

THE ULTIMA 8

The Ultima 8 is a heavy duty version of the fork-mounted Celestron 8. The Ultima 8 uses a single motor Byers worm gear drive and has a 2-5/8" tapered polar shaft. For easy transportation, the Ultima has two carrying handles; one on each fork tine. In addition, the Ultima comes standard with Starbright™ coatings, enhanced multilayer coatings on the primary and secondary mirrors for increased reflectivity. The Starbright™ coatings also includes an antireflection coating on both sides of the corrector plate that allows for maximum light transmission. The Ultima is shipped in three boxes. One contains the telescope with all the standard accessories, which are:

- 26mm Plössl Ocular 1-1/4"
- Visual Back 1-1/4"
- Star Diagonal 1-1/4"
- PEC Drive
- Hand Controller
- 7x50mm Polaris Finder with Bracket
- 9-volt Alkaline Battery
- Lens Cap
- Bolt Pack
- Allen Wrench Set

The second and third boxes contain the wedge and tripod which are also standard accessories.

Unpacking Your Ultima 8

Remove the wedge, tripod, and telescope from their respective boxes. Remove all the accessories as well, which are located in the box with the telescope. Save the boxes since you may want to ship your telescope via a common carrier at some time in the future.

Use the diagram on the following page (figure 5-1) to familiarize yourself with the various parts of your Ultima 8 telescope.

Ultima 8

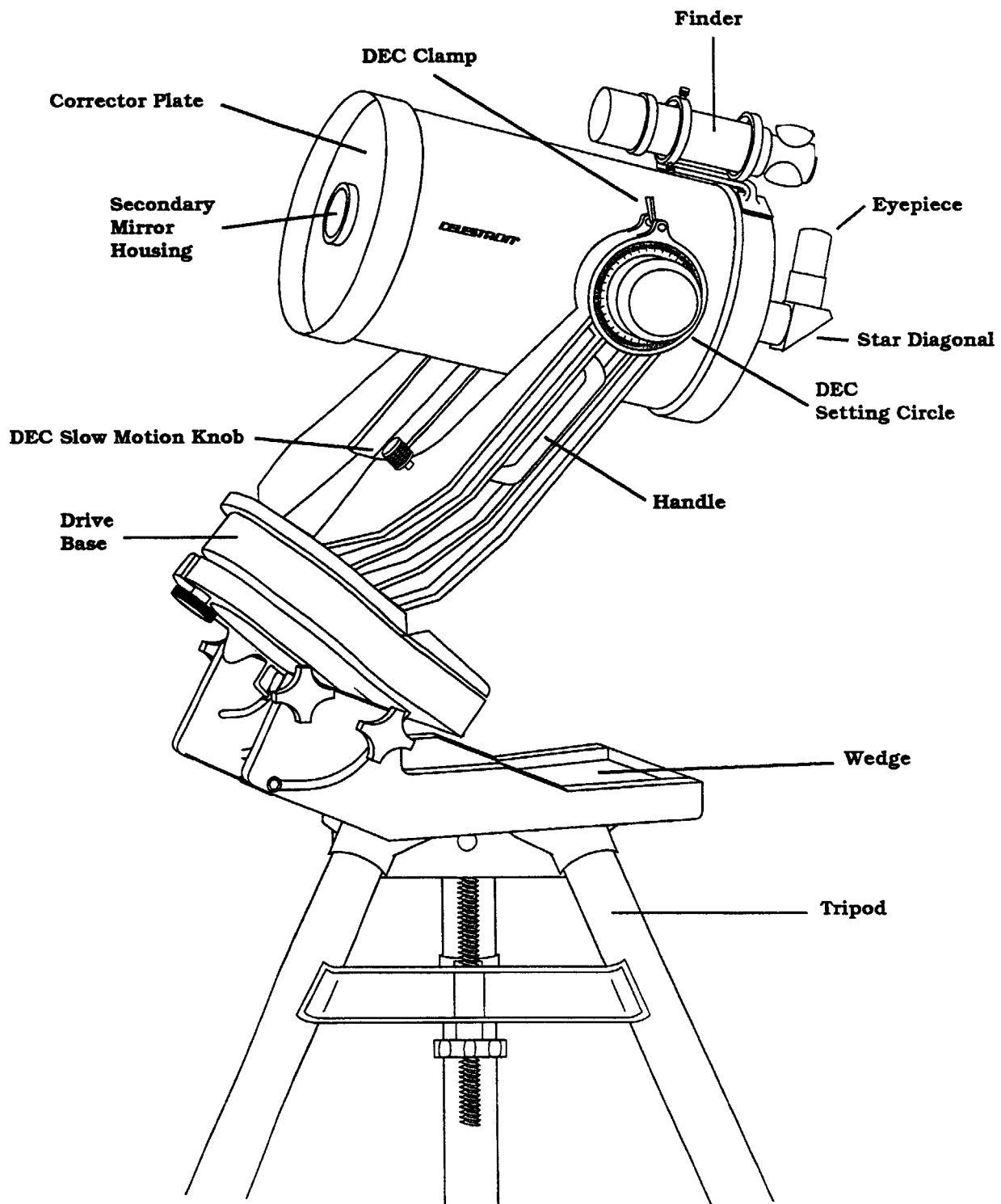


Figure 5-1

Setting Up the Tripod

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. The tripod is shipped with the leg support bracket attached to the central tripod column. However, each arm of the leg support bracket is in between the legs so the tripod legs collapse for shipping. To set up the tripod:

1. Hold the tripod with the head up and the legs pointing toward the ground.
2. Pull the legs away from the central column until they won't 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!**

The tripod comes with rubber feet which are ideal for smooth surfaces like asphalt and concrete. For uneven surfaces, like grass and dirt, remove the rubber feet beneath which are pointed aluminum feet.

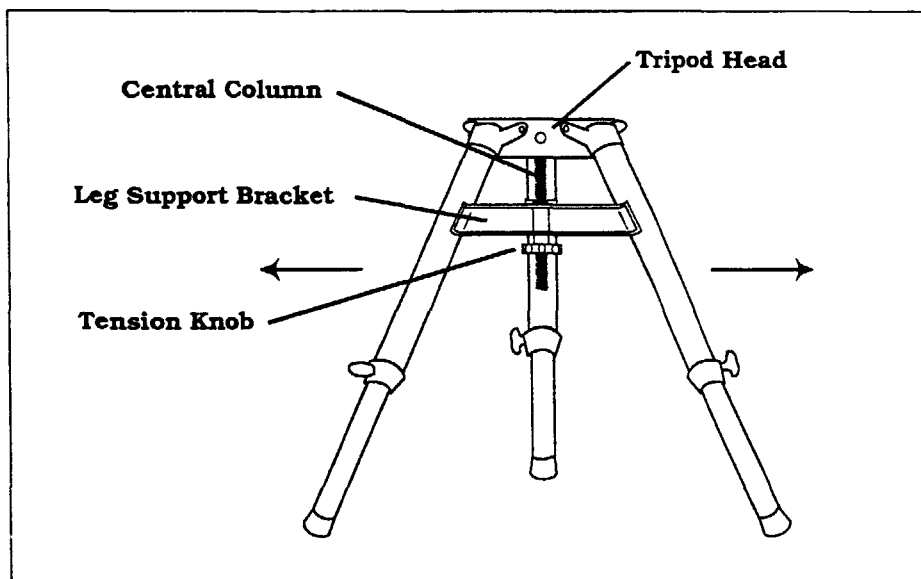


Figure 5-2

The field tripod fully assembled. To adjust the height, loosen the extension clamp and slide the tripod leg to the desired position.

Adjusting the Tripod Height

To adjust the height at which the tripod stands:

1. Unscrew the extension clamp on one of the tripod legs.
2. Extend the leg to the desired height and tighten the clamp.
3. Repeat this process for each of the remaining legs.

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 maximum 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.

WARNING: NEVER leave the tripod unattended when the legs are fully extended.

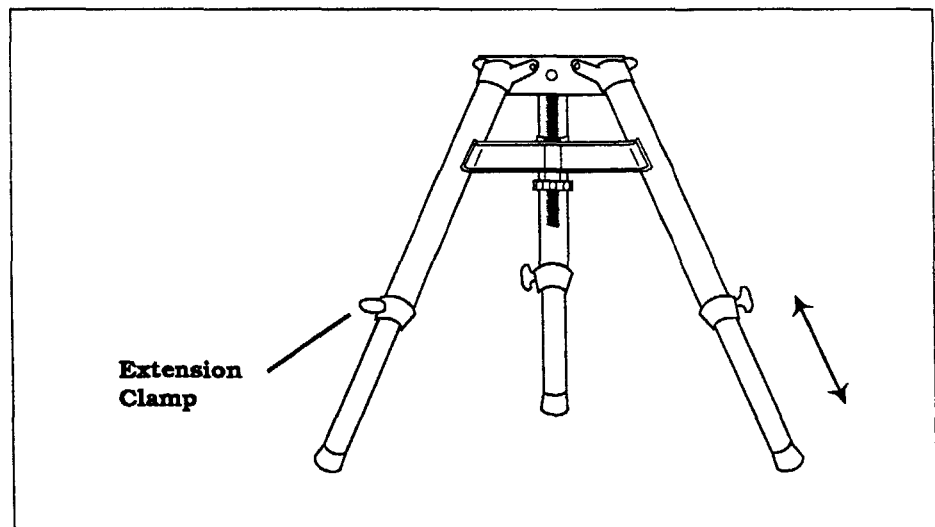


Figure 5-3

To adjust the height, loosen the extension clamp and slide the tripod leg to the desired position. It is best to extend the legs prior to attaching the telescope and then make minor adjustments after attaching the telescope.

Attaching the Wedge to the Tripod

After the tripod is set up, you are ready to attach the wedge. The wedge, like the tripod, is fully assembled and only needs to be attached to the tripod. The wedge allows you to adjust the telescope's axis of rotation so that it is parallel to the Earth's axis of rotation. Once parallel, the telescope will track the stars as they move across the sky. (The process of making the telescope's axis parallel to the Earth's, known as polar alignment, is discussed later in this manual)

To attach the wedge to the tripod:

1. Place the three slotted holes in the wedge over three of the holes in the tripod head.
2. Thread the three 5/16-18x1" Allen head bolts into the holes until tight (see figure 5-4).
3. Tighten the bolts until the wedge cannot be moved side to side. These can be loosened later for polar alignment.

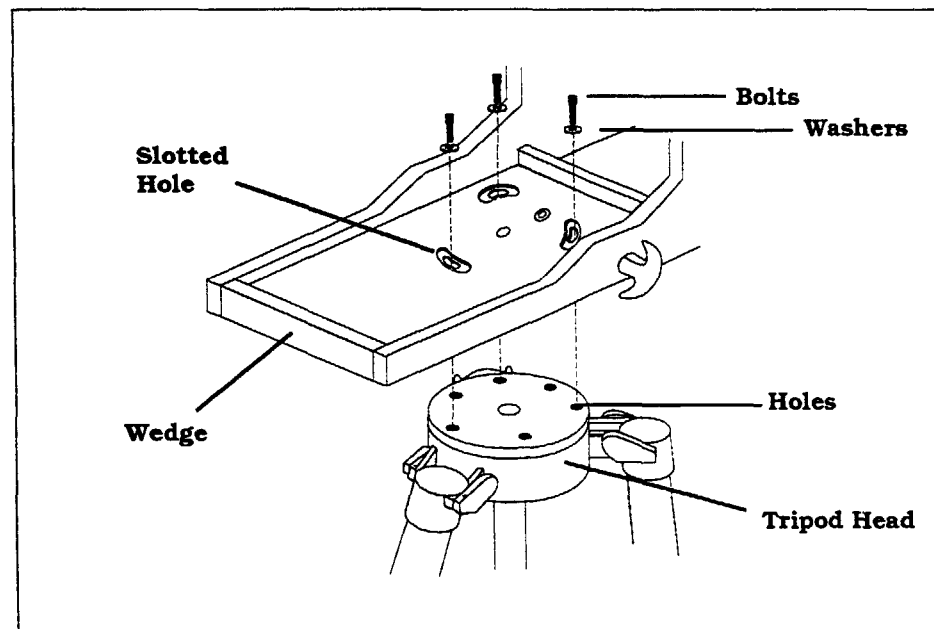


Figure 5-4

Attaching the Ultima 8 to the Wedge

With the wedge in place on the tripod, you are ready to mount the telescope on the wedge. The telescope base fits directly onto the tilt plate of the wedge. 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 insert one of the three (3/8-16x1") hand tightening knobs (supplied in the bolt pack) into the hole that is opposite the rectangular portion of the drive base. The rectangular portion of the base will slide between the side plates on the wedge and rest near the top of the tripod.
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 (see figure 5-5).
4. Slide the bolt into the slot on the top of the tilt plate.
5. 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.
6. Move the base of the telescope side-to-side until the two remaining holes in the drive base line up with the holes in the tilt plate on the wedge.
7. Insert the screws and tighten all three completely.

There is no need to loosen these until you are ready to remove the telescope from the wedge.

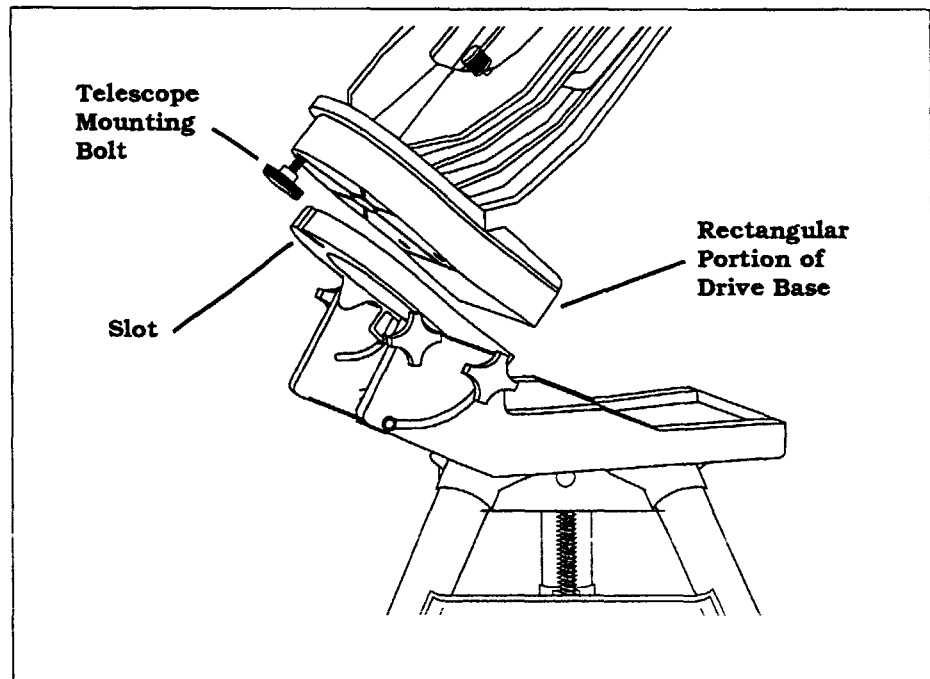


Figure 5-5

Installing the Finder

The Polaris 7x50 finderscope serves two basic purposes. First, it can be used as a regular finder to help you locate and center objects in the main field of your telescope. Second, it can be used to polar align your telescope. To accomplish this, the finder has a built in reticle that indicates the distance between the North Star, Polaris, and the true celestial pole. Since the finder does not come with the illuminator standard, we recommend purchasing the optional illuminator (#51614-IL). A setting plate (#60121), to show the exact position of Polaris on the reticle for the date and time you are observing, is offered as an optional accessory.

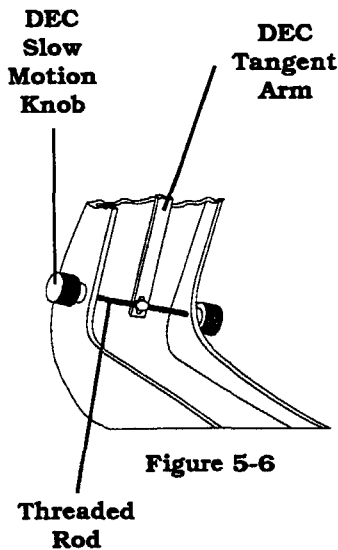
Start by removing the finder and hardware from the plastic wrapper. Included are the following:

- 7x50mm Finder
- Finder Bracket
- Rubber O-ring
- Three Nylon Tipped Thumbscrews (10-24x1/2")
- Two Allen Head Screws (8-32x1/2")

To install the finder:

1. Attach the bracket to the optical tube. To do this, place the curved portion of the bracket with the slot over the two holes in the rear cell. The bracket should be oriented so that the rings that hold the finder are over the telescope tube, not the rear cell. Start threading the screws in by hand and tighten fully with an Allen wrench.
2. Partially thread-in the three nylon-tipped thumbscrews that hold the finder in place inside the bracket. Tighten the screws until the nylon 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. (Having the screws in place when the finder is installed will be easier than trying to insert the screws after the finder has been installed.)
3. Slide the rubber O-ring over the back of the finder (it may need to be stretched a little). Once on the main body of the finder, slide it up about one inch from the end of the finder.
4. Rotate the finder until one cross hair is parallel to the R.A. axis and the other is parallel to the DEC axis.
5. Slide the eyepiece end of the finder into the front of the bracket.
6. Slightly tighten the three nylon tipped thumbscrews on the front ring of the bracket to hold the finder in place.
7. Push the finder back until the O-ring is snug inside the back ring of the finder bracket.
8. Hand tighten the three nylon tipped thumbscrews until snug.

Moving the Telescope in R.A. and DEC



Pointing the telescope is done by moving it in right ascension, or R.A. for short, and declination, or DEC for short (see figure 5-7). Right ascension corresponds to east/west movement while declination corresponds to north/south movement. To make considerable directional changes:

1. Loosen the R.A. and DEC clamps.
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, turn the declination slow motion knob. The DEC clamp does NOT have to be loosened. Once you have located the desired target, stop rotating the DEC slow motion knob. If the DEC slow motion knob will not turn, the DEC travel arm has most likely reached the end of the threaded rod. To correct this, turn the DEC slow motion knob in the opposite direction until the tangent arm is in the center of the fork tine (see figure 5-6). Release the DEC clamp and 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.

For fine adjustments in R.A., 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. 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.

The telescope comes equipped with setting circles to help you locate objects in the night sky. The DEC setting circle is incremented in degrees while the R.A. setting circle is incremented in 5-minute intervals. The numbers on the inner circle are for the northern hemisphere while those on the outer circle are for the southern hemisphere.

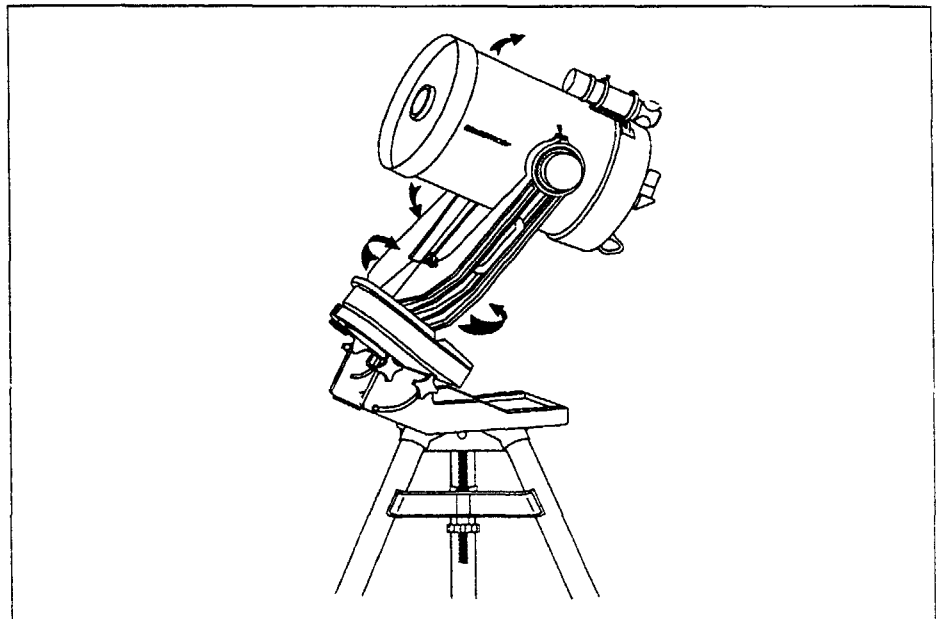


Figure 5-7

Setting up the Wedge

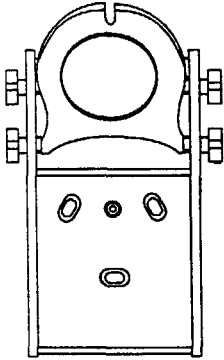


Figure 5-8

In order for the clock drive to track accurately, the telescope's axis of rotation must be parallel to the Earth's axis of rotation. The process of making these two axes parallel is called polar alignment. Polar alignment is achieved by moving the wedge, NOT by moving the telescope in R.A. or DEC. For the purpose of polar alignment, the wedge can be adjusted in two directions; vertically, which is called altitude and horizontally, which is called azimuth. Once aligned, the wedge should not be moved. Changes in the direction the telescope is pointing are made by moving the telescope in right ascension and declination. This section covers the correct movement of the wedge during the polar alignment process. The actual process of polar alignment is described later in this manual in the section on "Polar Alignment."

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

1. Loosen the four hex head bolts on the side plates of the wedge (two on each side). You will need a Crescent wrench or 1/2" wrench to do so.
2. Move the tilt plate until the latitude scale indicates the latitude of your observing site. The latitude scale is on the side plate.
3. Tighten the hex head bolts on the side plates to hold the tilt plate in place.

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

Once the appropriate adjustments have been made and you are aligned on the celestial pole, turn the clock drive on and the telescope will track.

Keep in mind that adjusting the wedge is done during the polar alignment process only. Once aligned, the wedge and tripod should NOT be moved.

Removing the Lens Cap

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

Using the Drive

The Ultima 8 drive is a state-of-the-art motor drive system designed specifically for our Ultima 8 telescope. The entire system is a self-contained unit built into the drive base. The clock drive is powered by a 9-volt battery which can run the telescope for up to 35 hours. The system can also run off AC power or external 12-volt DC power with optional adapters. The hand controller, which comes with the telescope, allows you to use the drive for astrophotography. The hand controller is **NOT** required for visual observing.

One of the most unique features of the drive is the Periodic Error Correction (PEC) function. This feature allows the drive system to “learn” the characteristics of the worm gear and as a result, improve the tracking accuracy. This typically reduces the periodic error to 30 percent or less of the original error. The amount of improvement will vary depending on guiding skill, atmospheric stability, the characteristics of the worm gear, and accuracy of the polar alignment.

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

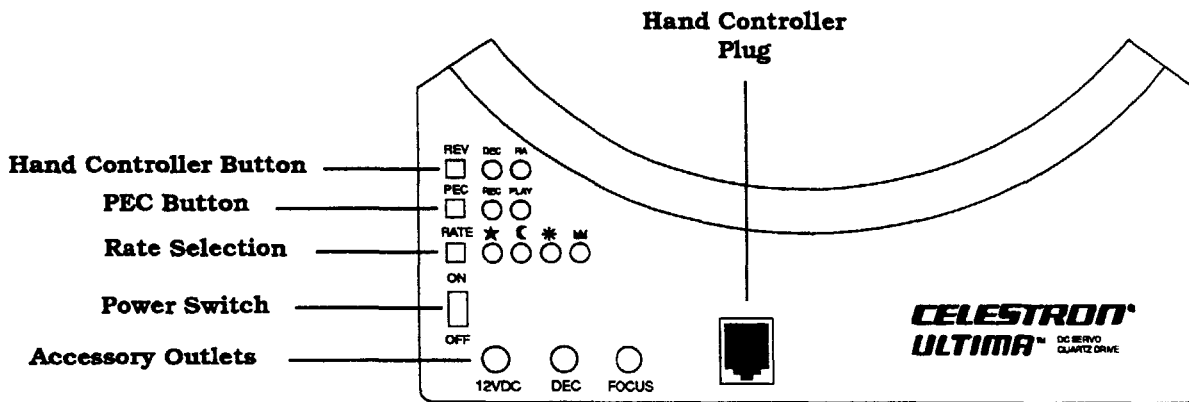


Figure 5-9

The cover plate on the Ultima 8 drive.

Powering Up the Drive

The “ON/OFF” switch supplies power to the drive motor. Each time the drive is turned on, it defaults to sidereal rate (i.e., the rate at which the stars move across the sky). All LEDs illuminate, but the LED for the tracking rate selected is brighter than the others so it is discernible in the dark. If the battery is low, the LED indicating the tracking rate will blink.

Changing the Direction of the Hand Controller Buttons

The buttons on the hand controller are intentionally left unlabeled (see figure 5-10). This is due to the fact that these buttons are user definable. With the hand controller cord facing down, the default setting are as follows:

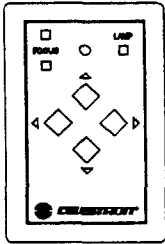


Figure 5-10

- “Up” button moves the telescope north
- “Down” button moves the telescope south
- “Right” button moves the telescope west
- “Left” button moves the telescope east

The button that controls these settings is found on the upper left hand corner on the cover of the drive base. The button is labeled “REV” and is next to two LEDs, one labeled “RA” and the other “DEC.” To change the settings, press the REV button. As the button is pressed, the LED will display which axis has been reversed (see figure 5-11).

- Pressing the button once reverses the RA setting
- Pressing the button twice reverses the DEC setting while returning RA to the default setting
- Pressing the button three times reverses both the RA and DEC settings
- Pressing the button four times returns both RA and DEC to their default settings

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

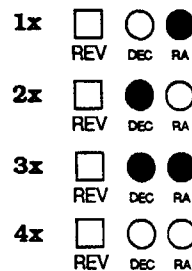


Figure 5-11

Tracking Rate Selection

The drive has four basic rates: sidereal, lunar, solar, and King (which is a modified sidereal rate that takes into account atmospheric refraction). Sidereal rate is the rate at which the stars move and is based on a single rotation of the Earth which takes 1,436.5 minutes. The lunar and solar rates are for the Moon and Sun respectively, both of which move relative to the background stars. For more accurate sidereal tracking there is the King rate. An astronomer by the name of King discovered that atmospheric 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 an icon. Sidereal rate is represented by a star (★), lunar rate by a crescent moon (☾), solar rate by a sun (☼), 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 PEC is activated, the drive rate is locked on the one selected. You can not change rates until PEC is turned off.

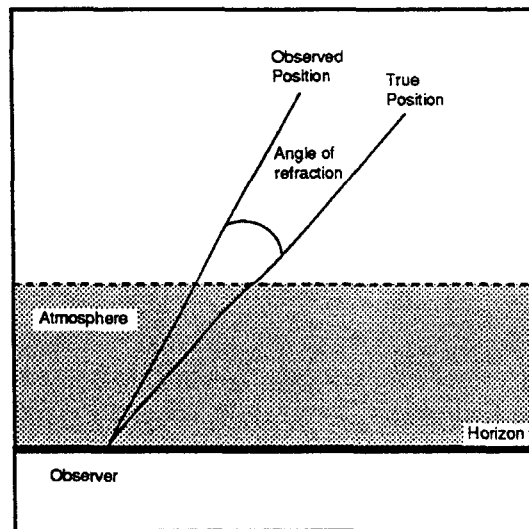


Figure 5-12

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

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 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 four minutes during which time the system records the corrections you make. (It takes the worm gear four minutes to make one complete revolution, hence the need to guide for four minutes.) This shows the PEC the characteristics of the worm gear. The second step is to play back the corrections you made during the recording phase.

Definition:

Periodic error is a slight oscillation of the mount caused by imperfections in the drive gears. The rate of the periodic error is equal to the rotation of the [worm] gear, in this case four minutes. All telescope drives have some periodic error.

Keep in mind, this feature is for advanced astrophotographers and requires careful guiding. Here's how to use the PEC function most effectively.

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 hair so that one is parallel to the DEC axis 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. The LED below the word "REC" will illuminate indicating that the record mode is working.

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 four minutes. Try not to overshoot corrections in right ascension. Ignore drift in declination.
7. Activate the playback function by pressing the "PEC" button once. All corrections made during the record mode will playback every four minutes.
8. Point the telescope at the object you want to photograph and you are ready to begin.

If you record for more than four minutes, the system will play back the corrections made during the first four minutes and continue to record new corrections (over the old ones) as long as the "REC" function is activated. Thus, you can technically guide a photo while in the "REC" mode. However, if a non-periodic error appears you will have to guide it out manually twice; once when it first appears, and a second time four minutes later when the system plays back the corrections.

NOTE: The focus buttons and the fast slew functions are locked while the PEC function is activated. This eliminates the possibility of shifting the focus or moving the telescope suddenly during an exposure.

Once you have used the PEC function for awhile you may mistake its operation for the way the drive normally operates. The best way to see how well the PEC function works is to turn it off. PEC results improve with practice and patience.

Connectors

On the drive base cover are four electrical connectors; three 3.5mm miniature phono jacks and one modular telephone jack (see figure 5-9). Starting from the left, the first, labeled "12VDC," is for an external power source. This outlet is for external power source adapters, either AC (#18772) or DC (#18767).

WARNING: When plugging into an external power source, **ALWAYS** plug the connector into the drive base first then the source outlet. Failure to do so may result in damage to the circuit board.

Next is the outlet for the optional 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.

The third outlet, labeled "FOCUS," is for the optional focus motor. This accessory allows you to focus the telescope using the buttons on the hand controller.

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 last outlet is the female end of a modular phone-type jack. This outlet accepts the male end of the hand controller. The hand controller is **NOT** needed for normal tracking. It is used to make corrections during long duration astrophotography. To plug the hand controller into the drive base:

1. Hold the end of the hand cable with the modular phone-type 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. If you are using the optional DEC motor, all corrections to the DEC axis will also be made from the hand controller.

The Hand Controller

On the hand controller there are seven buttons; four control the corrections in right ascension and declination, two control the optional focus motor, and one activates the LED map light (see figure 5-13).

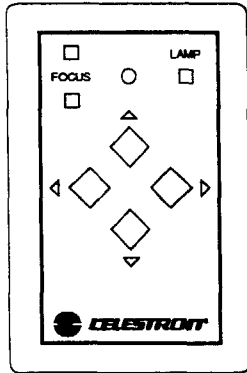


Figure 5-13

When guiding, press the appropriate button to center your guide star. 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).

To move 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. For example, if you want to slew the telescope west, hold the west button down and then press the east button. Conversely, if you want to slew the telescope east, hold the east button down then press the west button. The slewing rate varies between 300 to 400% of the normal sidereal rate, depending on how well your telescope is balanced. The slewing function also works in declination if using the optional 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. A good way to check this is to activate the LED map light.

The "Focus" buttons work in conjunction with the optional focus motor (#94143). Note that the buttons are locked when the PEC function is activated. If not using the optional focus motor, the buttons are inoperable and focus adjustment is done by turning the focus knob to the right of the diagonal and eyepiece.

The last button on the hand controller activates the map light. Press it once to turn the map light on. Press it once again to turn it off.

Replacing the Battery

Replacing the alkaline battery 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 to reveal the battery.
3. Unclip the battery from the metal holder.
4. Remove the terminal from the battery.
5. Install the new battery by attaching it to the terminal and clip it into the battery holder.
6. Replace the drive base cover.

To obtain the longest possible run time, use an alkaline battery which will power the drive for up to 35 hours of continuous use. Nickel cadmium or standard 9-volt batteries are not recommended. Keep in mind that the map light consumes more power than the main R.A. drive motor. Operating the declination and focus motors also draws more power from the battery.

Northern/Southern Hemisphere Operation

When using your Ultima 8 in the southern hemisphere, there is a need to reverse the motors. In previous models 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. With the power turned off, pressdown and hold the up and down buttons simultaneously.
2. Turn the power switch on (keep holding the buttons down).
3. In one or two seconds the red LED will blink. This will indicate the telescope is set for the southern hemisphere.
4. 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.

Trouble Shooting

When the battery is low, the LED that indicates the tracking rate will blink. At this point about 20 percent of the battery life remains. 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 of AC power or 12-volt DC power.

Transporting Your Ultima 8

You may leave your Ultima 8 fully set up in the house and carry it outside for a casual observing session. Since the telescope is fairly large and heavy when mounted on the tripod, you should remove the telescope and drive from the wedge. To do so:

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

The tripod and wedge can now be carried outside separately and the telescope reattached. If you are planning a trip to a remote site, you should remove the telescope from the wedge and return it to the case.

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. The only time you may want to remove the wedge is if you plan on packing your Ultima 8 and shipping it via a common carrier. If this is the case, you should return the wedge and tripod to their original shipping cartons.

Storing Your Ultima 8

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

What Next?

Now that you have completely assembled your Ultima 8, you are ready to begin attaching the accessories. Please turn to the section on "Telescope Basics" for more information.

THE 8" OPTICAL TUBE ASSEMBLY

The Celestron 8 Optical Tube Assembly (OTA) is simply the telescope without the fork mount and clock drive unit. In its standard configuration, the C8 Optical Tube Assembly is designed to attach to a standard, but rigid, photographic tripod for terrestrial viewing. However, this does not mean that the C8 Optical Tube Assembly can not be used for astronomical viewing. On the contrary, it can be used as an altazimuth telescope for casual astronomical observations. The C8 Optical Tube Assembly (11024-1) is shipped in one carton which contains the telescope and all standard accessories which include:

- 26mm Plössl Ocular 1-1/4"
- Visual Back 1-1/4"
- Star Diagonal 1-1/4"
- 6x30mm Finder and Bracket
- Piggyback Mount
- Balance Bracket (for tripod adaption)
- Allen Wrench Set

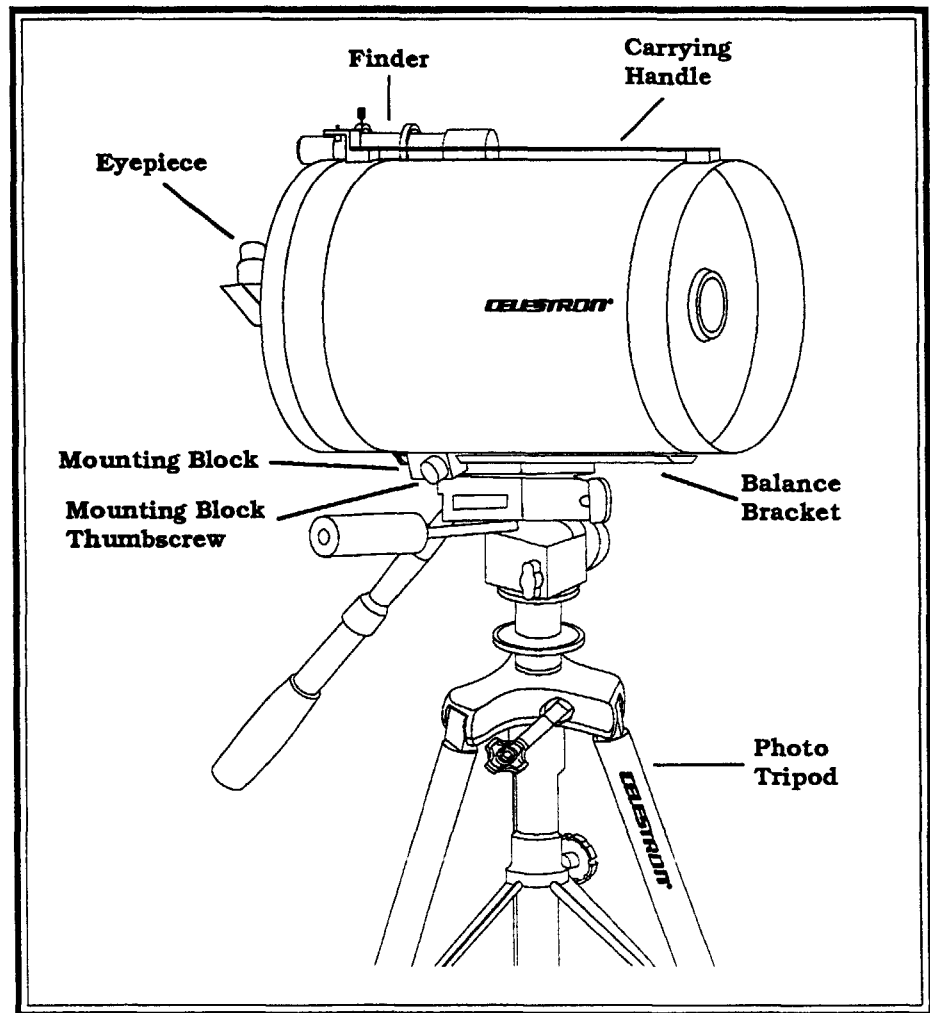


Figure 6-1

Setting Up Your C8 OTA

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

1. Place either of the 1/4x20 holes in the balance bracket over the 1/4x20 screw on your photographic tripod.
2. Tighten the screw to hold the bracket in place.

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

WARNING:

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

Installing the Finder

The C8 Optical Tube Assembly (#11024-1) comes standard with a 6x30mm finder. To ensure the finder and bracket are not damaged during shipping, they are **NOT** attached to the telescope. Begin by removing the finder and mounting hardware from the plastic shipping wrapper. Included with the finder are five Allen head screws: two hold the bracket to the telescope and three hold the finder in place inside the bracket. The three that hold the finder in place are easy to identify since they are nylon. In addition, there is also a rubber O-ring. This will slide over the finder to keep it secure in the bracket. Mounting the finder and bracket is a two step process; first mount the bracket to the telescope, then mount the finder in the bracket.

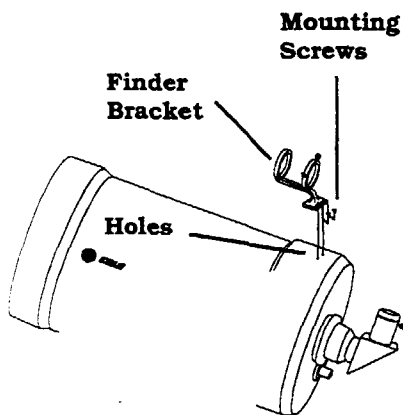


Figure 6-2

Attaching the Finder Bracket to the Telescope

1. Locate the two holes in the rear cell of the telescope just left of center (when looking from the back of the tube).
2. Remove the tape covering the two holes. The tape prevents dust and moisture from entering the optical tube.
3. Place the finder bracket over the holes. The bracket should be oriented so that the ring with the holes for the adjustment screws is closer to the rear cell of the telescope.
4. Thread the screws in by hand and then tighten with one of the Allen wrenches provided.

Attaching the Finder to the Bracket

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

1. Thread the three screws into the finder bracket that will hold the finder in place. Do not thread them in completely or they will interfere with the placement of the finder. Tighten the screws until the heads are flush with the inner diameter of the bracket ring.
2. Slide the rubber O-ring onto the back of the finder (it will NOT fit over the objective end of the finder). It may need to be stretched a little.
3. Position the O-ring on the main body of the finder so that it is toward the front (i.e., objective) end of the finder.
4. Slide the finder, eyepiece end first, into the front ring of the bracket. Push it back until the O-ring is snug inside the front ring of the bracket.
5. Hand tighten the three set screws until snug.

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

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

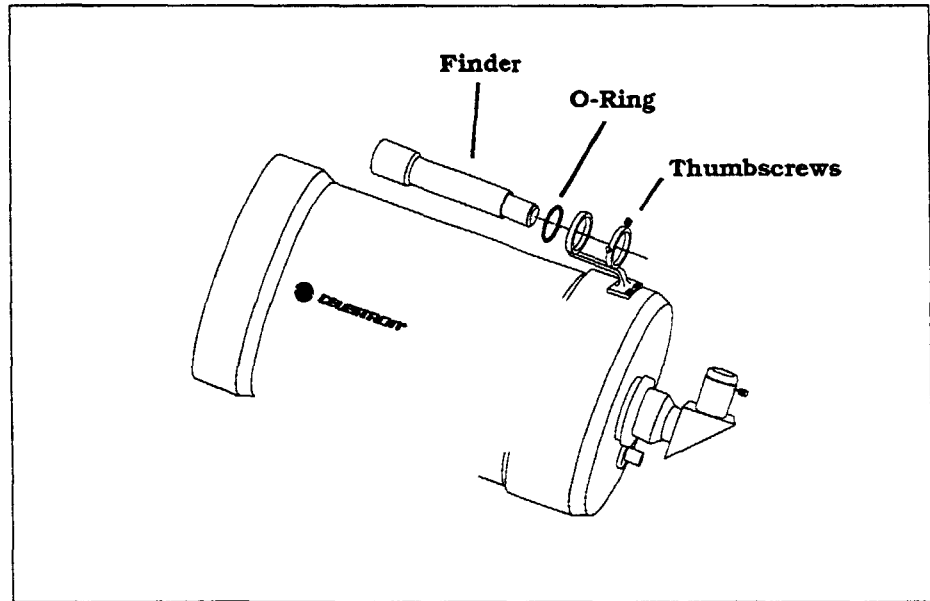


Figure 6-3

Removing the Lens Cap

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

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

Attaching the Accessories

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

The Visual Back

The visual back is the accessory that allows you to attach all visual accessories to the telescope. The GP-C8, and the C8 Optical Tube come with the visual back installed. It is not installed on the C8⁺, the C8⁺ Computerized, or Ultima 8. To attach the visual back:

1. Remove the rubber cover on the rear cell.
2. Place the knurled slip ring on the visual back over the threads on the rear cell (see figure 7-2).
3. Hold the visual back with the set screw in a convenient position and rotate the knurled slip ring clockwise until tight.

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

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

The Star Diagonal

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

1. Turn the set screw on the visual back until it no longer extends into (i.e., obstructs) its inner diameter of the visual back.
2. Slide the chrome portion of the star diagonal into the visual back (see figure 7-2).
3. Tighten the set screw to hold the star diagonal in place.

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

The Eyepieces

The eyepiece, or ocular, is an optical element that magnifies the image focused by the telescope. The eyepiece(s) fits into either the visual back directly (see figure 7-1), the star diagonal, or an erect image diagonal. To attach an eyepiece:

1. Loosen the set screw on the star diagonal so that it does not obstruct the inner diameter of the eyepiece end of the diagonal.
2. Slide the chrome portion of the eyepiece into the star diagonal (see figure 7-2).
3. Tighten the set screw to hold the eyepiece in place.

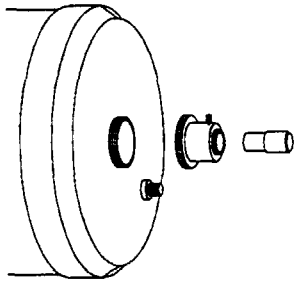


Figure 7-1

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

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

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

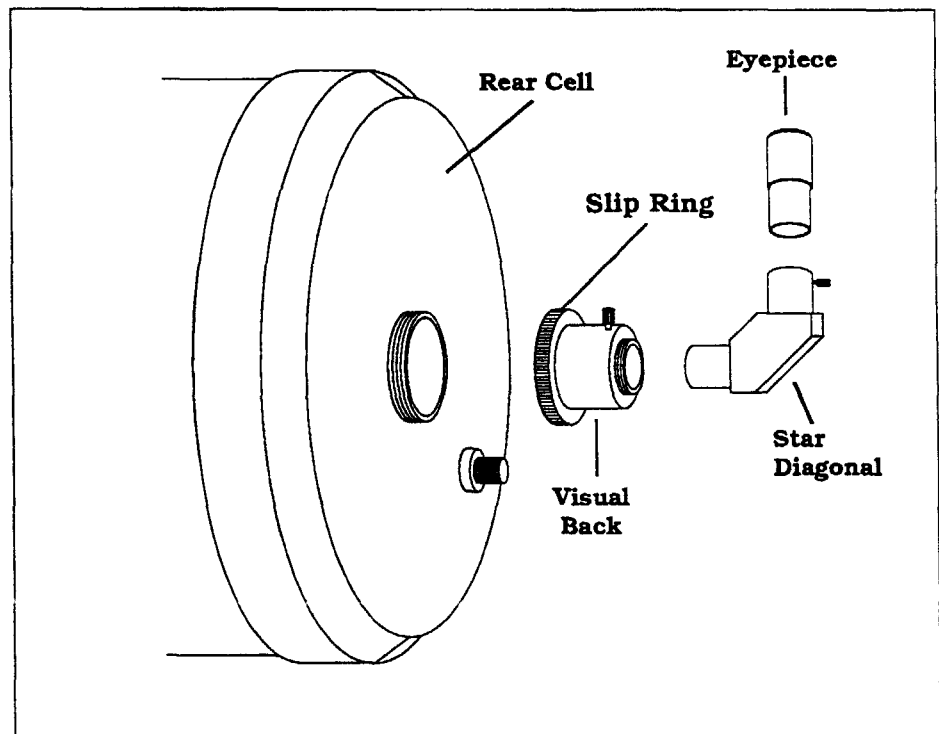


Figure 7-2

Image Orientation

It should be noted that the image orientation will change depending on the viewing configuration. When using the star diagonal, the image is right-side-up, but reversed from left-to-right. If inserting the eyepiece into the visual back (i.e., without the star diagonal), the image is inverted (upside down and reversed from left-to-right). This holds true for the 6x30 and 7x50 finder as well as the telescope. For correct orientation through the telescope, which is important primarily for terrestrial observing, use the optional 45° erect image diagonal 1-1/4" (94112-A).

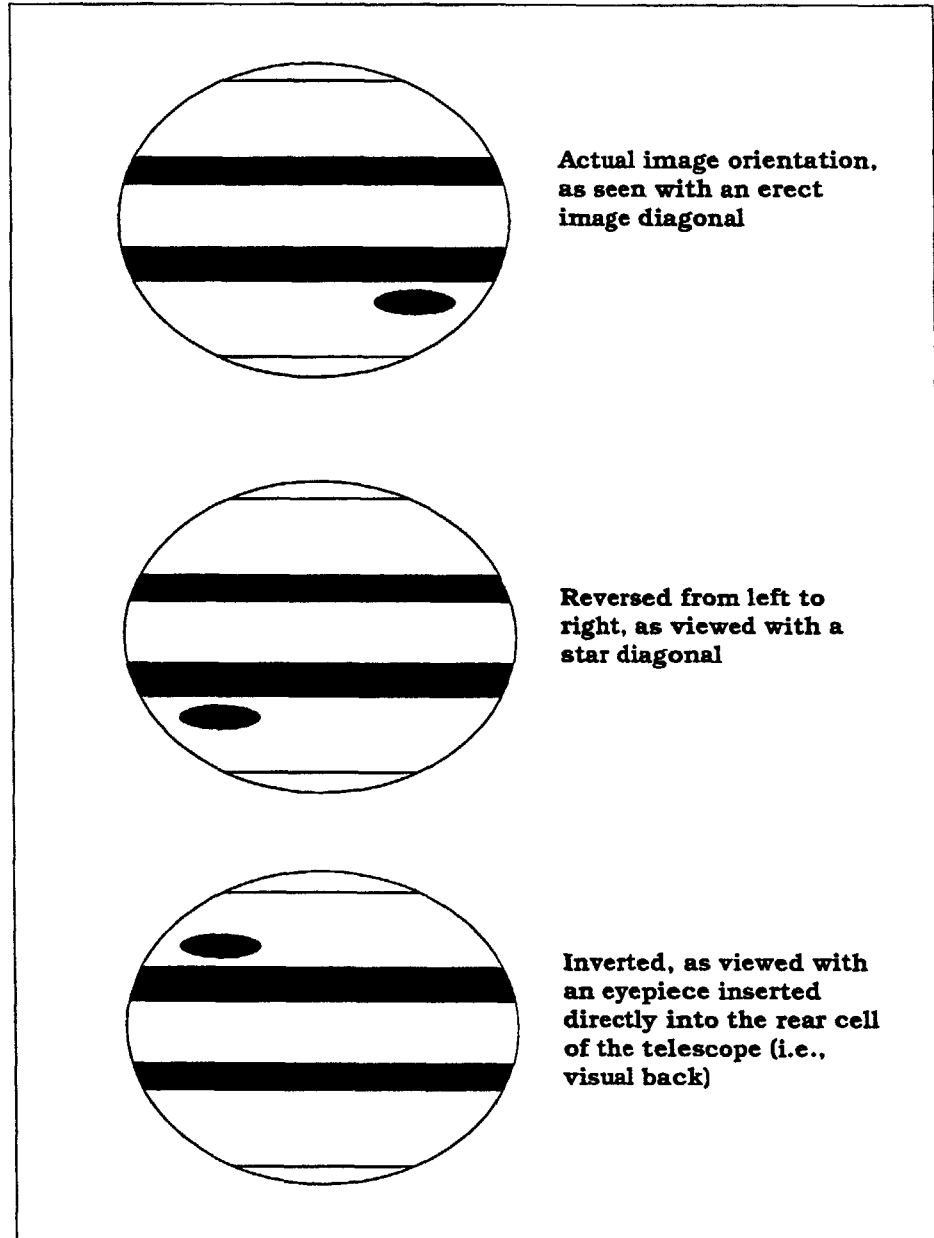


Figure 7-3

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

Focusing

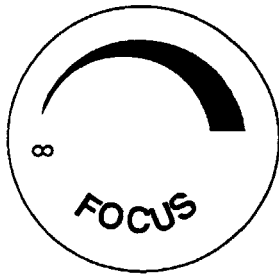


Figure 7-4

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

Each of the Celestron 8 telescopes uses the same focusing mechanism. The primary mirror is mounted on a ring which slides back and forth on the primary baffle tube (see figure 7-5). The focusing knob, which moves the primary mirror, is on the rear cell of the telescope. To focus, turn the focusing knob until the image is sharp. If the knob will not turn, it has reached the end of its travel on the focusing mechanism. Turn the knob in the opposite direction until the image is sharp. Once an image is in focus, turn the knob clockwise to focus on a closer object and counterclockwise for a more distant object (see figure 7-4). A single turn of the focusing knob moves the primary mirror only slightly. Therefore, it will take many turns (about 40) to go from close focus (approximately 25 feet) to infinity.

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

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

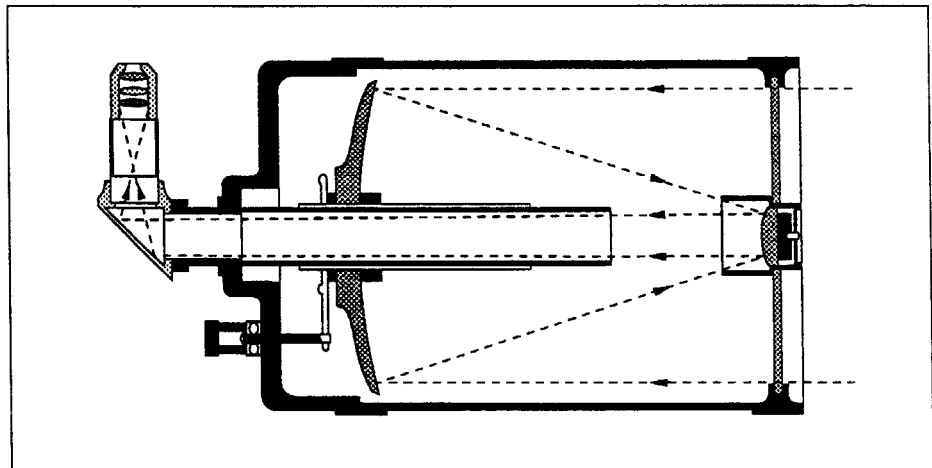


Figure 7-5

This diagram shows the focusing mechanism of the C8 telescopes.

Aligning the Finder

The Ultima 8 comes with an 7x50mm finder while the GP-C8, the C8*, the C8* Computerized, and the C8 Optical Tube Assembly come with a 6x30mm finder. The finder is designed to help you find objects that are easily overlooked in the main optics of the telescope. The first number used to describe the finder is the power. The second number is the diameter of the objective lens in millimeters. For example, the Ultima finder is 7x50 which means it is 7 power and has a 50mm objective lens. Incidentally, power is always compared to the unaided human eye. So, a 7 power finder magnifies images seven times more than the human eye.

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

1. Choose a conspicuous object that is over 500 yards away. This will eliminate any possible parallax effect.
2. Point your C8 at the target and center it in the main optics of the telescope.
3. Lock the R.A. and DEC clamps to hold the telescope in place.
4. Check the finder to see where the object is located in the field of view.
5. Adjust the screws on the finder bracket, tightening one while loosening another, until the cross hairs are centered on the target.
6. Tighten each screw an additional quarter of a turn until you are sure they will not come loose easily.

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

Your First Look

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

Daytime Observing

As mentioned in the introduction, your Celestron C8 telescope works well as a terrestrial spotting scope. When not used to examine objects in the night sky, it can be used to study objects here on Earth.

WARNING !

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

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

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

The optical tube assembly, when mounted on a photographic tripod, functions like an altazimuth telescope. Furthermore, the GP-C8, when removed from the mount, operates like the optical tube assembly.

Nighttime Observing

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

1. Orient the telescope so that the fork arms are pointing north, as close to true north as possible. You can use a landmark that you know faces north to get you in the general direction.
2. Adjust the wedge until the latitude indicator points to the latitude of your observing site.
3. Insert the eyepiece into the telescope to give you the widest field possible.
4. Turn the clock drive on and you are ready to observe.
5. Release the right ascension and declination clamps and point the telescope at the desired target. The Moon or one of the brighter planets is an ideal first target.
6. Locate the object in the finder.
7. Lock the R.A. and DEC clamps to hold the telescope in place.
8. Center the object in the finder using the slow motion controls.
9. Turn the focus knob until the image is sharp.
10. Take your time and study your subject. If looking at the Moon, look for small details in the craters.

That's all there is to using your Celestron C8 telescope. However, don't limit your view of an object to a single eyepiece. After a few minutes, try using a different optional eyepiece, a more powerful one. This gives you an idea of how the field of view changes.

Calculating Magnification

You can change the power of your Celestron C8 telescope just by changing the eyepiece (ocular). To determine the magnification for the C8, you would simply divide the focal length of the telescope (2000mm) by the focal length of the eyepiece that you are using. In equation format, the formula looks like this:

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

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

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

Determining Field of View

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

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

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

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

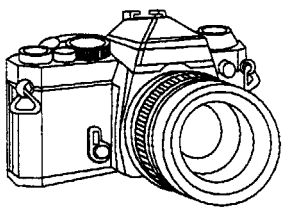
The apparent field of each eyepiece that Celestron manufacturers is found in the Celestron Accessory Catalog (#93685).

General Observing Hints

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

- Never look through window glass. Glass found in household windows is optically imperfect and, as a result, may vary in thickness from one part of a window to the next. This inconsistency can and will affect the ability to focus your telescope. In most cases you will not be able to achieve a truly sharp image. In some cases, you may actually see a double image.
- Never look across or over objects that are producing heat waves. This includes asphalt parking lots on hot summer days or building rooftops.
- Hazy skies, fog, and mist can also make it difficult to focus when viewing terrestrially. The amount of detail seen under these conditions is greatly reduced. Also, when photographing under these conditions, the processed film may come out a little grainier than normal with lower contrast.
- When using your C8 as a telephoto lens, the split screen or microprism focuser of the 35mm SLR camera may “black out.” This is common with all long focal length lenses. If this happens, use the ground glass portion of your focusing screen. To achieve a very sharp focus, consider using a focusing magnifier. These are readily available from your local camera store.
- If you wear corrective lenses (specifically glasses), you may want to remove them when observing with an eyepiece attached to your C8. When using a camera, however, you should always wear corrective lenses to ensure the sharpest possible focus. If you have astigmatism, corrective lenses should be worn at all times.

General Photography Hints



Your Celestron C8 can be used for both terrestrial and astronomical photography. Your C8 has a fixed aperture and, as a result, a fixed f /ratio. To properly expose your subjects photographically, you need to set your shutter speed accordingly. Most 35mm single lens reflex (SLR) cameras offer through-the-lens metering that lets you know if your picture is under or overexposed. This is important for terrestrial photography where exposure times are measured in fractions of a second. In astrophotography, the exposures are much longer, requiring that you use the “B” setting on your camera. The actual exposure time is determined by how long you keep the shutter open. More on this in the section on “Celestial Photography.”

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

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

The Celestial Coordinate System

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

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

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

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

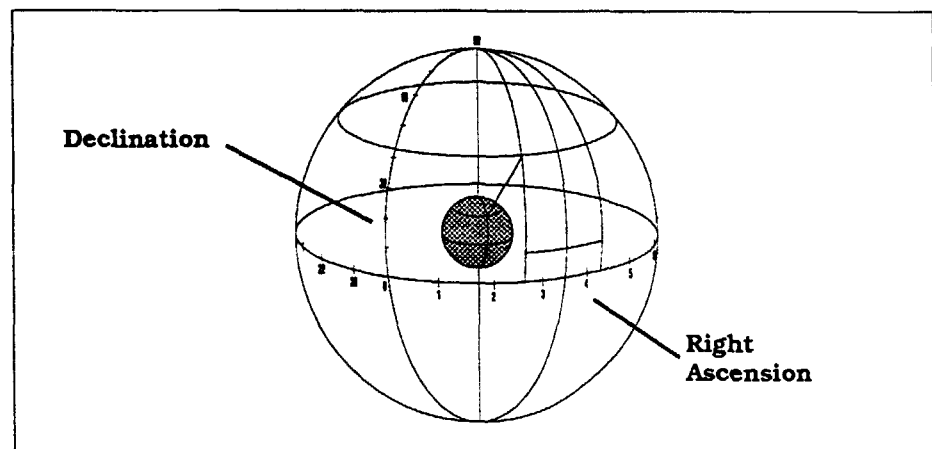


Figure 8-1

Motion of the Stars

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

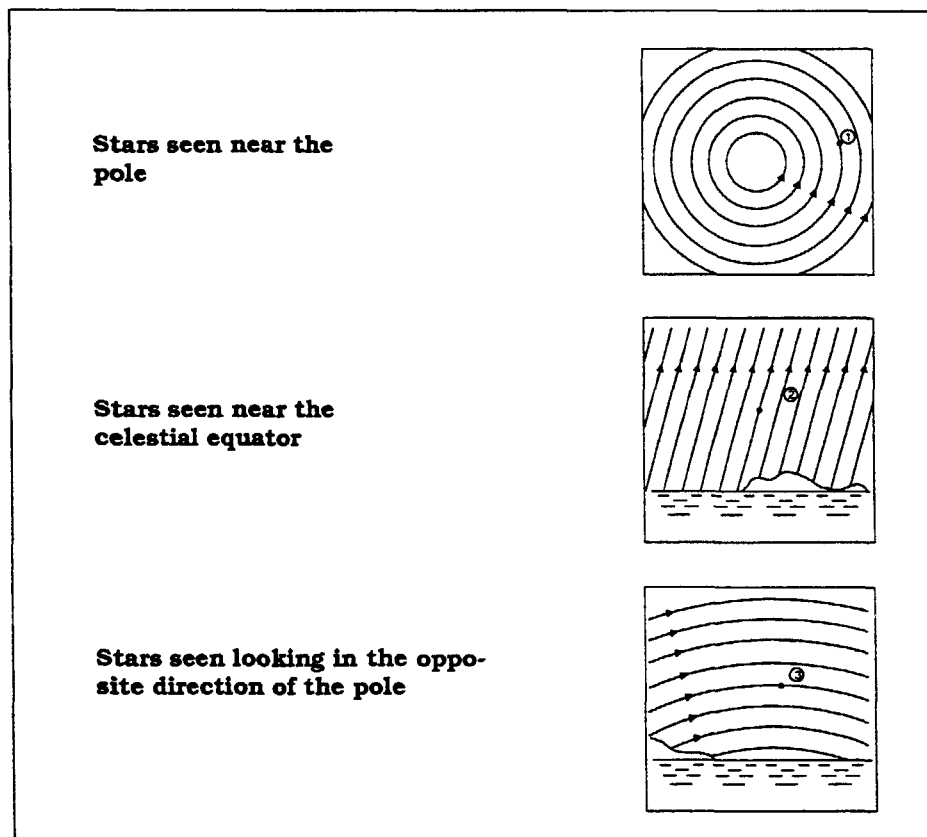


Figure 8-2

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

Polar Alignment

In order for the telescope to track the stars it must meet two criteria. First, you need a drive motor that will move at the same rate as the stars. The Ultima and C8+ have built-in drive motors designed specifically for this purpose. The GP-C8 can have optional drive motors fitted to it. The second thing you need is to set the telescope's axis of rotation so that it tracks in the right direction. Since the motion of the stars across the sky is caused by the Earth's rotation about its axis, the telescope's axis must be made parallel to the Earth's axis.

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

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

Definition:

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

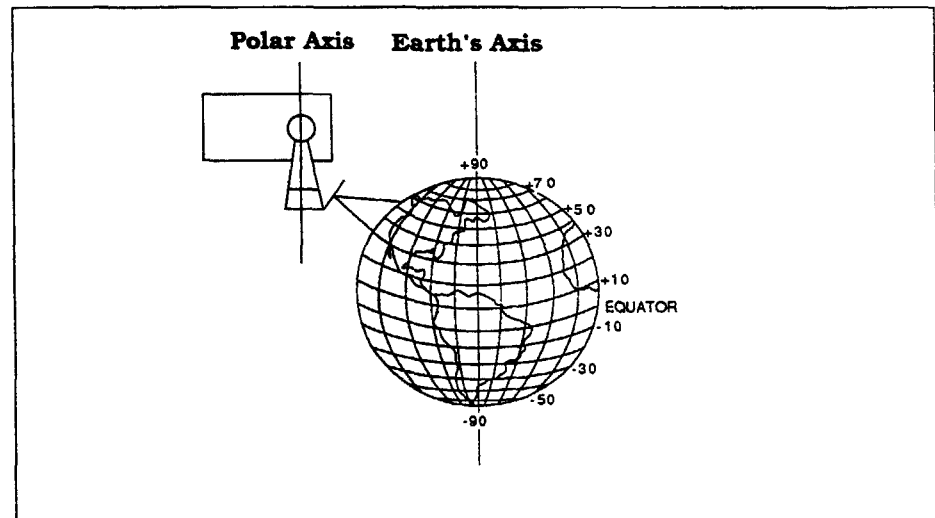


Figure 8-3

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

Finding the Pole

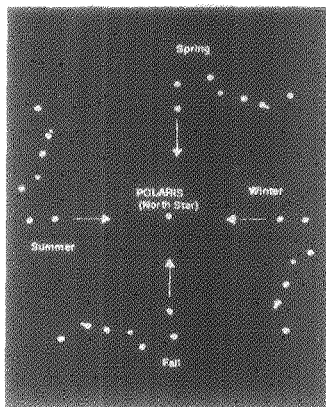


Figure 8-4

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

Definition:

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

Many of the methods of polar alignment require that you know how to find the celestial pole by identifying stars in the area. For those in the northern hemisphere, finding the celestial pole is relatively easy. Fortunately, we have a naked eye star less than a degree away. This star, Polaris, is the end star in the handle of the Little Dipper (see figure 8-5). Since the Little Dipper (technically called Ursa Minor) is not one of the brightest constellations in the sky, it may be difficult to locate, especially from urban areas. If this is the case, use the two end stars in the bowl of the Big Dipper. Draw an imaginary line through them (about five times the distance between these two stars) toward the Little Dipper. They will point to Polaris. The position of the Big Dipper will change during the year and throughout the course of the night (see figure 8-4). When the Big Dipper is difficult to locate, try using Cassiopeia.

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

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

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

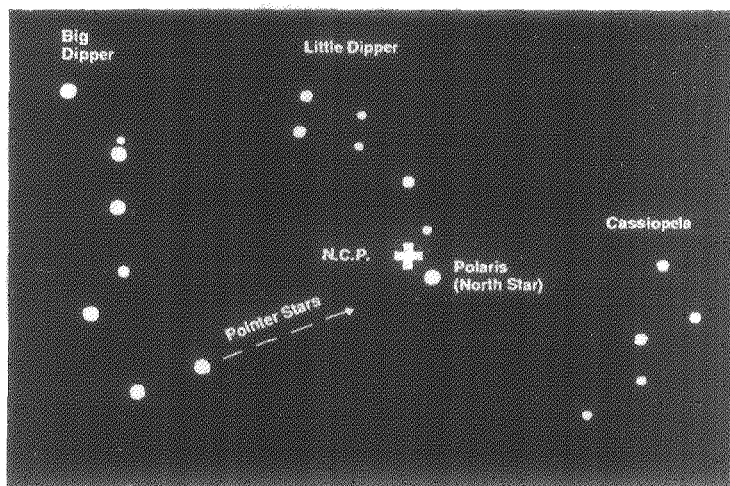


Figure 8-5

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 Scales

The easiest way to polar align a telescope is with a latitude scale. Unlike other methods that require you to find the celestial pole by identifying certain stars near it, this method works off of a known constant to determine how high the polar axis should be pointed. The latitude range varies depending upon the C8 you own. The range is 45° for the C8+, 90° for the Ultima and 50° for the GP mount.

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

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

1. Point your telescope due north. Use a landmark that you know faces north.
2. Level the tripod by raising or lowering the legs as needed. There is a bubble level built into the wedge (or tripod for GP mounts) for this purpose.
3. Adjust the telescope mount in altitude until the latitude indicator points to your latitude. (For specific information on adjusting the equatorial head, see the section "Adjusting the Wedge" or "Adjusting the Mount" for your particular telescope.)

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

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

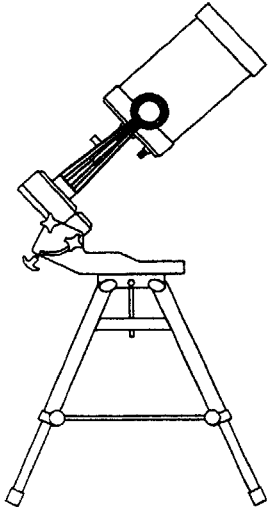


Figure 8-6

1. Set the telescope up so that the polar axis is pointing north.
2. Release the DEC clamp and move the telescope so that the optical tube is parallel to the fork tines (i.e., polar axis). When this is done the declination setting circle will read $+90^\circ$. If the declination setting circle is not aligned, move the telescope so that the tube is parallel to the fork tines (see figure 8-6). (If the DEC circle is not aligned, please see the instructions on "Aligning the Declination Setting Circle.")
3. Move the mount in altitude and/or azimuth until Polaris is in the field of view of the finder. Rough adjustments in azimuth can be made by moving the tripod (see figure 8-7).
4. Center Polaris using the fine altitude and azimuth controls. Remember, do not move the telescope in R.A. or DEC. You want to adjust the direction the mount is pointing and you are using the telescope to see where the mount is pointing.

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

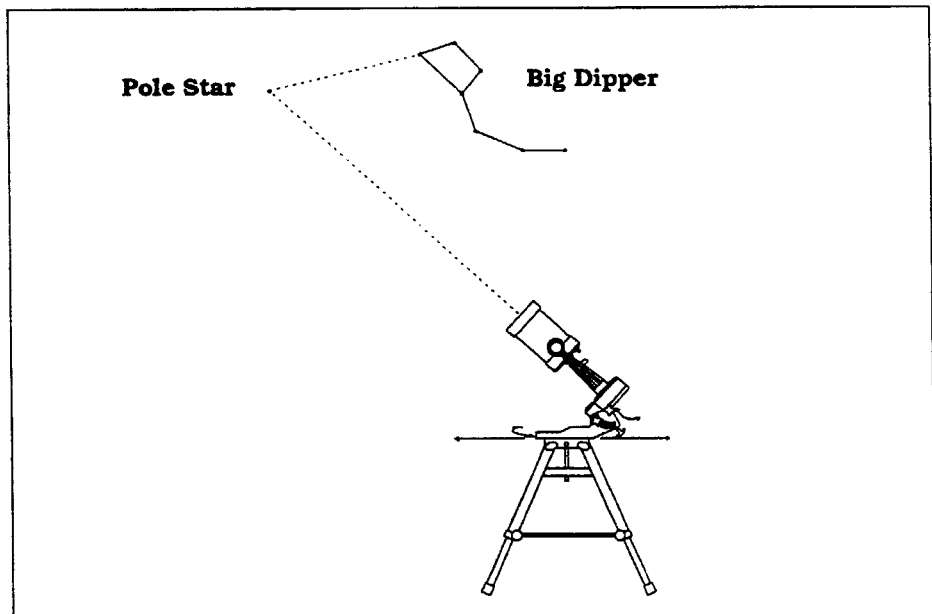


Figure 8-7

It might appear that pointing at the pole produces a parallax effect thus skewing the telescope's axis of rotation with that of the Earth's. Polaris, however, is over 50 light years away, thus making any parallax effect negligible. (One light year is 5.9 trillion miles. To find the distance to Polaris in miles, multiply 6.4 trillion by 50!)

Declination Drift

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

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

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

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

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

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

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

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

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

Polar Alignment Finders

There are two finders specifically designed for polar alignment that can be used with the Celestron 8 telescopes. The first finder, known as the 7x50 Polaris finder, is used as a regular finder. This finder can be purchased as an optional accessory for the GP-C8, C8*, and C8* Computerized.

The second polar alignment finder is standard with the GP-C8 and is built into the polar shaft (i.e., axis) of the mount. Its sole purpose is polar alignment and can NOT be used to find objects in the telescope. Both these finders work on the same principle, but their methods of operation are slightly different. These methods are generally easier than those already described and they are fairly accurate.

The 7x50mm Polaris Finder

Built into the Polaris finder is a reticle with a single cross hair and two circles which will be used for polar alignment. The inner circle is approximately 4/5 of a degree in radius, roughly the distance between Polaris and the celestial pole. In order to use the 7x50 Polaris finder, you will need two optional parts. The first is the illuminator (#51614-IL) which, among other things, illuminates the cross hairs of the finder. When not used for that purpose, it can be used as a map light. The second thing you are going to need is a Polaris setting plate (#60121). This little accessory indicates the position of Polaris relative to the celestial pole. Prior to using the finder for polar alignment, it must be aligned with the telescope. To polar align:

1. Wait until it is dark enough to see Polaris with the naked eye. Remember, Polaris is the last star in the handle of the Little Dipper.
2. Release the declination clamp and move the telescope until the setting circle reads +90°.
3. Tighten the clamps to hold the telescope in place on the mount.
4. Move the telescope, with the tripod attached, until it is pointing in the general direction of Polaris.

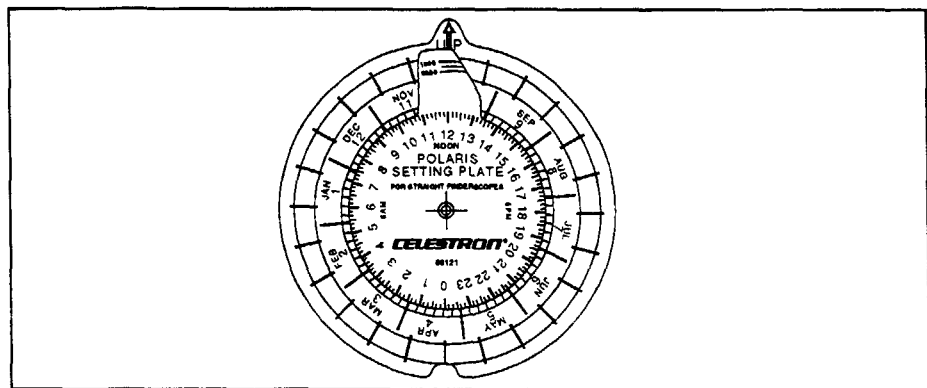


Figure 8-8

The Polaris Setting Plate indicates the position of Polaris relative to the celestial pole as seen through the Polaris finder. The center of the Polaris Setting Plate corresponds to the celestial pole while the slanted tab corresponds to the position of Polaris. The plate currently indicates the position of Polaris at 10:00 PM on December 21.

5. Hold the Polaris setting plate alongside the telescope. The edge with the arrow should point up, away from the northern horizon.
6. Rotate the inner circle, which is a graduated hour circle, until your current local time corresponds to the proper date on the outer circle. If this is done during daylight savings time, subtract one hour. The time is listed as a 24 hour clock (i.e., 6:00 PM is 1800 hours, etc.). The date circle lists the months numerically (i.e., January is 1, February is 2, etc.) and there is an indicator for every fifth day. Once this is done, the position of Polaris relative to the celestial pole is indicated by the slanted tab that extends out into the month circle. The numbers 1990 and 2000 show the position of Polaris in 1990 and 2000, respectively.
7. With the position provided by the Polaris setting plate, you are now ready to polar align your telescope. The outer portion of the month circle (i.e., the two concentric circles) looks exactly like the reticle in the finder. While looking through the finder, move the telescope mount in altitude and azimuth (i.e., vertically and horizontally) until Polaris is in the same position on the reticle as indicated on the Polaris Setting Plate. Remember, do NOT move the telescope in R.A. or DEC.

Once this is done, your telescope is properly polar aligned and ready for use.

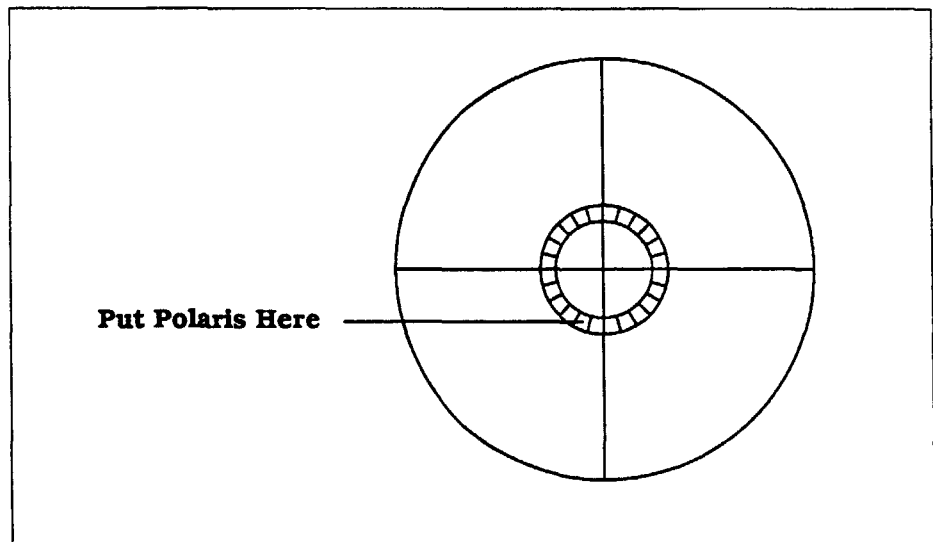


Figure 8-9

GP-C8 Polar Axis Finder

With the GP-C8 set up and ready for use, you can polar align the telescope using the built-in polar axis finder. First, familiarize yourself with the three different scales at the eyepiece end on the polar axis finder. The first one, which runs all the way around the mount, is the R.A. setting circle. This is used as a time scale during polar alignment. Next to the time circle is the date circle listing the months numerically 1 (January) to 12 (December). The longest mark indicates the last day of the preceding month. Medium tick marks show every tenth day, while the shortest tick marks show every other day. The distance between the last short tick and the longest (which shows the last day of the previous month) will vary depending on how many days are in the month. On the inside of the date circle is the meridian offset scale. This allows you to indicate how far, east or west, you are from the closest standard time meridian. All you have to do is line up the circles and the reticle inside the polar axis finder will show you the exact position of Polaris relative to the celestial pole.

In addition to northern hemisphere alignment, the polar axis finder contains a reticle for southern hemisphere alignment. The process for southern hemisphere alignment is different from that of the north and is considered separately.

Using Your Polar Axis Finder in the Northern Hemisphere

Before utilizing this method you need to know the longitude of your observing site. This information can be obtained from a map of the area. Once you know your longitude, find the difference between that and the closest time meridian. The standard time meridians are 75, 90, 105 and 120 degrees for the continental United States and 150 and 165 degrees for Alaska and Hawaii. (Generally, the central longitude lines for each time zone are multiples of 15.) The difference between your longitude and the standard meridian for your zone will be set on the time meridian offset scale. Let's take an example to make more sense out of this. Say you are observing at 85 degrees 0 minutes longitude. This is exactly 5 degrees east of the 90 degree standard time meridian. Armed with this information, you are ready to polar align.

1. Level the mount by adjusting the tripod legs. There is a bubble level built into the mount to indicate the level position.
2. Install the illuminator into the mount and turn it on.
3. Release the DEC clamp and move the telescope until the DEC setting circle reads -10 degrees. This allows you to see through the polar axis.
4. Look through the eyepiece and make sure the reticle is sharp. If not, turn the diopter to focus the reticle.
5. Rotate the setting circle (by hand) until the 0 hour mark lines up with the vernier indicator on the mount.
6. Turn the date circle (by hand) until the time meridian indicator points to 5 degrees east. The 5 degrees comes from the example mentioned above.

7. Release the R.A. clamp and rotate the telescope until the date circle matches the R.A. setting circle for the exact time you are polar aligning. For polar alignment, the times on the setting circle equate to the time of the day. 600 hours is 6:00 AM while 1800 hours is 6:00 PM. As you rotate the telescope in R.A. the date circle will move with the telescope. If this is done during daylight savings time, subtract one hour.
8. Lock the R.A. clamp to hold the telescope in place.
9. Look through the polar axis finder and the small circle will indicate the correct position of Polaris relative to the celestial pole.
10. Adjust the mount in altitude and azimuth until Polaris is in the small circle on the straight line (see figure 8-11).

Once in the small circle, you have achieved an accurate polar alignment. If you have the optional drive motors, you can do prime focus astrophotography for long periods of time.

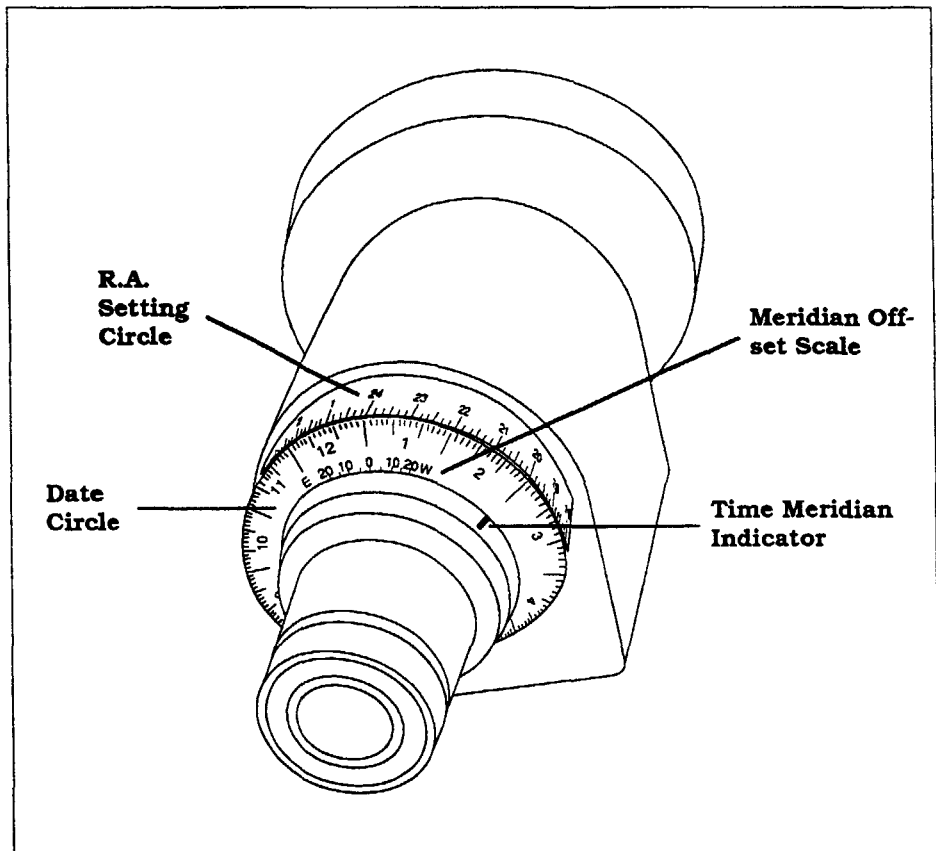


Figure 8-10

The three scales used in conjunction with the polar axis finder are the time circle, the date circle, and the time meridian offset scale.

Using Your Polar Axis Finder in the Southern Hemisphere

As mentioned earlier, the polar axis finder also contains a reticle for the southern hemisphere. The reticle shows the relative positions of four stars near the south celestial pole. The stars are Sigma (σ), Tau (τ), Chi (χ), and Upsilon (υ) Octantis. Here's how to use it.

1. Release the DEC clamp and move the telescope until the DEC setting circle reads -10° . This allows you to see through the polar axis.
2. Point the polar axis of the mount toward the south celestial pole.
3. Adjust the mount in altitude and azimuth until the four stars mentioned above are in the field of view.
4. Rotate the polar alignment reticle until the orientation of the four circles match the orientation of the four stars. The polar alignment reticle is rotated by moving the telescope in right ascension.
5. Adjust the mount in altitude and azimuth until each star is in the respective circle on the reticle. (Ignore the Polaris circle.)

NOTE:

There are four other stars that form a similar asterism (i.e., arrangement). Make sure you have the four described above.

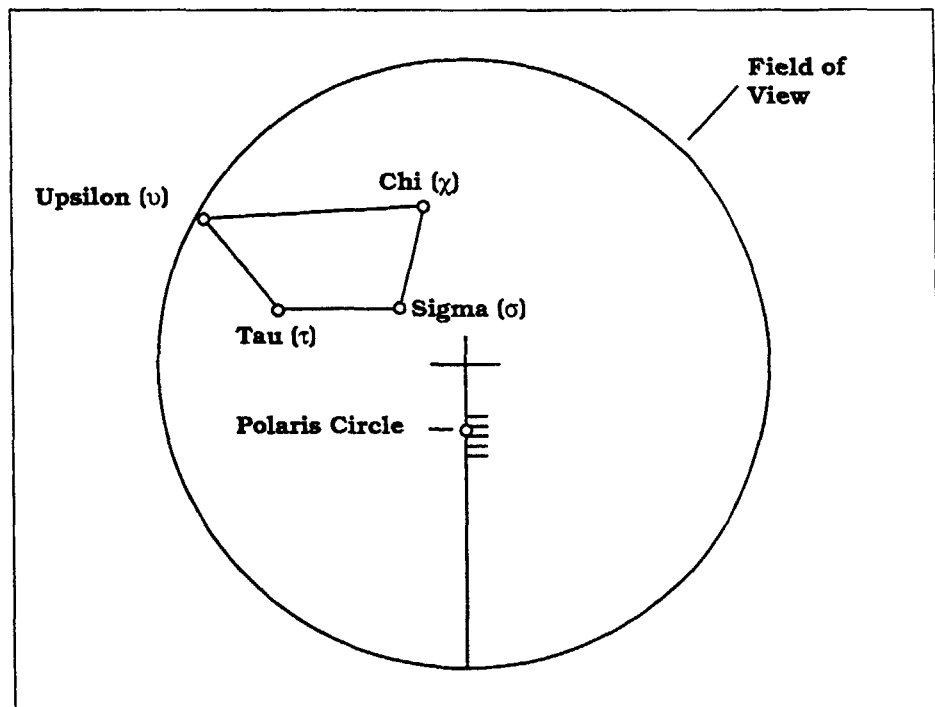


Figure 8-11

The reticle of the polar axis finder is designed for use in the northern and southern hemispheres. The straight line with the small circle is for the northern hemisphere while the four small circles are for the southern hemisphere. The star names for the southern hemisphere reticle are shown on the illustration but not on the reticle itself.

Calibration

The polar axis finder is installed and calibrated at the factory. If the adjustment screws are loosened or if the mount is jarred severely, the polar axis finder may have to be recalibrated. Calibrating the polar axis finder is a two-step process. First, the small circle which indicates the proper position of Polaris relative to the pole must be aligned. Second, the optical axis of the finder must be made parallel to the rotational (R.A.) axis of the mount.

Calibrating the Polaris Indicating Circle

Start by calibrating the position of the Polaris indicating circle. First, to see through the polar axis finder, you must release the DEC clamp and rotate the telescope until the DEC circle reads -10° . If you do not do this, the polar axis will be blocked and, as a result, the polar axis finder can NOT be used.

1. Release the R.A. clamp and rotate the telescope until the small circle is directly below the point where the two lines intersect at the center of the field. (Ignore the southern hemisphere reticle.)
2. Turn the date circle until October 10th lines up with 1:00 AM on the time circle. (At this time on this date Polaris is at upper culmination, that is, directly above the pole. Since the image in the finder is inverted, the small circle is placed below the cross hairs.)
3. Loosen the set screw that secures the ring with the time meridian indicator.
4. Turn the ring until the time meridian indicator points to the "0" mark on the time meridian offset scale.
5. Tighten the set screw and the circle is correctly calibrated to indicate the position of Polaris relative to the celestial pole.

Aligning the Optical Axis

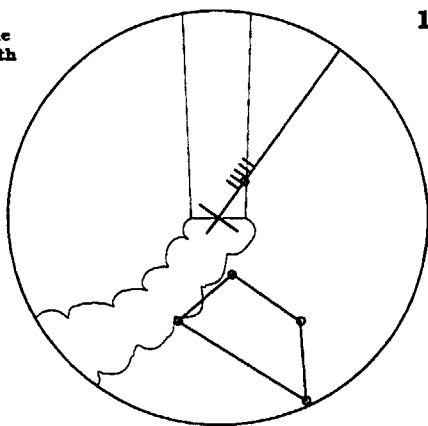
Misalignment of the optical axis means that the polar axis finder is pointing in a different direction than the polar axis. If this is the case, the optical axis needs to be aligned with the mechanical axis in order for the finder to work properly.

Before calibrating the optical axis, remove the telescope, the counterweights, and the counterweight bar from the mount. To align the optical axis of the finder:

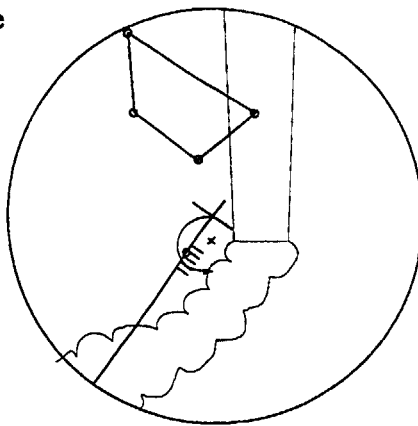
1. Release the R.A. clamp and rotate the telescope platform until it is on the right side of the mount.
2. Find an object in excess of one mile away and center it on the cross hairs of the polar axis finder. To do this, you must adjust the mount in altitude and azimuth.
3. Release the R.A. clamp again and rotate the mount so that the telescope platform is on the left side of the mount. The object originally seen at the intersection of the cross hairs will, most likely, have moved off center. The point where the two lines intersect (center of the optical axis) will scribe a semicircle around the point where the mechanical axis is pointing (see figure 8-12).
4. Determine how far and in what direction the optical axis moved from the mechanical axis.
5. Locate the three set screws on the polar axis finder that move the optical axis. They are 120 degrees apart and are close to the knurled focusing ring.
6. Move the optical axis of the polar axis finder (point where the two lines intersect) toward the point where the mechanical axis is pointing by turning the set screws on the polar axis finder. Keep in mind that the image in the finder is inverted and, as a result, it may take a few minutes to familiarize yourself with the screws that move the finder in the appropriate direction.
7. Repeat this process until the optical axis of the finder is centered on the rotational axis of the mount.

When finished, tilt the mount to your correct latitude and re-install the optical tube, counterweight bar, and counterweights.

Bring an object to the center using the altitude and azimuth adjustment screws.

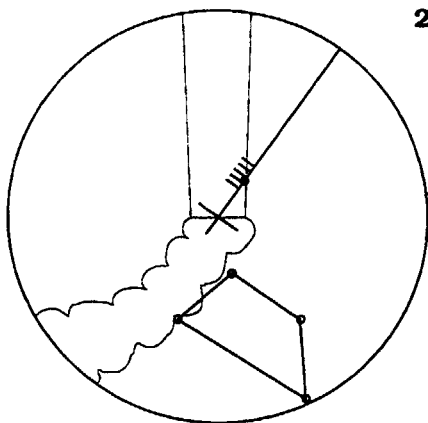


1st time

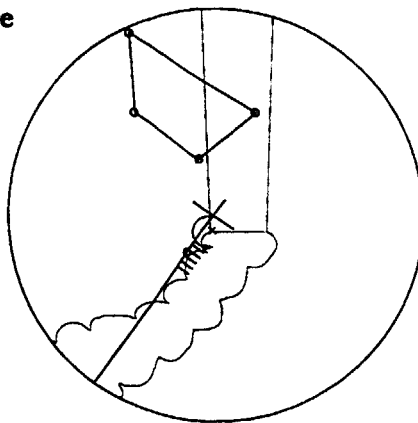


Adjust the set screws that control the optical axis of the polar axis finder to bring the cross hairs over the 'x'.

Use the fine adjustment screws to center the object again.

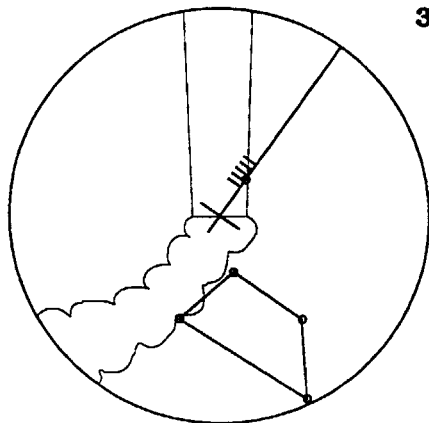


2nd time

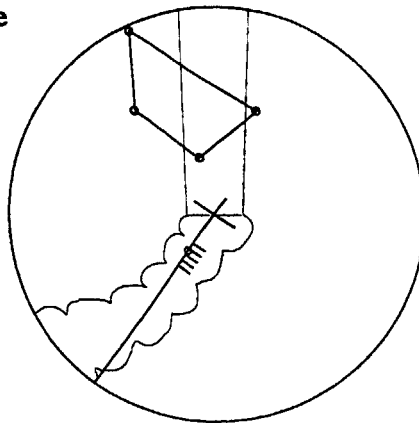


Adjust the set screws that control the optical axis of the polar axis finder to bring the cross hairs over the 'x'.

Use the fine adjustment screws to center the object again.



3rd time



Done.

Figure 8-12

The optical axis is aligned by rotating the mount 180° in right ascension while looking at a distant object through the polar axis finder. When properly aligned, the object on the cross hairs remains centered while rotating the mount. The three calibration screws are located on the polar axis finder eyepiece. While this illustration shows it being done in three steps, it may actually take many more.

Aligning the R.A. Setting Circle

Before you can use the setting circles to find objects in the sky you need to align the R.A. setting circle. The declination setting circle is aligned during the polar alignment process. In order to align the R.A. setting circle you will need to know the names of a few of the brightest stars in the sky (see figure 8-13). If you don't, they can be learned by using the Celestron Sky Maps (#93722) or consulting a current astronomy magazine. To align the R.A. setting circle:

1. Locate a bright star near the celestial equator. The farther you are from the celestial pole the better your reading on the R.A. setting circle will be. The star you choose to align the setting circle with should be a bright one whose coordinates are known and easy to look up. (For a list of bright stars to align the R.A. setting circle, see the list at the back of this manual.)
2. Center the star in the finder.
3. Look through the main telescope and see if the star is in the field. If not, find it and center it.
4. Start the clock drive so that it will track the star.
5. Look up the coordinates of the star.
6. Rotate the circle until the proper coordinates line up with the R.A. indicator (the zero mark on the vernier scale). The R.A. setting circle should rotate freely.

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

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

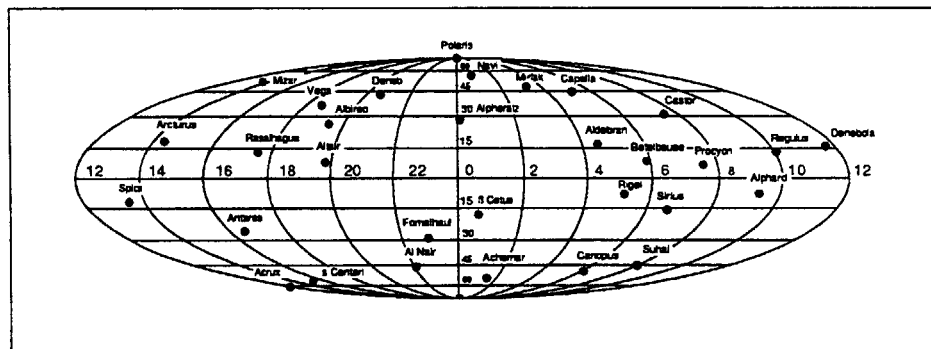


Figure 8-13

Adjusting the DEC Setting Circle

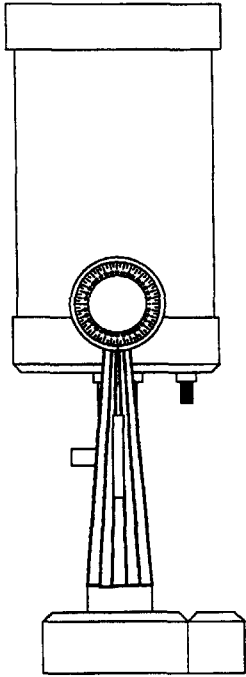


Figure 8-14

The declination setting circle is calibrated at the Celestron factory and, as mentioned previously, the process of polar alignment then correctly sets it for astronomical use. However, the DEC setting circle on the fork mounted C8 telescopes may slip and, as a result, need to be recalibrated or aligned. To align the DEC setting circle:

1. Place your telescope base (without wedge) on a flat, level surface. Verify that the surface is flat by using a bubble level.
2. Place the bubble level across the base of the drive unit to determine if the telescope is sitting perfectly flat. If not, shim the base until it is flat.
3. Release the DEC clamp and rotate the telescope tube until it is pointing straight up (see figure 8-14). To ensure that it is pointed straight up, place the bubble level across the front cell of the telescope.
4. Lock the declination clamp to hold the telescope in place.
5. Pry the cover off of the center of the DEC setting circle. Inside you will notice a hex head screw. Use the appropriate Allen wrench to loosen the screw. On the C8*, and the C8* Computerized, simply loosen the Phillips screw at the center of the DEC setting circle.
6. Rotate the declination setting circle until it indicates 90°. Since the circle is NOT labeled as to the plus or minus, it makes no difference which one of the 90° marks you use.
7. Tighten the hex head screw in the center of the DEC setting circle. Hold the DEC setting circle in place while tightening the screw to prevent the setting circle from slipping.
8. Replace the cover on the DEC circle.

A faster but less accurate method would be simply to make the tube parallel to the fork tines just by looking at the scope. This can be done with the telescope on or off the wedge.

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 great 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 if using the lunar tracking rate. Consult your local newspaper or a current astronomy magazine to find out when the Moon is visible.

LUNAR OBSERVING HINTS

- For telescopes with the PEC drive, select the lunar rate to ensure accurate tracking.
- To increase contrast and bring out detail on the lunar surface, use filters. A yellow filter works well at improving contrast.

Observing the Planets

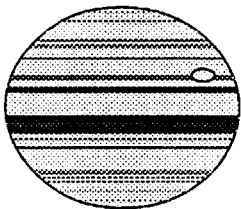


Figure 9-1

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

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 this gas giant. 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

- For telescopes with the PEC drive, select King or sidereal rates for accurate tracking of the planets
- To increase contrast and bring out detail on the planetary surfaces, 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.

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

For safe solar viewing, use a Celestron solar filter (#94162). This filter reduces the light intensity making the Sun 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 finder when observing the Sun. This will ensure that the finder itself is not damaged and that no one looks through it inadvertently.

SOLAR OBSERVING HINTS

- The best time to observe the Sun is in the early morning or late afternoon when the air is cooler.
- To locate the Sun without a finder, watch the shadow of the telescope tube until it forms a circular shadow.
- For telescopes with the PEC drive, select the solar rate to ensure accurate tracking.

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 star 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 setting circles are aligned, you can use them to find any objects with known coordinates.

1. Select an object to observe. Use a seasonal star chart or planisphere to make sure the object you chose is above the horizon. As you become more familiar with the night sky, this will no longer be necessary.
2. Look up the object's coordinates in an atlas or reference book.
3. Move the telescope in declination until the indicator points at the correct declination coordinate.
4. Move the telescope in R.A. until the indicator points to the correct coordinate (do NOT move the R.A. circle).
5. Look through the finder to see if you have located the object.
6. Center the object in the finder.
7. Look in the telescope 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.
8. Repeat the process for each object observed throughout the observing session.

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

The declination setting circle is scaled in degrees while the R.A. setting circle is incremented in minutes with a marker every 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 Celestron C8 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).
2. Start at the star in the northeast corner — Alpha (α) Andromedae.
3. Move northeast approximately 7° . There you will find two stars of equal brightness — Delta (δ) and Pi (π) Andromedae — about 3° apart.
4. Continue in the same direction another 8° . There you will find two stars — Beta (β) and Mu (μ) Andromedae — also about 3° apart.
5. Move 3° northwest — the same distance between the two stars — to the Andromeda galaxy. It is easily visible in the finder.

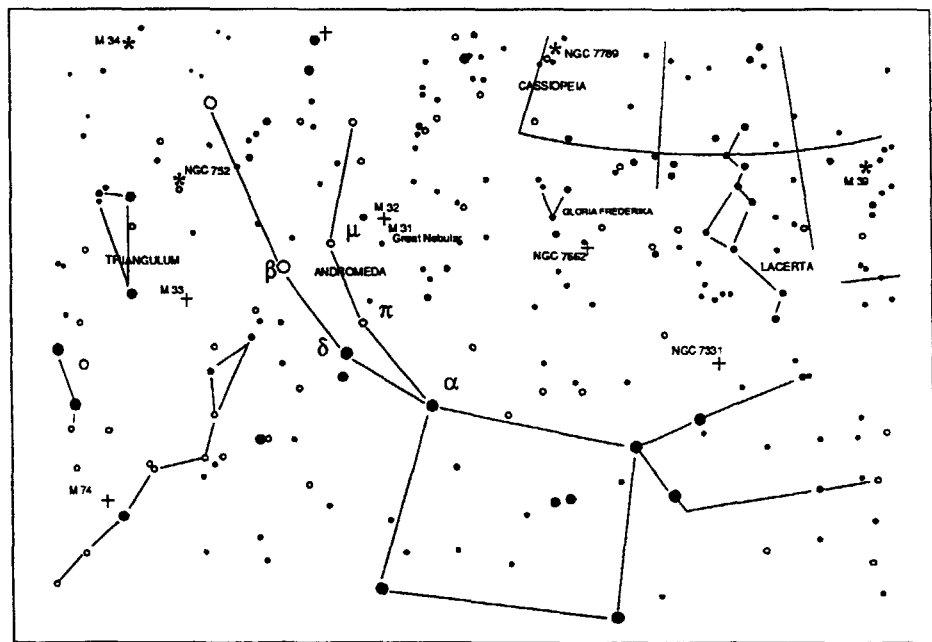


Figure 9-2

Star hopping to the Andromeda Galaxy 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 only 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. Furthermore, some objects are not visible in the finder. One such object is M57, the famed Ring Nebula. Here's how to find it:

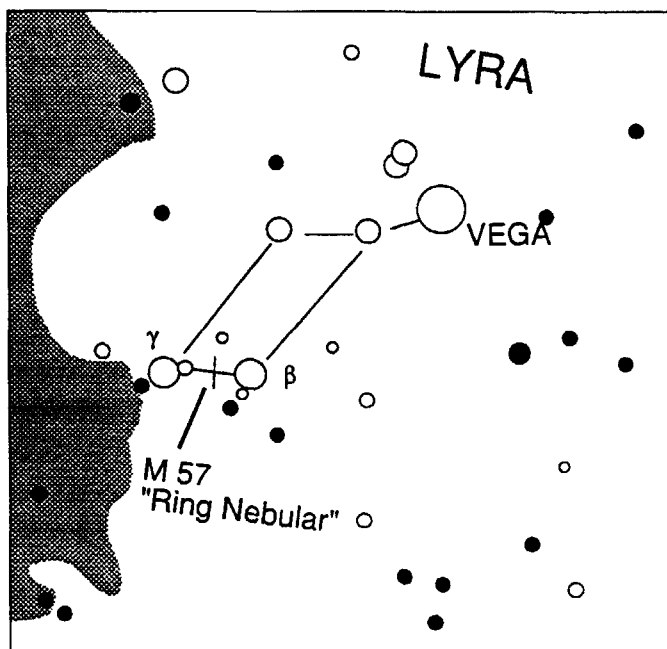
1. Find the constellation of Lyra, a small parallelogram visible in the summer and fall months. Lyra is easy to pick out because it contains the bright star Vega.
2. Start at the star Vega — Alpha (α) Lyrae — and move a few degrees southeast to find the parallelogram. The four stars that make up this geometric shape are all similar in brightness making them easy to see.
3. Locate the two southern most stars that make up the parallelogram — Beta (β) and Gamma (γ) Lyrae (see figure 10-3).
4. Point the finder half way between these two stars.
5. Move about $1/2^\circ$ toward Beta (β) Lyrae, but remaining on a line that connects the two stars.
6. Look through the telescope and the Ring Nebula should be in the telescope. Its angular size is quite small and, therefore, not visible in the finder.

Because the Ring Nebula is rather faint, it is best observed with averted vision. 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 in 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.

Figure 9-3

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



Viewing Conditions

Viewing conditions affect what you can see through your C8 telescope during an observing session. Conditions include transparency, sky illumination, and seeing. Understanding viewing conditions and the affect they have on observing will help you get the most out of your C8.

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 affect 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 refer to the stability of the atmosphere and directly effects the clarity of star images and the amount of fine detail seen in extended objects. Our atmosphere acts like 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 9-4). 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. When pointing the telescope, hold the C8 by the visual back and diagonal. If observing with others, make sure no one stands in front of or directly below the telescope tube.

The images produced by Type 2 seeing conditions don't move as quickly as those produced by Type 1 conditions, but the images are quite blurry. Fine detail is lost and the contrast is low for extended objects. Stars are spread out and not sharp. The source of Type 2 seeing is the lower atmosphere, most likely heat waves from the ground or buildings. To avoid the problems associated with Type 2 seeing, select a good observing site. Look for broad hilltops 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 ploughed 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.



Figure 9-4

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

CELESTIAL PHOTOGRAPHY

After looking at the night sky for awhile you may want to try photographing it. Several forms of celestial photography are possible with your Celestron C8 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 need 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 and some still do.

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

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) and a T-Ring for your specific camera (e.g., Minolta, Nikon, Pentax, etc.). The T-Ring replaces the 35mm SLR camera's normal lens. Prime focus photography allows you to capture the entire lunar disk or solar disk (if using the proper filter). To attach your camera to your C8 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 C8 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 C8 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 10-1).
5. Trip the shutter using a cable release.
6. Advance the film and repeat the process.

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

Table 10-1

Above is a listing of recommended exposure times when photographing the Moon at the prime focus of your Celestron C8 telescope.

The exposure times listed in table 10-1 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 help ensure that you will get a good photo. If using black and white film, try a yellow filter to reduce the light intensity and to increase contrast.

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

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

Piggyback

The easiest way to enter the realm of deep-sky, long exposure astrophotography is via the piggyback method. Piggyback photography is done with a camera and its normal lens riding on top of the telescope. Through piggyback photography you can capture entire constellations and record large scale nebulae that are too big for prime focus photography. Because you are photographing with a low power lens and guiding with a high power telescope, the margin for error is very large. Small mistakes made while guiding the telescope will not show up on film. To attach the camera to the telescope, use the piggyback mount (#93598). The GP-C8 comes standard with a piggyback mount. For the GP-C8 you will also need the optional motor drive. All other C8 telescopes come standard with a motor drive.

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. Attach the camera with a normal or wide angle lens to the piggyback mount.
4. Set the f /ratio of your camera lens so that it is a half stop to one full stop down from completely open.
5. Set the shutter speed to the "B" setting and focus the lens to the infinity setting.
6. Locate the area of the sky that you want to photograph and move the telescope so that it points in that direction.
7. 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.
8. Lock open the shutter using a cable release.
9. Monitor your guide star for the duration of the exposure making the necessary corrections needed to keep the star centered.
10. 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 50 to 500mm for lenses designed for 35mm cameras.

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

- Ektar 1000 (color print)
- Konica 3200 (color print)
- Fujichrome 1600D (color slide)
- 3M 1000 (color slide)
- 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.

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 (e.g., 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 table 10-2).
7. Replace the black card over the front of the telescope.
8. Close the camera's shutter.

Advance the film and you are ready for your next exposure. Don't forget to take photos of varying duration and keep accurate records of what you have done. Record the date, telescope, exposure duration, eyepiece, f/ratio, film, and some comments on the seeing conditions.

The following table lists exposures for eyepiece projection with a 10mm eyepiece. All exposure times are listed in seconds or fractions of a second.

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

Table 10-2

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 help 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

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 Celestron C8 telescope. The brightness of these objects, however, requires long exposure times and, as a result, are rather difficult to record.

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) 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 a 6mm guiding eyepiece (#93324). Here is a brief summary of the technique.

1. Polar align the telescope using the declination drift method.
2. Remove all visual accessories.
3. Thread the Radial Guider onto your Celestron C8.
4. Thread the Multi Function Focal Tester-55 onto the back of your C8 and focus the telescope on a star using a focusing aid.
5. Thread the T-Ring onto the Radial Guider.
6. Mount your camera body onto the T-Ring the same as you would any other lens.
7. Set the shutter speed to the "B" setting.
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. Lock open the shutter using a cable release.
11. Monitor your guide star for the duration of the exposure making the necessary adjustments to keep it centered.
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.

TELESCOPE MAINTENANCE

While your C8 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 C8 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 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 C8 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. The optional Dew Cap/Lens Shade (#94017) helps reduce the amount of dew build up on the corrector plate.

If moisture condenses on the inside of the corrector, place the telescope in a dust-free environment. 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 C8 telescope is directly related to its collimation. Your C8 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.

Definition:

Collimation is the alignment of the optical elements. In the Schmidt-Cassegrain optical system used in the C8, this is the alignment of the primary and secondary mirrors.

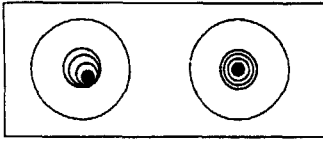


Figure 11-1

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

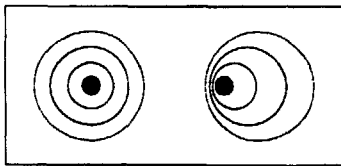


Figure 11-2

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

To check the collimation of your telescope you 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 don't have to manually track the star. Or, if you are not using the clock drive, use Polaris. Its 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.

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

To accomplish this, you need to tighten the secondary collimation screw(s) that move the star across the field toward the direction of the skewed light (see figure 11-1). Make only a small field correction — 1/6 to 1/8 of the field. Making these corrections will move the star off center. So, before making any more adjustments, center the star by moving the telescope in right ascension and declination. Then once the star is centered, continue adjusting the secondary mirror. Repeat this process until the image is symmetrical.

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 11-2), not the out-of-focus image. 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.

NOTE:

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

OPTIONAL ACCESSORIES

The following is a list of optional accessories that can be used with your Celestron 8. Certain accessories are confined to the use of one particular Celestron 8 model. The first section lists all the accessories that are common to all models. After that, all accessories are grouped by the scope with which they can be used.

Accessory Case (#93500) - This rugged ABS plastic case is designed for carrying a few accessories. Inside is foam padding that is die cut to 1x1 inch squares. These squares can be removed to accommodate accessories with a custom fit.

Advanced Astro Master (#93900) - 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 now 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 C8 fork mounts is #93911 while the hardware kit for the Great Polaris mount is #93913. This accessory is standard equipment with the C8+ Computerized unit.

Barlow Lenses - 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.

Dew Cap/Lens Shade (#94017) - 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.

Erect Image Diagonal (#94112-A) - For daytime terrestrial viewing, the Erect Image Diagonal produces images through your C8 that match what you see with the unaided eye. This accessory uses an Amici prism arrangement that, in addition to producing correctly oriented images, allows you to look into the telescope at a 45° angle, a desirable arrangement for terrestrial viewing.

Eyepieces - 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 three different eyepiece designs available.

- **Plössl** - Plössl eyepieces have a 4-element lens designed for low-to-high power observing. The Plössls offer razor sharp views across the entire field, even at the edges! In the 1-1/4" barrel diameter, they are available in the following focal lengths: 7.5mm, 10mm, 17mm, 26mm, and 40mm.
- **Ultima** - 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. In the 2" design, Celestron offers 45mm, 60mm, and 80mm.
- **Lanthanum Eyepieces (LV Series)** - Lanthanum is a unique rare earth glass used in one of the field lenses of this new eyepiece. The Lanthanum glass reduces aberrations to a minimum. All are fully multicoated and have an astounding 20mm of eye relief — perfect for eyeglass wearers! In the 1-1/4" barrel diameter, they are available in the following focal lengths: 2.5mm, 4mm, 5mm, 6mm, 9mm, 10mm, 15mm, 20mm, and 25mm. There is also a 30mm ocular with a 2" barrel.

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.

Eyepiece Filters - 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: #1A Skylight, #8 Yellow, #12 Deep Yellow, #15 Deep Yellow, #21 Orange, #23A Light Red, #25 Red, #38A Blue, #47 Violet, #56 Light Green, #58 Green, #80A Light Blue, #82A Pale Blue, #96 Neutral Density (50% T, 25% T, and 13% T) and Polarizing filters. For 2" eyepieces, Celestron offers the following filters: #1A Skylight, #12 Deep Yellow, #21 Orange, #23A Light Red, #38A Blue, #47 Violet, #58 Green, #80A Light Blue, #96 Neutral Density (50% T and 13% T), and Polarizing filters.

Filter Adapter (#93551) - This accessory allows you to attach screw-in filters to eyepieces that are NOT threaded. The filter is threaded into the adapter which is then placed on the eyepiece.

Finders - 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. The only option for finders is the straight-through illuminated Polaris 7x50 finder (#93785-8). Included are the finder, finder bracket, and illuminator. The finder illuminator (#51614-IL) and the setting plate (#60121) can be purchased separately for Ultima 8 owners. You can also purchase the Finder Bracket, Quick Release (#51149).

Flashlight (#93592) - 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.

Illuminated Reticle Ocular - 6mm - 1-1/4" (#93324) - When it comes to guiding eyepieces, you can't get more magnification in a single ocular. With 6mm of focal length, this ocular produces 333 power with your C8! The reticle has adjustable illumination making it easy to see the cross hairs. The X and Y axis of the cross hairs are adjustable making it easy to center a guide star. The LED is battery operated so there are no cords or wires to get in the way.

Light Pollution Reduction (LPR) Filters - These filters are designed to enhance your views of deep-sky astronomical objects when viewed from urban areas. LPR Filters selectively reduce the transmission of certain wavelengths of light, specifically those produced by artificial lights. This includes mercury and high and low pressure sodium vapor lights. In addition, they also block unwanted natural light (sky glow) caused by neutral oxygen emission in our atmosphere. Celestron offers a model for 1-1/4" eyepieces (#94126A), a model that attaches to the rear cell ahead of the star diagonal and visual back (#94127A), and one that attaches to the back of the radial guider (#94129). This last model allows you to guide on an unfiltered star while the light from your subject passes through the filter to a camera.

Micro Guide Eyepiece (#94171) - 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.

Multi Function Focal Tester-55 (#94200) - The Celestron MFFT-55, short for Multi Function Focal Tester-55, is a unique focusing aid developed and successfully used in Europe for years. This tool allows astrophotographers to accurately evaluate their telescope's focal plane in three main areas of interest; focus, collimation (squareness), and curvature of field. With the MFFT-55 it is now possible to focus on and off the optical axis at 3, 16, 22, and 30mm diameters in four quadrants in a single setup. When used as a null focus tool for long exposure astrophotography, focus results are excellent and repeatable.

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

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

Reducer/Corrector (#94175) - This lens reduces the focal length of the telescope by 37%, making your 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-space viewing. It is perfect for beginning prime focus long-exposure astrophotography. It makes guiding easier and exposures shorter.

Skylight Filter (#93621) - 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.

Sky Maps (#93722) - 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.

Solar Filter (#94162) - The Celestron Solar Skreen® solar filter permits direct observation of the Sun in complete safety. This filter, which transmits .001% of visible light, allow 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.

NOTE: NEVER LOOK DIRECTLY AT THE SUN WITH THE NAKED EYE OR WITH A TELESCOPE. NEVER POINT YOUR TELESCOPE AT THE SUN UNLESS YOU HAVE THE PROPER FILTER.

Star Diagonal (#93519) - Like the 1-1/4" Star Diagonals, the 2" Star Diagonal allows you to use 2" eyepieces with your Celestron C8 telescope. These larger eyepieces offer wider fields and better eye relief for greater viewing comfort. This accessory is **NOT** recommended for use with the Reducer/Corrector Lens.

T-Adapter (#93633) - A T-Adapter (with T-Ring) allows you to attach your camera to the prime focus of a C8. This is used for terrestrial photography and short exposure lunar and filtered solar photography. It can be used for long exposure deep-space photography if you use a separate guide scope.

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

T-Ring - The T-Ring couples your camera body to the T-Adapter, Radial Guider 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.

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

Vibration Suppression Pads (#93503) - 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.

The following accessories work only on the C8+, the C8+ Computerized, and the Ultima 8:

AC Adapter - 110V - 60Hz (#18772) - The AC Adapter allows you to run your Ultima 8, C8+, or C8+ Computerized off of AC rather than the standard DC battery.

Car Battery Adapter (#18767) - To save the internal battery, Celestron offers the Car Battery Adapter which allows you to run the Ultima 8 drive, C8+, and C8+ Computerized off an external power source. The adapter attaches to the cigarette lighter of your car.

Counterweight Bar Assembly (#94191) - When attaching optional accessories to your telescope, like 2" eyepieces or cameras, there is the need to add weights to counter balance 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) size.

Declination Motor - The Electric DEC Motor allows you to make corrections to the DEC axis of your telescope without touching the instrument. All corrections are made from a hand control box which eliminates the possibility of bumping or shaking the telescope while making manual corrections. Model # 93549 works on the C8+ and Ultima 8 telescopes.

Piggyback Mount (#93598) - 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.

Photo Tripod Adapter - 8" (#93595) - The photo tripod adapter allows you to attach your C8 telescope tube only to a heavy-duty photographic tripod. Such a mounting configuration is ideal for terrestrial photography and viewing.

Tilt Plate - 0° (#93645) - The zero latitude tilt plate allows you to adjust the equatorial wedge from 0 to 70 degrees. Although older models allowed a wide latitude range, at extremely low settings the fork tines would hit the side plates of the wedge. Not so any more. This new tilt plate allows you to set the latitude to zero and swing the forks around 360 degrees without hitting the wedge.

These accessories work only on the Ultima 8:

Motorized Focuser (94143) - 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.

Wedge Upgrade Kit (#93662) - This accessory allows you to make fine adjustments to the Wedge (#93655) in altitude and azimuth.

The following accessories are for the GP-C8 only:

Great Polaris/Super Polaris Motor Drive Controller (#93820-C) - This drive motor with corrector capabilities is designed for the Celestron Great Polaris (GP) and Super Polaris (SP) series mounts. The purpose is to allow precise control of your telescope's tracking speed during long exposure astrophotography, thereby producing the best possible images. Drive systems are a must if you are interested in celestial photography. This state-of-the-art motor drive is operated by a single 9-volt battery for up to 50 hours! The hand controller is very small and fits easily in the palm of your hand. Motors for both R.A. and DEC axes are included along with brackets and hardware to attach to any GP and most SP mounts.

Great Polaris Half Pier (#93801) - When observing near the zenith, the tripod can get in the way of the telescope. To eliminate this interference, Celestron offers the half pier, which raises the mount approximately 13 inches.

The following accessories are for the C8+ and C8+ Computerized:

Adjustable Tripod - A stable tripod is a must for serious astronomical observing and photography. Celestron offers two field tripods for this purpose. Model #93501 is the same tripod that comes standard with the Ultima 8. It weighs approximately 26 pounds, and offers maximum rigidity. The second is a lightweight field tripod (#93591). It weighs less than 10 pounds and folds down to a compact 6"x36".

Carrying Case for C8's (#302069) - For easy transportation of the tube and fork mount, Celestron offers a heavy duty, foam fitted deluxe case.

Deluxe Latitude Adjuster (#93528) - Also an important accessory, this device allows you to raise and/or lower the tilt plate with fine accuracy. Although used primarily for polar aligning, it is a tremendous time saver.

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

THE MESSIER CATALOG

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

M#	NGC#	Const.	R.A. H M S	DEC ° ' "	Mag	Type	Proper Name
M1	NGC 1952	Tau	5 34.5	22 01	8.4	P. Neb.	Crab Nebula
M2	NGC 7089	Aqr	21 33.5	-00 49	6.5	Gl. Cl.	
M3	NGC 5272	CVn	13 42.2	28 23	6.4	Gl. Cl.	
M4	NGC 6121	Sco	16 23.6	-26 32	5.9	Gl. Cl.	
M5	NGC 5904	Ser	15 18.5	2 05	5.8	Gl. Cl.	
M6	NGC 6405	Sco	17 40.0	-32 13	4.2	Op. Cl.	Butterfly Cluster
M7	NGC 6475	Sco	17 54.0	-34 49	3.3	Op. Cl.	
M8	NGC 6523	Sgr	18 03.7	-24 23	5.8	D. Neb.	Lagoon Nebula
M9	NGC 6333	Oph	17 19.2	-18 31	7.9	Gl. Cl.	
M10	NGC 6254	Oph	16 57.2	-4 06	6.6	Gl. Cl.	
M11	NGC 6705	Sct	18 51.1	-6 16	5.8	Op. Cl.	Wild Duck Cluster
M12	NGC 6218	Oph	16 47.2	-1 57	6.6	Gl. Cl.	
M13	NGC 6205	Her	16 41.7	36 28	5.9	Gl. Cl.	Hercules Cluster
M14	NGC 6402	Oph	17 37.6	-3 15	7.6	Gl. Cl.	
M15	NGC 7078	Peg	21 30.0	12 10	6.4	Gl. Cl.	
M16	NGC 6611	Ser	18 18.9	-13 47	6.0	D. Neb.	Eagle Nebula
M17	NGC 6618	Sgr	18 20.8	-16 11	7.0	D. Neb.	Omega Nebula
M18	NGC 6613	Sgr	18 19.9	-17 08	6.9	Op. Cl.	
M19	NGC 6273	Oph	17 02.6	-26 16	7.2	Gl. Cl.	
M20	NGC 6514	Sgr	18 02.4	-23 02	8.5	D. Neb.	Trifid Nebula
M21	NGC 6531	Sgr	18 04.7	-22 30	5.9	Op. Cl.	
M22	NGC 6656	Sgr	18 36.4	-23 54	5.1	Gl. Cl.	
M23	NGC 6494	Sgr	17 56.9	-19 01	5.5	Op. Cl.	
M24	NGC 6603	Sgr	18 16.4	-18 29	4.5	Op. Cl.	
M25	IC 4725	Sgr	18 31.7	-19 15	4.6	Op. Cl.	
M26	NGC 6694	Sct	18 45.2	-9 24	8.0	Op. Cl.	
M27	NGC 6853	Vul	19 59.6	22 43	8.1	P. Neb.	Dumbbell Nebula
M28	NGC 6626	Sgr	18 24.6	-24 52	6.9	Gl. Cl.	
M29	NGC 6913	Cyg	20 23.0	38 32	6.6	Op. Cl.	
M30	NGC 7099	Cap	21 40.4	-23 11	7.5	Gl. Cl.	
M31	NGC 224	And	0 42.7	41 16	3.4	Sp. Gx.	Andromeda Galaxy
M32	NGC 221	And	0 42.7	40 52	8.2	El. Gx.	
M33	NGC 598	Tri	1 33.8	30 39	5.7	Sp. Gx.	Pinwheel Galaxy
M34	NGC 1039	Per	2 42.0	42 47	5.2	Op. Cl.	
M35	NGC 2168	Gem	6 08.8	24 20	5.1	Op. Cl.	
M36	NGC 1960	Aur	5 36.3	34 08	6.0	Op. Cl.	
M37	NGC 2099	Aur	5 52.0	32 33	5.6	Op. Cl.	
M38	NGC 1912	Aur	5 28.7	35 50	6.4	Op. Cl.	
M39	NGC 7092	Cyg	21 32.3	48 26	4.6	Op. Cl.	
M40		UMa	12 22.2	58 05	8.0	dbl	

M#	NGC#	Const.	R.A. H M S	DEC ° ' "	Mag	Type	Proper Name
M41	NGC 2287	CMa	6 47.0	-20 44	4.5	Op. Cl.	Great Orion Nebula
M42	NGC 1976	Ori	5 35.3	-5 27	4.0	D. Neb.	
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.	
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.	
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.	Ring Nebula
M57	NGC 6720	Lyr	18 53.6	33 02	9.0	P. Neb.	
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.	Sunflower Galaxy Black Eye Galaxy 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.	
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	Cork Nebula
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.	
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.	Bodes Nebula
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.	
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.	

M#	NGC#	Const.	R.A. H M S	DEC ° ' "	Mag	Type	Proper Name
M86	NGC 4406	Vir	12 26.2	12 57	9.2	El. Gx.	Virgo A
M87	NGC 4486	Vir	12 30.8	12 24	8.6	El. Gx.	
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.	Owl Nebula
M97	NGC 3587	UMa	11 14.9	55 01	11.2	P. Neb.	
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.	
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.	Sombrero Galaxy
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.	
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.	

(* denotes object of special interest.)

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

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

LIST OF BRIGHT STARS

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

Star Name	Constellation	Epoch 2000.0		Magnitude
		R.A. H M S	DEC ° ' "	
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	Aql	19 50 47	+08 52 06	+0.77
Aldebaran	Tau	04 35 55	+16 30 33	+0.86
Spica	Vir	13 25 12	-11 09 41	+0.91
Antares	Sco	16 29 24	-26 25 55	+0.92
Fomalhaut	PsA	22 57 39	-29 37 20	+1.15
Pollux	Gem	07 45 19	+28 01 34	+1.16
Deneb	Cyg	20 41 26	+45 16 49	+1.28
Beta Crucis	Cru	12 47 43	-59 41 19	+1.28
Regulus	Leo	10 08 22	+11 58 02	+1.36

FOR FURTHER READING

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

Astronomy Texts

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

Atlases

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

Catalogs

Sky Catalog 2000.0 Vol 1 & 2	Hirshfeld & Sinnott
NGC 2000.0	Sinnott

General Observational Astronomy

The Cambridge Astronomy Guide	Liller & Mayer
A Complete Manual of Amateur Astronomy	Sherrod
The Guide to Amateur Astronomy	Newton & Teece

Visual Observation

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

Astrophotography

Skys shooting	Mayall & Mayall
Astro photography A Step-by-Step Approach	Little
Astro photography for the Amateur	Covington
Astro photography	Gordon
Astro photography II	Martinez
A Manual of Celestial Photography	King
Manual of Advanced Celestial Photography	Wallis & Provin
Colours of The Stars	Malin & Muir den

CELESTRON OWNER REGISTRATION CARD

Please register your new product with Celestron by completing and returning this postage paid card.

Mr. Mrs. Ms.

Name _____ Age _____

Address _____

City _____ State _____ Zip _____

Home Phone () _____ Bus. Phone () _____

Occupation _____

Model Purchased _____

Dealer _____ Date _____

1. Do you own other Celestron products? _____ Yes _____ No
If yes, which models? _____

2. What was the most important factor which led to your purchase?

Magazine Ads Seeing one at a dealer Celestron Reputation
 Product Quality Sale Price Recommendation from
 Dealer Reputation Value For Money friend/relative

3. Which magazines do you read most often?

Astronomy Petersen's Photographic Popular Photography
 Audubon Natural History Popular Science
 Outside Sierra Magazine Sky & Telescope
 Smithsonian Scientific American National Geographic
 Field & Stream Other:

4. Please check your main areas of interest (check all that apply): _____

Astronomy Sports Other:
 Hunting Target shooting
 Photography Birding

Fold card in half and staple.



CELESTRON INTERNATIONAL
 2835 Columbia Street
 Torrance, California 90503

Postage Will Be Paid By Addressee

BUSINESS REPLY MAIL
 FIRST CLASS Permit No. 593 Torrance, Calif.

No Postage
 Necessary
 if Mailed
 in the
 United States



5. Which of the following ranges best describes your total household income?
- | | | |
|---|---|---|
| <input type="checkbox"/> Under 15,000 | <input type="checkbox"/> 25,000 to 34,999 | <input type="checkbox"/> 50,000 to 74,999 |
| <input type="checkbox"/> 15,000 to 24,999 | <input type="checkbox"/> 35,000 to 49,999 | <input type="checkbox"/> 75,000 and over |

6. Would you like to be placed on Celestron's mailing list and receive mailings on product updates? Yes No

7. Are you a member of an astronomy club? Yes No
 If yes, which one? _____

8. Any questions/comments? _____

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 will 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 costs of transportation and insurance, both to and from the factory of CI, and shall be required to prepay such costs.

ACCESSORIES/ELECTRONIC COMPONENTS

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.

WARRANTY

CI shall use reasonable efforts to repair or replace any product covered by this limited warranty within thirty days of receipt. In the event repair or replacement shall require more than thirty days, CI shall notify the customer accordingly. CI reserves the right to replace any product which has been discontinued from its product line with a new product of comparable value and function. In the event no product of comparable value and function is then marketed by CI, CI may, in lieu of replacement, pay the current fair market value of the product in serviceable condition.

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

CI DISCLAIMS ANY WARRANTIES, EXPRESS OR IMPLIED, WHETHER OF MERCHANTABILITY OF FITNESS FOR A PARTICULAR USE, EXCEPT AS EXPRESSLY SET FORTH HEREIN.

THE SOLE OBLIGATION OF CI UNDER THIS LIMITED WARRANTY SHALL BE TO REPAIR OR REPLACE THE COVERED PRODUCT, IN ACCORDANCE WITH THE TERMS SET FORTH HEREIN. CI EXPRESSLY DISCLAIMS ANY LOST PROFITS, GENERAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM BREACH OF ANY WARRANTY, OR ARISING OUT OF THE USE OR INABILITY TO USE ANY CI PRODUCT. ANY WARRANTIES WHICH ARE IMPLIED AND WHICH CANNOT BE DISCLAIMED SHALL BE LIMITED IN DURATION TO A TERM OF ONE YEAR FROM THE DATE OF ORIGINAL RETAIL PURCHASE.

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

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

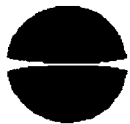
CI reserves the right to modify or discontinue, without prior notice to you, any model or style optical instrument.

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

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

This warranty supersedes all other product warranties.

NOTE: This warranty is valid to U.S.A. customers who have purchased this product from an Authorized CI Dealer in the U.S.A. Warranty outside the U.S.A. is valid only to customers who purchase this product from a CI International Distributor or Authorized CI Dealer in the specific country.



CELESTRON®

2835 Columbia Street
Torrance, CA 90503
Tel. (310) 328-9560
Fax (310) 212-5835

Copyright 1995 Celestron International
All rights reserved.

(Products or instructions may change
without notice or obligation.)

Item # 94140
01-95
Price \$10.00