses in the 1-1/4" size for the C8 telescope. 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. It works very well with all Celestron eyepieces. The latest Barlow to be added to Celestron's product line (#93507) is a low profile achromatic design. It weighs just 4 oz. and it is under 3" in length.	X	X

Accessory Name - Part Number - Description	Compatible with	
	Celestar	Celestar Deluxe
<b>C-5/C-8 Case (302070)</b> - This case is perfect for storing the Celestar telescope with the finderscope attached. It is constructed of space age resin, making it waterproof, unbreakable, airtight and extremely durable. The case is lined with die cut foam for custom fitting. (31.5" x 21.75" x 11.5")	X	X
<b>Car Battery Adapter (#18767)</b> - To save the internal battery, Celestron offers the Car Battery Adapter which allows you to run the telescope off an external power source. The adapter attaches to the cigarette lighter of your car. A car battery adapter comes standard with the Celestar Deluxe.	X	standard equipment
<b>Collimated Barlow Diagonal-1<math>\frac{1}{4}</math> (94117)</b> - An ultra compact 90° barlow diagonal. It contains an integral 1.7X large aperture multi-coated achromatic Barlow lens. The diagonal is laser aligned (collimated) for rotating centration. Ideal for visual centering of CCD objects and critical setting circle use.	X	X
<b>Counterweight Bar Assembly (#94191)</b> - When attaching optional accessories to your telescope, like 2" eyepieces or cameras, there is the need to add weights to counterbalance the telescope. This unique design produces the best dynamic balance of any counterweight system on the market. Not only do the weights slide parallel to the telescope tube, but they can also be adjusted vertically. Included is one 2.5 pound weight. Additional counterweights are available in 2.5 (#94193) and 5 pound (#94194) sizes.	X	X
<b>Declination Motor (#93549)</b> - The electric DEC Motor allows you to make corrections to the DEC axis of your Celestar 8 telescope without touching the instrument. All corrections are made from the optional hand control box (#28983) which eliminates the possibility of bumping or shaking the telescope while making manual corrections.	X	standard equipment (different style)
<b>Dew Cap/Lens Shade (#94017)</b> - The Dew Cap/Lens Shade 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 builds up on the corrector plate when observing at night. For daytime observing, this accessory works as a lens shade to prevent stray light from falling on the corrector, a situation which could reduce contrast. Day or night, the Dew Cap/Lens Shade will enhance all your views.	X	X
<b>Dew Eliminator (#94122)</b> - The Dew Eliminator blows warm air to keep your corrector plate and any optional accessories dew-free. It plugs into any 12V cigarette lighter.	X	X
<b>Diagonal, 2 inch (#93519)</b> - Like the 1-1/4" Diagonals, the 2" Star Diagonal allows you to use 2" eyepieces with your Celestron telescope. These larger eyepieces offer wider fields and better eye relief for greater viewing comfort. <b>This accessory is <u>NOT</u> recommended when using the Reducer/Corrector Lens.</b>	X	X
<b>Erect Image Diagonal (#94112-A &amp; 94108)</b> - For daytime terrestrial viewing the Erect Image Diagonal	X	X

Accessory Name - Part Number - Description	Compatible with	
	Celestar	Celestar Deluxe
produces images through your Celestar that match what you see with the unaided eye. This accessory uses an Amici prism arrangement that, corrects the image. The model #94112-A allows you to look into the telescope at a 45° angle, a desirable arrangement for terrestrial viewing. If you desire to view at a 90° angle, then model #94108 is available.		
<b>Eyepiece Filters</b> - To enhance your visual observations of planetary objects, Celestron offers a wide range of colored filters that thread into the 1-1/4" oculars. Available are: #12 Deep Yellow, #21 Orange, #25 Red, #58 Green, #80A Light Blue, #96 Neutral Density (25% T and 13% T) and Polarizing filters. Filters are also available in sets of four.	X	X
<p><b>Eyepieces</b> - Like telescopes, eyepieces come in a variety of designs. And, with the advent of different eyepieces, Celestron also has a variety of designs each with its own advantages and disadvantages. For the 1-1/4" barrel diameter there are four different eyepiece designs available.</p> <ul style="list-style-type: none"> <li>• <b>SMA</b> - The SMA design is an improved version of the Kellner eyepiece. SMA's are very good, economical, general purpose eyepieces. Available in the focal lengths 6mm, 10mm, 12mm, and 25mm (standard with the Celestar 8).</li> <li>• <b>Plössl</b> - Plössl eyepieces have a 4-element lens designed for low-to-high power observing. The Plössl's 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.</li> <li>• <b>Ultima</b> - Ultima is not really a design, but a trade name for our 5-element, wide field eyepieces. In the 1-1/4" barrel diameter, 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 the C8 with or without the Reducer/Corrector.</li> <li>• <b>Lanthanum Eyepieces (LV Series)</b> - 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 1-1/4" barrel diameter in the following focal lengths: 2.5mm, 4mm, 5mm, 6mm, 9mm, 10mm, 12mm, 15mm. Also available is an LV Zoom Eyepiece with the focal length range of 8 to 24mm.</li> </ul>	X	X

Accessory Name - Part Number - Description	Compatible with	
	Celestar	Celestar Deluxe
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 111 to 307 power on the C8 when used at prime focus.		
<p><b>Finders</b> - Finders 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 (<b>#93785-8P</b>). It comes with the bracket, finderscope, and illuminator. Another option is the 9x50 finder (<b>93783-8</b>) which is standard with the Celestar Deluxe. This includes the finder, and the finder bracket. There is also a Quick Release Finder bracket (<b>#51149-A</b>) which allows you to easily remove and replace the finderscope without losing alignment. The Quick Release Bracket is only available for the 9x50 and 7x50 Finderscopes.</p> <p>Another tool for finding objects in the sky is the <b>Star Pointer (#51630)</b>. 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.</p>	X	X
<b>Flashlight (#93592)</b> - The LED flashlight uses a red LED to allow reading star maps without ruining your night vision. The LED flashlight is small, only 6 inches long, and weighs in at a mere 3 ounces.	X	X
<b>Flashlight, Night Vision (#93588)</b> - Celestron's premium model for astronomy, using two red LEDs to preserve night vision. The brightness is adjustable and it operates on a single 9V battery.	X	X
<b>Focus Micrometer(#94148)</b> - A digital mechanical counter that attaches to the focus mechanism and gives an extremely accurate readout of focus position. This is a necessity for anyone doing CCD imaging or astrophotography.	X	X
<b>Hand Controller (#28983)</b> - This plugs into the drivebase of the Celestar 8 and is essential for long exposure astrophotography. <b>This item is needed to use the Celestar in the Southern Hemisphere.</b>	X	standard equipment
<b>Illuminated Reticle Ocular, 7.5mm (#94174)</b> - An eyepiece made specifically for astrophotography and CCD imaging. It is a Plossl design and the reticle is focusable. The reticle is a cross pattern with several boxes and smaller crosses for a variety of guiding choices.	X	X
<b>Light Pollution Reduction (LPR) Filters</b> - 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	X	X

Accessory Name - Part Number - Description	Compatible with	
	Celestar	Celestar Deluxe
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).		
<b>Micro Guide Eyepiece (#94171)</b> - This multipurpose illuminated 12.5mm 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 160 power when used with the C8 at f/10.	X	X
<b>Motorized Focuser (94142)</b> - This accessory allows you to focus the telescope electronically instead of manually. The motorized focuser eliminates the possibility of bumping or shaking the telescope when focusing. This accessory has its own hand controller box and it's own power source.  <b>Cannot be used if using the Focus Micrometer.</b>	X	X
<b>Piggyback Mount (#93598)</b> - The best way to enter the realm of deep-sky photography is via the piggyback method. Piggyback photography allows you to record constellations and large scale nebulae that don't fit in the field of your telescope. The piggyback mount allows you to attach a camera to the top of the telescope. This way, the camera can photograph with its normal or wide angle lens while you guide through the telescope. The piggyback mount attaches to the rear cell of the telescope next to the finder.	X	X
<b>Planisphere</b> - A map of the night sky, oriented by month and day, to display exactly which stars and planets will be visible. There are three different models to match the latitude from which you're observing. For 20° to 40° latitude - <b>93720-30</b> , for 30° to 50° latitude - <b>93720-40</b> , and for 40° to 60° - <b>93720-50</b> .	X	X
<b>Polarizing Filter Set (#93608)</b> - 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.	X	X
<b>Radial Guider (#94176)</b> - 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	X	X

Accessory Name - Part Number - Description	Compatible with	
	Celestar	Celestar Deluxe
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.		
<b>Reducer/Corrector (#94175)</b> - This lens reduces the focal length of the telescope by 37%, making your C8 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. It also increases the field of view significantly and is ideal for wide-field, deep-sky viewing. It is perfect for beginning prime focus long-exposure astrophotography. It makes guiding easier and exposures shorter.	X	X
<b>Sky Maps (#93722)</b> - When learning the night sky, the Celestron Sky Maps offer the ideal solution. The maps include all the constellations and brighter deep-sky objects. The maps are printed on a heavy stock paper that is moisture-resistant. On the front cover is a rotating planisphere which indicates when specific constellations are visible.	X	X
<b>Skylight Filter (#93621)</b> - The Skylight Filter is used on C8 telescopes as a dust seal. The filter threads onto the rear cell of your telescope. All other accessories, both visual and photographic, thread onto the Skylight Filter. Although it does cut down on a portion of the incoming light, it is a very small amount. It should be noted, that most Barlow lenses can NOT be inserted into the visual back when the skylight filter is attached.	X	X
<b>Solar Filter (#94162)</b> - The 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 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 color Sun). This filter can be used for visual observation and photography. This model is a full aperture filter.	X	X
<b>T-Adapter (#93633-A)</b> - A T-Adapter (with T-Ring) allows you to attach your camera to the prime focus of a Celestron Schmidt-Cassegrain telescope. This is used for terrestrial photography and short exposure lunar and filtered solar photography. It can be used for long exposure deep-sky photography if you use a separate guidescope.	X	X
<b>T-Adapter/Barlow (#93640)</b> - A special T-Adapter with an integral 2x Barlow lens. The barlow is removable so you can attach your camera to your Celestar and shoot at prime focus or 2x prime focus.	X	X

Accessory Name - Part Number - Description	Compatible with	
	Celestar	Celestar Deluxe
<b>T-C Adapter (#93636)</b> - 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.	X	X
<b>T-Ring</b> - The T-Ring couples your camera body to the T-Adapter, Radial Guide Body, or Tele-Extender. This accessory is mandatory if you want to do astrophotography through the telescope. Each camera make (i.e., Minolta, Nikon, etc.) has its own unique mount and therefore, its own T-Ring.	X	X
<b>Tele-Extender, Deluxe (#93643)</b> - 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.	X	X
<b>Tripod and Wedge</b> - For the serious astrophotographer and CCD imager, Celestron offers a wedge and tripod that allows you to accurately polar align your Celestar and adds rigidity for successful long exposures. The parts needed are the <b>Wedge (#93656)</b> , the <b>Tripod (#93499)</b> , and the <b>Deluxe Latitude Adjuster (#93528)</b> .	X	standard equipment
<b>Vibration Suppression Pads (#93503)</b> - These pads reduce the amplitude and vibration time of your telescope when shaken by the wind or an accidental bump. They rest between the ground and tripod feet of your telescope. VSPs are recommended for all observing conditions.	X	X

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.	DEC	Mag	Type	Proper Name
M1	NGC 1952	Tau	05 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	02 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.	Trifid Nebula
M20	NGC 6514	Sgr	18 02.4	-23 02	8.5	D. Neb.	
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.	Dumbbell Nebula
M27	NGC 6853	Vul	19 59.6	22 43	8.1	P. Neb.	
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.	

M#	NGC#	Const.	R.A.	DEC	Mag	Type	Proper Name
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.	Pinwheel Galaxy
M33	NGC 598	Tri	1 33.8	30 39	5.7	Sp. Gx.	
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.	
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.	Great Orion Nebula
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.	Beehive Cluster Pleiades
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.	
M45		Tau	3 47.5	24 07	1.2	Op. Cl.	
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.	Whirlpool Galaxy
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.	
M52	NGC 7654	Cas	23 24.2	61 35	6.9	Op. Gx.	Ring Nebula
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.	Sunflower Galaxy Black Eye Galaxy Leo's Triplet
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.	Leo's Triplet
M63	NGC 5055	CVn	13 15.8	42 02	8.6	Sp. Gx.	
M64	NGC 4826	Com	12 56.7	21 41	8.5	Sp. Gx.	
M65	NGC 3623	Leo	11 18.9	13 05	9.3	Sp. Gx.	
M66	NGC 3627	Leo	11 20.3	12 59	9.0	Sp. Gx.	
M67	NGC 2682	Cnc	8 50.3	11 49	6.9	Op. Cl.	Leo's Triplet
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.	

M#	NGC#	Const.	R.A.	DEC	Mag	Type	Proper Name
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.	
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.

Epoch 2000.0				
Star Name	H M S	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

# TECHNICAL SPECIFICATIONS

Optical Tube Design	Schmidt-Cassegrain
Aperture:	8" (203mm)
Focal Length:	80" (2032mm)
F/ratio:	10
Highest Useful Magnification:	480x
Lowest Useful Magnification:	29x
Resolution	.68 arcseconds
Photographic Resolution:	182 lines/mm
Light Gathering Power:	842x the unaided eye
Back Focus	18" $\pm$ 5"
Near Focus with Eyepiece:	~25'
Near Focus with Camera:	~25' (Using the Radial Guider)
Optical Tube Length:	16"
Optical Tube Diameter	9"
R.A. Setting Circle Diameter Northern Hemisphere:	6 <sup>3</sup> / <sub>4</sub> " (Celestar 8 and Celestar 8 Computerized) 7 <sup>3</sup> / <sub>4</sub> " (Celestar Deluxe 8 and Celestar Deluxe 8 Computerized)
R.A. Setting Circle Diameter Southern Hemisphere:	7 <sup>3</sup> / <sub>4</sub> " (Celestar 8 and Celestar 8 Computerized) 8 <sup>3</sup> / <sub>4</sub> " (Celestar Deluxe 8 and Celestar Deluxe 8 Computerized)
DEC. Setting Circle Diameter:	4"
DEC. Slow Motion Resolution	6 turns per degree
DEC Slow Motion Maximum Angle	10 degrees
Weight of Tube, Drivebase, and Forks	22 lb. (Celestar 8 and Celestar 8 Computerized) 27 lb. (Celestar Deluxe 8 and Celestar Deluxe 8 Computerized)
Weight of Wedgpod (Celestar 8)	15 lb.
Weight of Wedge (Celestar Deluxe 8)	4 lb.
Weight of Tripod (Celestar Deluxe 8)	19 lb.

# 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.....Audolsze & 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 45c 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 dc 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

# **CELESTRON LIMITED WARRANTY**

## **CELESTRON PRODUCTS**

Celestron International (CI) warrants that each Celestron telescope shall be free from defects in materials and workmanship for **one year**. CI repair or replace such product or part thereof which, on 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.

## **RETURN AUTHORIZATION ALL PRODUCTS**

The Proper Return Authorization Number must be obtained from CI in advance of return. Call Customer Service 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 cost of transportation and insurance, both to and from the factory of CI, and shall be required to prepay such costs.

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CI warrants that all CI accessories and electronic components shall be free from defects in materials and workmanship for one year from the date of sale to the first retail purchaser. The warranties set forth in this paragraph shall be the exclusive warranties provided by CI with respect to CI accessories and electronic features and shall be deemed to limit the obligation of CI under any other provisions of this warranty.

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310/328-9560  
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This warranty supersedes all other product warranties.

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