Instruction Manual

ETX-90EC Astro Telescope
ETX-125EC Astro Telescope

Meade Instruments Corporation

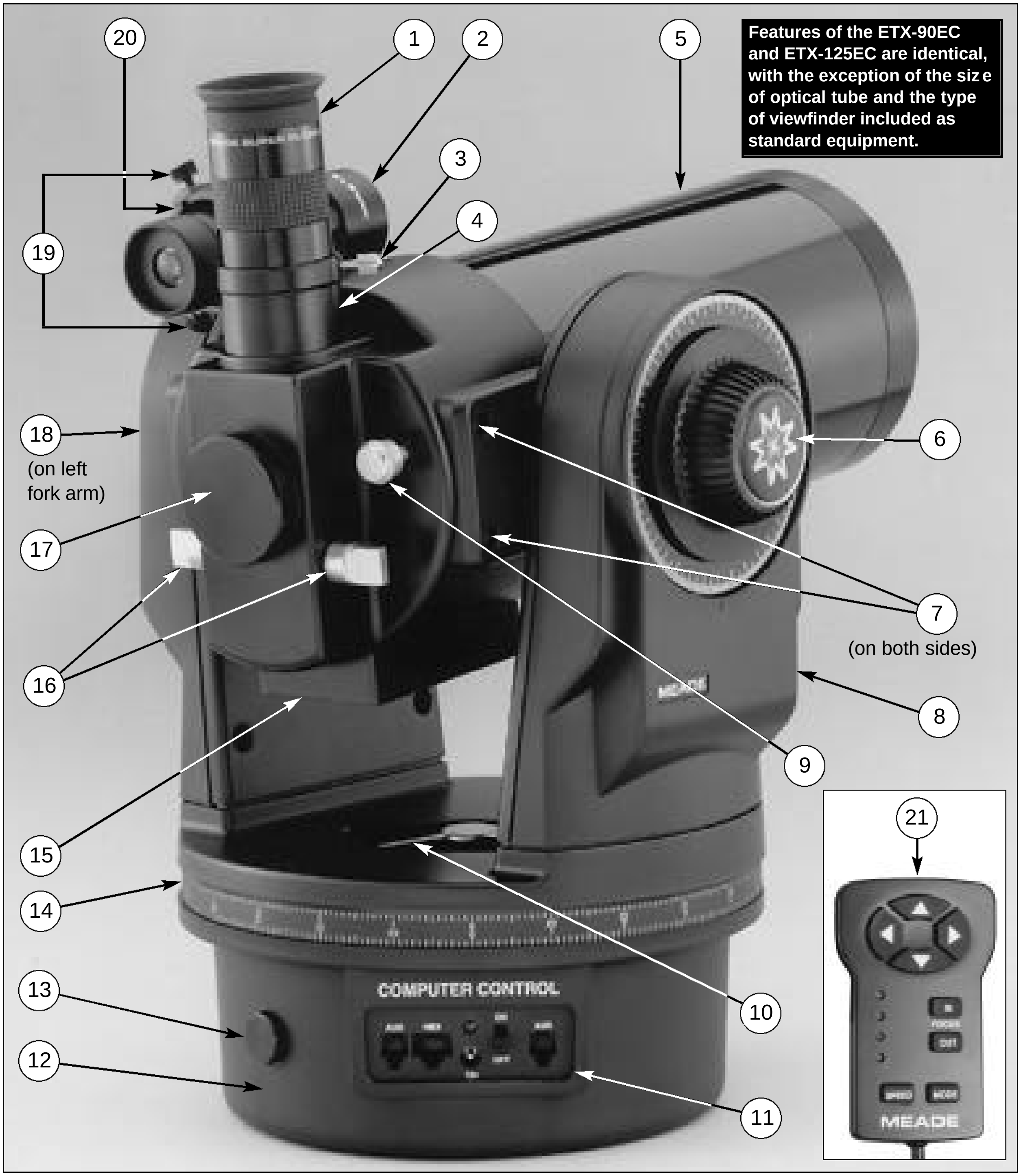


Fig. 1: The ETX-90EC Astro Telescope.

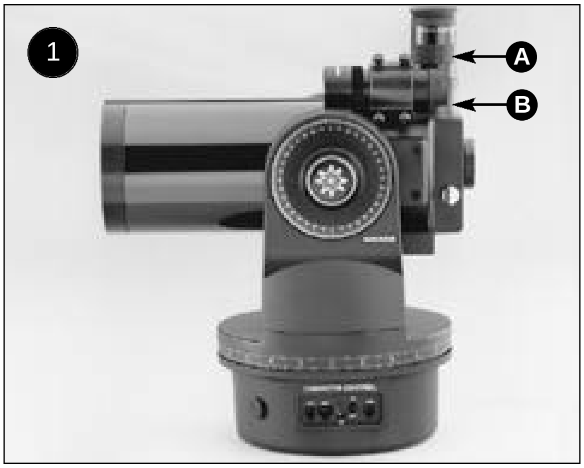
1. **Eyepiece**
2. **Viewfinder:**
   ETX-90EC: 8 x 21mm Erect-Image Viewfinder
   ETX-125EC: 8 x 25mm Right-Angle Viewfinder
3. **Eyepiece holder thumbscrew**
4. **90° eyepiece holder**
5. **Optical tube:** ETX-90EC: 90mm clear aperture
   ETX-125EC: 127mm clear aperture
6. **Vertical (or Declination) lock**
7. **Fork-mount attachment screws**
8. **Fork arm**
9. **Focus knob**
10. **Horizontal (or Right Ascension) lock**
11. **Computer control panel**
12. **Drive base**
13. **Hole cover for optional tripod legs (2)**
14. **Right Ascension (R.A.) setting circle**
15. **1/4-20 photo tripod adapter block**
16. **Flip-mirror control knobs**
17. **Photo port**
18. **Declination (Dec.) setting circle (on left fork arm)**
19. **Viewfinder alignment screws**
20. **Viewfinder bracket**
21. **Electronic controller with attached coil cord**

WARNING!

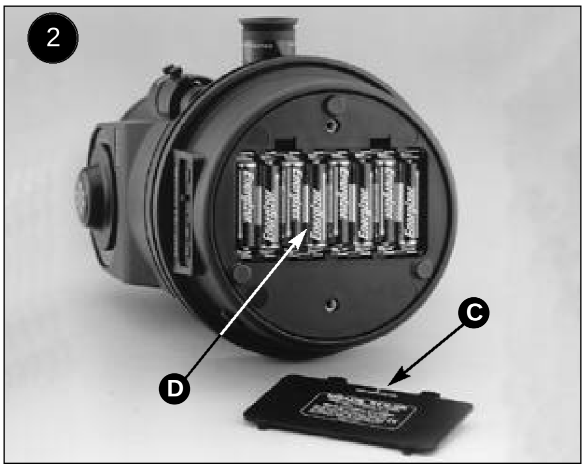
Never use a Meade® ETX® Astro Telescope to look at the Sun! Looking at or near the Sun will cause *instant* and *irreversible* damage to your eye. Eye damage is often painless, so there is no warning to the observer that damage has occurred until it is too late. Do not point the telescope or its viewfinder at or near the Sun. Do not look through the telescope or its viewfinder as it is moving. Children should always have adult supervision while observing.

CAUTION: Use care to install batteries as indicated by the battery compartment. Follow battery manufacturers precautions. Do not install batteries backward or mix new and used batteries. Do not mix battery types. If these precautions are not followed, batteries may explode, catch fire, or leak. Improperly installed batteries void your Meade warranty.

If you are anxious to use your ETX Astro Telescope for the first time, before a thorough reading of this instruction manual, see the Quick-Start Guide on page 4.



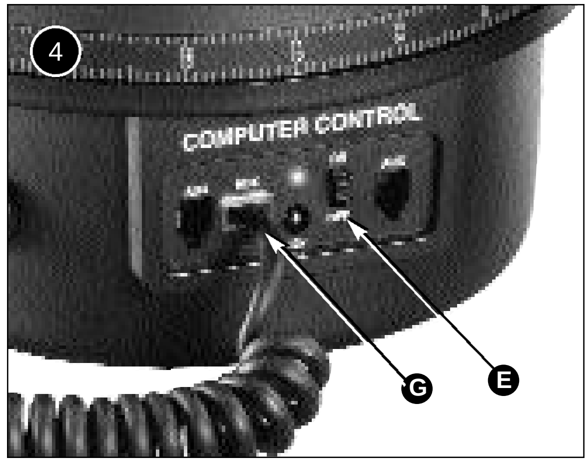
Remove the ETX from its packaging and place it on a sturdy surface. Place the eyepiece (A) and viewfinder (B) into their appropriate positions on the telescope and tighten the appropriate attachment screws to a firm feel only.



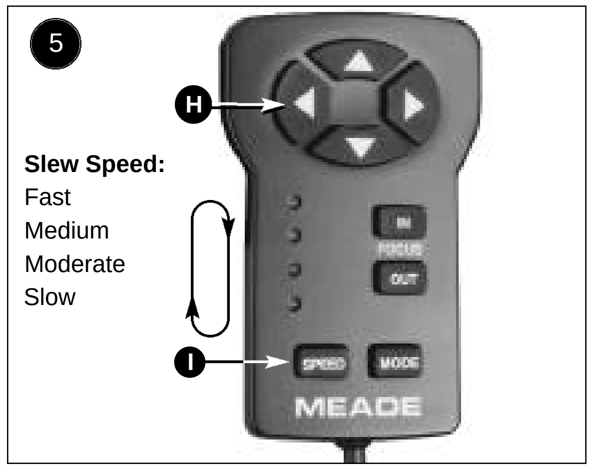
Securely place the ETX on its side and remove the battery compartment cover (C) from the underside of the drive base. Insert eight (user-supplied) AA-size batteries into the battery compartment (D) in the proper orientation. Replace the cover and return the telescope to an upright position.

NOTE:The telescope has rotational hard stops in the horizontal and vertical axes to prevent damage to the telescope. See Quick Tips, page 6, for more information.

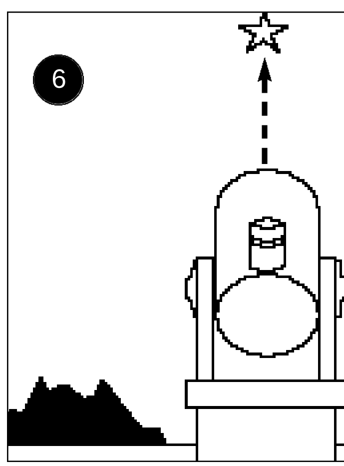
Verify that the computer control panel power switch (E) is in the OFF position. Remove the Electronic Controller (F) from the packing materials and plug it into the HBX port (G). Tighten the vertical and horizontal locks (6 and 10, Fig. 1), then remove the dust cover from the end of the telescope tube.



Flip the Power Switch (E) on the computer control panel to the ON position. The lights flicker on the Electronic Controller. Press any key and the motors briefly move the telescope. The Electronic Controller is now operational.



Use the arrow keys (H) of the Electronic Controller to move the telescope up and down and/or left and right. To change the telescope's slew speed, press the SPEED key (I). The indicator lights signify the speed, with the upper light showing the highest speed. Each press slows the speed down one level, then cycles back to the highest speed.



NOTE: Before observing, verify that the flip-mirror control (16, Fig. 1) is in the "up" position. See Flip-Mirror Control, page 6, for more information.

Sight along the side of the telescope's main tube to locate an object. Practice using the arrow keys on the Electronic Controller to center an object in the telescope's field of view. Use the telescope's focus knob (9, Fig. 1) to bring the object into focus.

INTRODUCTION

A Meade ETXAstro Telescope is an extremely versatile, high-resolution imaging system that, with advanced features similar to larger and more specialized telescopes, can be used by casual observers and serious astronomers alike. With pushbutton controls, automatic tracking of celestial objects (with one of the optional tripods), and diffraction-limited imaging, an ETX telescope may be all the telescope ever required by many terrestrial and astronomical observers.

As a first telescope, the ETX-90EC or ETX-125EC reveals nature in an ever-expanding level of detail: observe the feather structure of a bird from 50 yards or study the rings of the planet Saturn from a distance of 800 million miles. Beyond the Solar System observe nebulae, star clusters, galaxies, and other deep-sky objects. Both telescopes are instruments fully capable of growing with your interest.

Your Meade ETX Astro Telescope is one of the most revolutionary telescope systems ever developed. Read this manual thoroughly to take full advantage of the telescope's numerous advanced features.

This manual provides instructions for the following products:

- ETX-90EC Astro Telescope
- ETX-125EC Astro Telescope

The Electronic Controller

Control of both ETX model telescopes is through pushbutton operation of the standard-equipment Electronic Controller (Fig. 2). Nearly all functions of the telescope are accomplished through the Electronic Controller with just a few button pushes:

- Move the telescope on two axes (up-and-down or left-and-right) at any of 4 drive speeds for precise tracking of astronomical or terrestrial objects.
- Mount the telescope in the polar mode for fully automatic tracking of celestial objects using the optional #880 (ETX–90EC), #881 (ETX-125EC) Table Tripod, or #883 Deluxe Field Tripod (see **OPTIONAL ACCESSORIES**, page 17).
- When in the polar mode, switch the motor drive between northern and Southern Hemisphere operation for observing from anywhere in the world.

Fig.2: Electronic Controller.

A detailed description of the functions and operation of the Electronic Controller is found in **Electronic Controller Functions**, page 6.

Parts List

In keeping with the ETX philosophy of elegant simplicity, an ETX telescope is virtually completely assembled at the Meade factory. Getting the telescope ready for first observations requires only a few minutes. When first opening the packing box, note carefully the following parts:

- The ETX Astro Telescope with fork-mount system.
- Electronic Controller with attached coil cord.
- Viewfinder, packed in a separate small box.
- Super Plössl (SP) 26mm eyepiece, packed in a plastic storage container, in a separate small box.
- Hex-wrench set (2 wrenches), packed with the manual.

The viewfinder is packed separately from the main telescope to avoid the possibility of the viewfinder slipping in its bracket and scratching the viewfinder tube during shipment.

Assembly Instructions

Assembly of both ETX model telescopes requires eight (user-supplied) AA-size batteries and the following steps:

1. a. **ETX-90EC 8 x 21mm Viewfinder:** Slide the eyepiece end of the viewfinder through the *front* of the viewfinder bracket (1, Fig. 3).

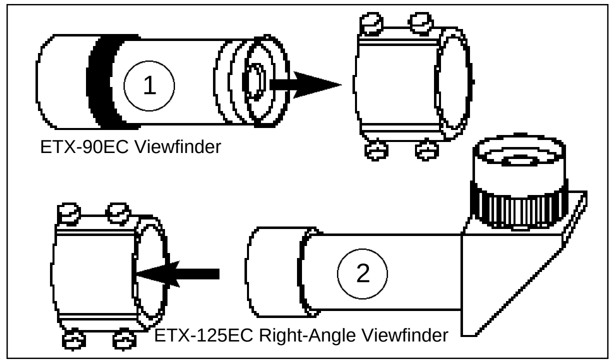


Fig.3: Installation of the Viewfinder.

   b. **ETX-125EC 8 x 25mm Right-Angle Viewfinder:** Slide the front cell end of the right-angle viewfinder through the *rear* of the viewfinder bracket (2, Fig. 3).

   You may need to unthread the six alignment screws slightly to fit the viewfinder through the bracket. With the viewfinder in place, tighten *(to a firm feel only)* the six alignment screws against the viewfinder tube. To align the viewfinder, see page 8.

2. Remove the SP26mm eyepiece (1, Fig. 1) from its container and place it in the eyepiece holder (4, Fig. 1). Tighten the thumbscrew (3, Fig. 1) to a *firm feel* only.
3. The telescope's battery compartment (6, Fig. 4) is at the bottom of the drive base. Place the telescope securely on its side as shown in Fig. 4. Open the battery compartment by simultaneously depressing the two release latches (4, Fig. 4) and pulling the battery cover (5, Fig. 4) away from the drive base. Insert eight AA-size batteries into the battery compartment, oriented as shown on the battery mounting board. Put the cover back in place.
4. Place the telescope in an upright position on a flat surface. Be certain that the power switch on the computer control panel (1, Fig. 5) is in the OFF position. Plug the coil cord for the Electronic Controller into the HBX port (3, Fig. 5).

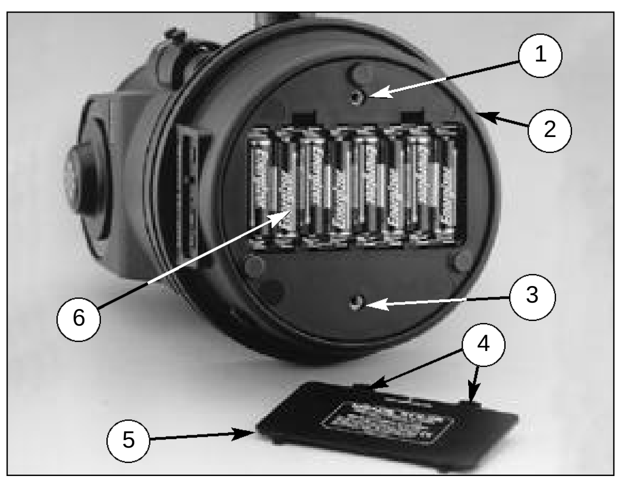


Fig.4: Bottom view of an ETX showing eight AA-size batteries mounted inside the battery compartment.
(1) High-latitude tripod leg hole; (2) Drive base;
(3) Alternate tripod leg hole; (4) Release latches;
(5) Battery compartment cover; (6) Battery compartment.

Basic assembly of either ETX model is now complete.

CHAPTER 1

TELESCOPE FEATURES

Quick Tips

- **Rotational Limits:** The telescope base and fork mount are designed with internal “rotational limit stops.” The *horizontal limit stop* prevents the telescope from rotating more than 630° to avoid damage to the internal wiring. The *vertical limit stop* prevents the viewfinder from contacting the fork mount when the telescope is pointed upward just past 90° and prevents the optical tube from contacting the base if pointed downward more than 30°. *Do not force the telescope to move beyond these stops or damage to the telescope will result.*
- **Vertical Lock;Declination Setting Circle:** The vertical lock knob (6, Fig. 1) is a knurled knob located on the fork arm to the right of the focus knob (9, Fig. 1). Mounted beneath the knob is a circular scale with no numbers. Do not confuse this scale with the Dec setting circle (18, Fig. 1) on the opposite fork arm which has a number scale used to locate astronomical objects.
- **A Note on Indoor Viewing:** While casual, low-power observations may be made with the telescope through an open or closed window, the best observing is always done outdoors. Temperature differences between inside and outside air and/or the low quality of most home window glass can cause blurred images through the telescope. *Do not expect high-resolution imaging under these conditions.*

Telescope Controls

An important array of features and manual controls facilitates operation of an ETX telescope. *Be sure to become acquainted with all of these controls before attempting observations through the telescope.*

Horizontal Lock (10, Fig. 1): Controls manual horizontal rotation of the telescope while sitting upright as shown in Fig.1. Turning the horizontal lock *counterclockwise* unlocks the telescope, enabling it to be freely rotated by hand about the horizontal axis. Turning the horizontal lock *clockwise* prevents the telescope from being rotated manually, but engages the horizontal motor drive clutch for Electronic Controller operation. When polar aligned, the horizontal lock serves as the Right Ascension, or R.A. lock (see **Right Ascension**, page 12).

Vertical Lock (6, Fig. 1): Controls manual vertical movement of the telescope while sitting upright as shown in Fig. 1. Turning the vertical lock *counterclockwise* unlocks the telescope enabling it to be freely rotated by hand about the vertical axis. Turning the vertical lock *clockwise (to a firm feel only)* prevents the telescope from being moved manually, but engages the vertical motor drive clutch for Electronic Controller operation. When polar aligned, the vertical lock serves as the Declination, or Dec lock (see **Declination**, page 12).

Focus Knob (9, Fig. 1): Causes a finely-controlled internal motion of the telescope’s primary mirror to achieve precise image focus. An ETX can be focused on objects from a distance of about 11.5 ft (ETX-90EC) or 15 ft (ETX-125EC) to infinity. Rotate the focus knob *clockwise* to focus on distant objects; *counterclockwise* to focus on near objects.

Flip-Mirror Control (16, Fig. 1): Both ETX models include an internal optically-flat mirror. With the flip-mirror control in the “up” position, as shown in Fig. 1, light is diverted at a 90° angle to the eyepiece. Alternately, with the flip-mirror control in the “down” position, light proceeds straight through the telescope and out the photo port (17, Fig. 1) for telephoto or astronomical photography using the optional #64 T-Adapter, or for observing with the optional #932 45° Erecting Prism (see **OPTIONAL ACCESSORIES**, page 17).

NOTE: The flip-mirror control is in the “up” position when the control is vertical (perpendicular to the telescope tube). It is “down” when the control is horizontal (parallel with the telescope tube).

Computer Control Panel

The computer control panel (Fig. 5) of the ETX-90EC and ETX–125EC models include a connector for either the standard-equipment Electronic Controller or the optional #497 Autostar Computer Controller, an external power supply connector, and two auxiliary ports (see **OPTIONAL ACCESSORIES**, page 16).

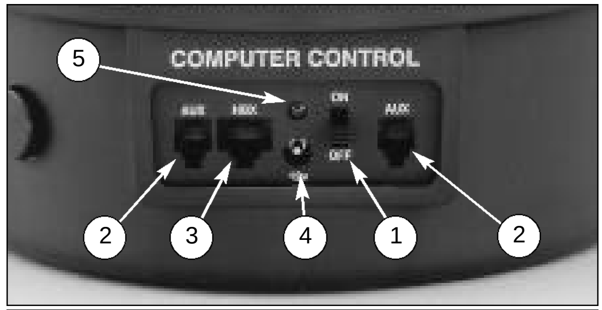


Fig. 5: Computer Control Panel. (1) ON/OFF switch; (2) Auxiliary ports; (3) Handbox port; (4) 12v connector; (5) Power indicator light.

ON/OFF (1, Fig. 5): When the ON/OFF switch is moved to the ON position, the red power indicator light (5, Fig. 5) illuminates and power is supplied to the Electronic Controller and to the telescope’s motor drive.

AUX (2, Fig. 5): Two identical auxiliary ports provide connections for current and future Meade accessories.

CAUTION:Using products other than standard Meade accessories may cause damage to the telescope’s internal electronics and may void the Meade warranty.

HBX (3, Fig. 5): The HBX (handbox) port is designed to accept the plug from the coil cord of the Electronic Controller or the optional #497 Autostar Computer Controller.

12v (4, Fig. 5): The 12v connector is designed to accept an external power supply such as the optional #541 AC adapter or the #607 Power Cord (see **OPTIONAL ACCESSORIES**, page 18). When one of these alternate powering options is used, the internal batteries are disconnected from the power circuit.

NOTE: Always remove the batteries if they are not to be used for a long period of time.

Electronic Controller Functions

The Electronic Controller provides the observer with the means to control the telescope motors from a compact handbox. The Electronic Controller (Fig. 6) has soft-touch keys designed to have a positive feel, even through gloves.

Primary functions of the Electronic Controller are to move (slew) the telescope, indicate the slew speed, and to operate the optional #1244 (ETX-90EC) or #1247 (ETX-125EC) Electric Focuser (see **OPTIONAL ACCESSORIES**, page 18). Other functions are also possible when using the MODE key (see **Electronic Controller Modes**, page 11 and **APPENDIX A**, page 22).

Arrow Keys (1, Fig. 6): The four arrow keys slew the telescope in four directions (i.e., up-and-down or left-and-right) at any one of four slew speeds (see **SPEED Key**, page 7).

Important Note: *While using the arrow keys to slew to an object, when reversing direction there may be a slight pause as the telescope motors compensate for the reversal of the internal gears.*

Indicator Lights (2, Fig. 6): Four red LED (Light Emitting Diode) lights are used to indicate the current slew speed.

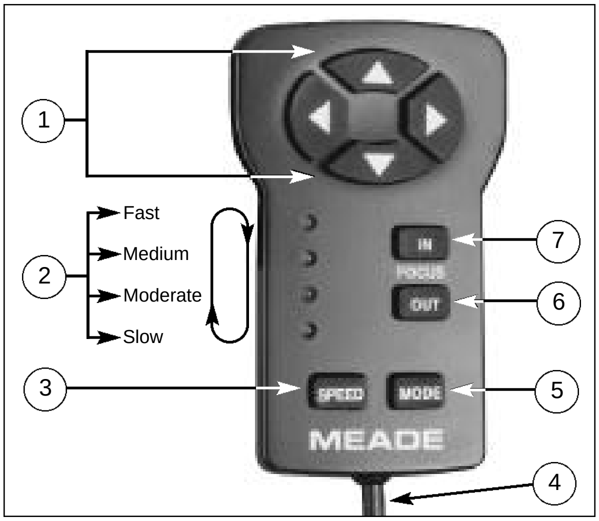
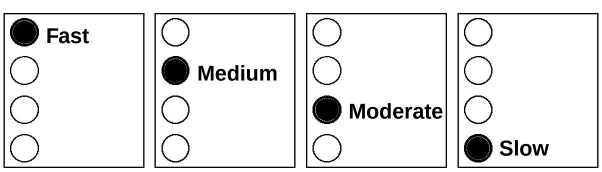


Fig.6: Electronic Controller. (1) Arrow Keys; (2) Indicator Lights; (3) SPEED Key; (4) Coil Cord; (5) MODEKey; (6) OUT Key; (7) IN Key.

NOTE: For purposes of this manual, the lights are identified as 1 through 4, with 1 being the top light and 4 the bottom light.

Indicator Light Key	**Light No.**	**Light Status**
The procedures in this manual identify the status of the four indicator lights in a box to the left of the appropriate step. They are depicted as *on*, *blinking,* or *off*, depending on the mode at that point.	● **Light 1** ● **Light 2** ● **Light 3** ● **Light 4**	● **On** ☼ **Blinking** ○ **Off**

SPEED Key (3, Fig. 6): The SPEED key is used to change the speed at which the telescope slews when the arrow keys are pressed. Each press of the SPEED key changes the slew speed to the next slower setting. If the controller is already on the slowest slew speed (light 4), pressing the SPEED key cycles back to the highest speed (light 1). Slew speeds are signified by the indicator lights (2, Fig. 6).



MODE Key (5, Fig. 6): Pressing and holding the MODE key puts the Electronic Controller into the Mode function (see **Electronic Controller Modes**, page 11).

OUT Key (6, Fig. 6): The OUT key is used in conjunction with the optional #1244 (ETX-90EC) or #1247 (ETX-125EC) Electric Focuser (see **OPTIONAL ACCESSORIES**, page 18) to move the focus point outward.

IN Key (7, Fig. 6): The IN key is used in conjunction with the optional Electric Focuser to move the focus point inward.

First Observations

Unthread the metal dust cap from the front lens of the telescope *(counterclockwise*), and the ETX may now be used for terrestrial (land) observing.

NOTE:The dust cap should be replaced after each observing session and the power turned off to the telescope. Verify that any dew that might have collected during the observing session has evaporated prior to replacing the dust cap.

With the standard-equipment SP 26mm eyepiece inserted in the eyepiece holder, the telescope is operating at the following power (see Understanding Magnification, page 9):

- ETX-90EC 48X
- ETX-125EC 73X

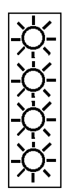
Objects viewed through the eyepiece are correctly oriented up-and-down in the telescope but are reversed left-for-right. Image orientation is discussed further in Terrestrial Observing, page 10. The flip-mirror control (16, Fig. 1) must be in the “up” position in order to observe an image through the telescope’s eyepiece (see Flip-Mirror Control, page 6).

For the ultimate viewing experience, become familiar with the features of your ETX telescope and the functions of the Electronic Controller. Upon completing this chapter make first observations of a simple land object several hundred yards in the distance— perhaps a telephone pole or a building. Locate objects first in the viewfinder before viewing them in the main telescope (see Aligning the Viewfinder, page 8). Practice focusing on the object using the focus knob (9, Fig. 1) and centering the object in the eyepiece using the Electronic Controller arrows keys (1, Fig. 6).

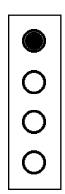
Observing with the Electronic Controller

With the Electronic Controller in the factory pre-set “Alt/Az” (vertical-horizontal) mode, the Electronic Controller arrow keys permit pushbutton movements (slewing) of the telescope. To move the telescope using the Electronic Controller:

1. Set the telescope on a level and stable surface, or mount to the Meade #883 Deluxe Field Tripod (see **OPTIONAL ACCESSORIES**, page 17).
2. Insert a low-power eyepiece (e.g., SP 26mm) into the eyepiece holder (4, Fig. 1) and tighten the eyepiece thumbscrew (3, Fig. 1).
3. Tighten the vertical and horizontal locks (6 and 10, Fig. 1).
4. Verify that the power switch (1, Fig. 5) on the telescope’s computer control panel is OFF.
5. Plug in the Electronic Controller coil cord (4, Fig. 6) to the HBXport (3, Fig. 5) on the computer control panel.



6. Flip the power switch to ON. The power indicator light (5, Fig. 5) on the computer control panel comes on and all four Electronic Controller indicator lights (2, Fig. 6) blink rapidly.
7. Press any key on the Electronic Controller and the telescope slews momentarily in the vertical and horizontal directions to test the motors.



8. When the test is complete, light 1 comes on steady; lights 2, 3, and 4 turn off.
9. Use the four arrow keys (1, Fig. 6) to slew the telescope to the desired object. To change the slew speed, press the SPEED key.
10. Fine-adjust the position of the object with the Electronic Controller arrow keys so that it is centered in the viewfinder. The object is now ready to be viewed through the telescope’s eyepiece.

Observing Tip: *If the Electronic Controller has previously been placed in the polar mode (see Electronic Controller Modes, page 11) and Alt/Az operation is desired, flip the telescope power switch to OFF and perform steps 6, 7, and 8 above. The telescope is now in the Alt/Az mode. This procedure does not work if one of the mode screws has been removed (see Using the Mode Screws, page 11).*

THE VIEWFINDER

As with most astronomical telescopes, both ETX model telescopes present a fairly narrow field of view to the observer. As a result it is sometimes difficult to locate and center objects in the telescope's field of view. The viewfinder, by contrast, is a low-power, wide-field sighting scope with crosshairs that let you easily center objects in the eyepiece of the main telescope's field of view. A telescope's viewfinder is a tremendous aid in the location of faint astronomical objects before observation is made through the telescope's eyepiece.

ETX-90EC 8 x 21mm Erect-Image Viewfinder: Standard equipment with the ETX-90EC, the 8 x 21mm Erect-Image Viewfinder has 8-power magnification and an aperture of 21mm. This viewfinder presents a correctly oriented image both up-and-down and left-to-right.

ETX-125EC 8 x 25mm Right-Angle Viewfinder: Standard equipment with the ETX-125EC, the 8 x 25mm Right-Angle Viewfinder has 8-power magnification and an aperture of 25mm. This viewfinder presents a correctly oriented image up-and-down, but is reversed left-for-right.

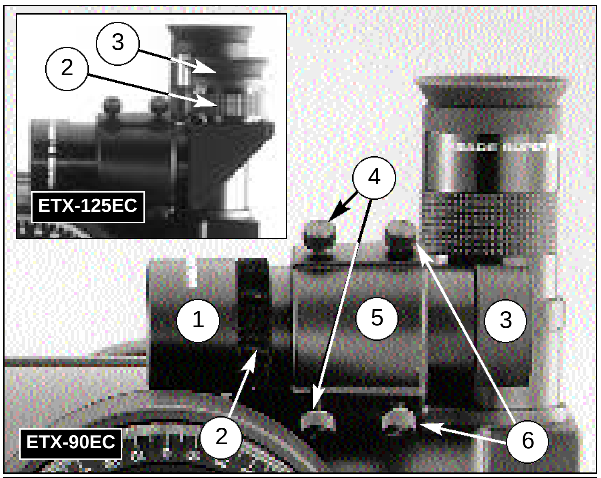


Fig.7: The Viewfinder. (1) Front lens cell; (2) Knurled lock-ring (ETX-90EC) or focus ring (ETX-125EC); (3) Viewfinder eyepiece; (4) Front alignment screws; (5) Viewfinder bracket; (6) Rear alignment screws.

Focusing the Viewfinder

Both ETX model viewfinders are factory pre-focused to objects located at infinity. Individual eye variations may require that the viewfinder be re-focused. To check the focus look through the viewfinder. Point the viewfinder at a distant terrestrial (land) object such as a telephone pole or light pole. If the viewfinder image is not in sharp focus, follow the procedure for your type of telescope.

ETX-90EC

1. If the viewfinder is mounted in the viewfinder bracket (5,Fig. 7), remove it by slightly unthreading the six alignment screws (4 and 6, Fig. 7) until it can slip easily out of the bracket.
2. Loosen the knurled lock-ring (2, Fig. 7) located near the viewfinder's front lens cell (1, Fig. 7). Unthread this ring (*counterclockwise*, as seen from the eyepiece-end of the viewfinder) by several turns.
3. Look through the viewfinder and focus on a distant object. Slowly rotate the front lens cell in one direction or the other, until the object appears sharp. One or two rotations of the lens may have a significant effect on image focus.
4. Lock the focus in place by threading the knurled lock-ring *clockwise* up against the viewfinder's lens cell.
5. Place the viewfinder into the viewfinder bracket on the main telescope. Gently tighten the six alignment screws. Proceed with **Aligning the Viewfinder**.

ETX-125EC

Turn the focus ring (2, Fig. 7) at the base of the viewfinder eyepiece (3, Fig. 7) in either direction until a sharp focus is reached.

Aligning the Viewfinder

In order for the viewfinder to be useful, it must first be aligned with the main telescope, so that both the viewfinder and the main telescope are pointing at precisely the same location. To align the viewfinder follow this procedure:

1. The viewfinder bracket (5, Fig. 7) includes six alignment screws (4 and 6, Fig. 7). Turn the three *rear* alignment screws (6, Fig. 7) so that the viewfinder tube is roughly centered within the viewfinder bracket.

NOTE: Do not overtighten the alignment screws. When tightening one screw it may be necessary to loosen one or both of the two other alignment screws.

2. Using the SP26mm eyepiece, point the main telescope at some easy-to-find, well-defined land object, such as the top of a telephone pole. Center the object precisely in the eyepiece's field of view, then tighten the vertical and horizontal locks (6 and 10, Fig. 1) so that the object does not move (1, Fig. 8).

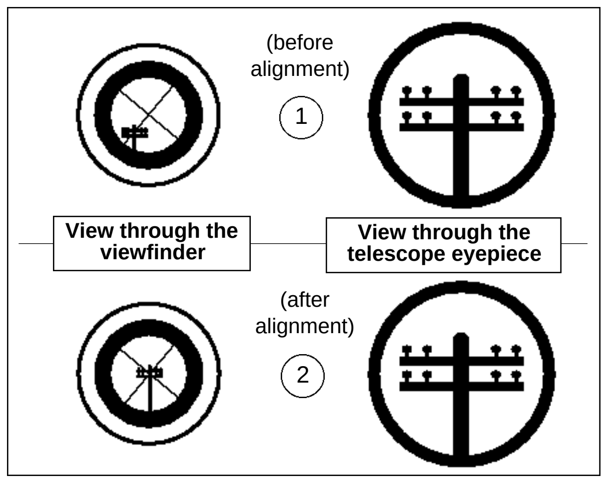


Fig.8: Aligning the Viewfinder.

3. While looking through the viewfinder, turn one or more of the three *front* viewfinder alignment screws (4, Fig. 7), until the crosshairs of the viewfinder point at precisely the same position as the view through the eyepiece of the main telescope (2, Fig. 8).

Re-check that the viewfinder's crosshairs and the main telescope are now pointing at precisely the same object. The viewfinder is now aligned to the main telescope. Unless the alignment screws are disturbed or the viewfinder jarred, the viewfinder should remain aligned indefinitely.

Using the Viewfinder

To locate any object, terrestrial or astronomical, first center the object in the crosshairs of the viewfinder; the object should also then be centered in the field of view of the main telescope.

Observing Tip*: If higher observing magnifications are intended, first locate, center, and focus the object using a low-power eyepiece (e.g., SP 26mm eyepiece). Remove the low-power eyepiece and replace it with a higher-power eyepiece; the object should still be centered in the field of view. Objects are much easier to locate and center at lower powers; higher powers are employed simply by changing eyepieces.*

INTRODUCTION

Both ETX model telescopes can be used for immediate observation right out of the box. However, becoming familiar with the fundamentals of a telescope makes subsequent viewing easier and more rewarding.

Choosing an Eyepiece

The function of a telescope's eyepiece is to magnify the image formed by the telescope's main optics. Each eyepiece has a focal length (expressed in millimeters, or "mm"). The smaller the focal length, the higher the magnification. Low power eyepieces offer a wide field of view, bright high-contrast images, and eye relief during long observing sessions. To find an object with a telescope it is always best to start with a low power eyepiece such as the SP 26mm supplied with both ETX models. When the object is located and centered in the eyepiece, switch to a higher power eyepiece to enlarge the image as much as practical for prevailing seeing conditions.

Lower power eyepieces are recommended for terrestrial viewing. Haze, heat waves, and particulate matter in the air distort images when using higher powers.

For astronomical observing a selection of several different eyepieces is recommended. For general observing of the Moon and planets, low to medium powers are preferred. For deep-sky objects such as nebulae and galaxies, higher powers may be needed for the best view if conditions permit.

NOTE: Viewing conditions vary widely from night to night. Turbulence in the air, even on an apparently clear night, can distort images. If an image appears fuzzy and ill-defined, back off to a lower power eyepiece for a better resolved image (see Fig.9).

Understanding Magnification

The magnification, or power, at which a telescope is operating is determined by two factors: the *focal length of the telescope* and the *focal length of the eyepiece employed.*

Telescope Focal Length is the distance that light travels inside the telescope before reaching a focus. In the mirror-lens design of both ETX models, however, this focal length is, in effect, compressed by the telescope's secondary mirror, so that a long effective focal length is housed in the short ETX optical tube. For example, the ETX-90EC's focal length is 1250mm, or about 49". This means that if the ETX–90EC were a classical refracting-type of telescope, its optical tube would be more than four feet long instead of the ETX–90EC's compact 11" tube length.

Eyepiece Focal Length is the distance light travels inside the eyepiece before reaching focus. Focal length is usually printed on the side of the eyepiece. Both ETX models are supplied with at least one eyepiece as standard-equipment. For instance, the Super Plössl (SP) 26mm eyepiece supplied with the ETX-90EC and ETX-125EC has a focal length of 26mm. "Super Plössl" refers to the optical design of the eyepiece, a design specifically intended for high-performance telescopes and one which yields a wide, comfortable field of view with extremely high image resolution.

Technical note to the advanced amateur astronomer: *The SP 26mm eyepiece supplied with the Meade ETX-90ECand ETX-125EC is a special low-profile version of the standard Meade SP 26mm eyepiece which is about 1/4" (6mm) shorter than the standard eyepiece. This low-profile SP 26mm is designed to harmonize with the ultracompact scale of both ETX models and utilizes the exact same optics as the standard SP 26mm eyepiece. The SP 26mm low-profile eyepiece is not parfocal with other eyepieces in the SP series (i.e., the eyepiece requires re-focusing when it is interchanged with other SP eyepieces).*

Calculating Magnification: On a telescope, such as the ETX, different eyepiece focal lengths are used to achieve different magnifications, from low to high. The standard-equipment SP 26mm eyepiece yields 48X ("48-power") on the ETX-90EC and 73X on the ETX-125EC. A variety of powers are obtainable with the addition of optional eyepieces as well as the #126 2X Barlow Lens which double the power of the eyepiece employed (see **OPTIONAL ACCESSORIES**, page 16).

Use this formula to calculate the magnification obtained with a given eyepiece:

$$\textbf{Power} = \frac{\textbf{Telescope Focal Length}}{\textbf{Eyepiece Focal Length}}$$

Example: The power obtained with the ETX-125EC using the SP 26mm eyepiece is:

$$\textbf{Power} = \frac{\textbf{1900mm}}{\textbf{26mm}} = \textbf{73X}$$

Too Much Power: The most common mistake of the beginning observer is to overpower the telescope by using high magnifications, which typical atmospheric conditions and the telescope's aperture cannot reasonably support. A smaller but bright and well-resolved image is far superior to one that is larger, but dim and poorly resolved (see Fig. 9). Powers above 300X (ETX–90EC) or 500X (ETX–125EC) should be employed only under the steadiest atmospheric conditions.

Most observers should have 3 or 4 eyepieces plus the #126 2X Barlow Lens to achieve the full range of reasonable magnifications possible with both ETX models.

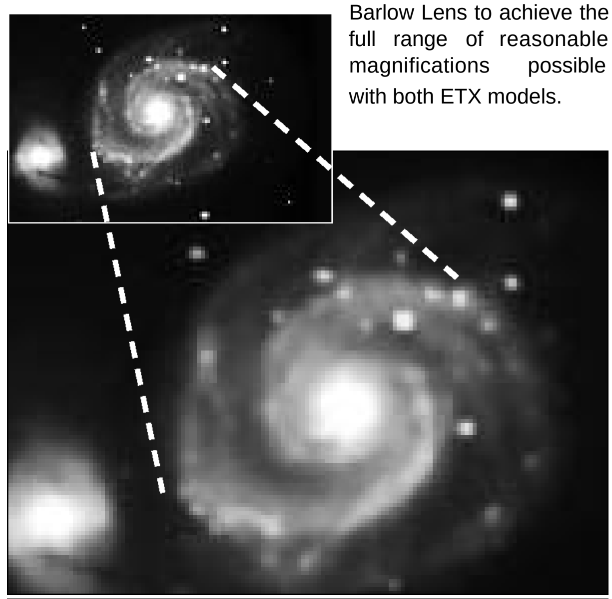


Fig.9: Example of too much magnification (Galaxy M51).

Telescope Mountings

The telescope *mounting* or *mount* is the mechanical means that causes the telescope's optical tube to move in various directions. Telescope mounts are of two basic types.

Altazimuth (Alt/Az) mounts permit motion of the telescope tube in vertical (altitude) and horizontal (azimuth) directions. Both ETX models incorporate an altazimuth mount (as shown in Fig. 10). For all terrestrial applications and for casual astronomical observing, the telescope operates very well in the altazimuth configuration. The telescope may be placed on a rigid tabletop or on the optional Meade #883 Deluxe Field Tripod (see page 17) to provide a secure, variable-height, altazimuth observing platform. To track objects, either terrestrial or astronomical, with the telescope in the altazimuth configuration, press the arrow keys of the Electronic Controller (see page6).

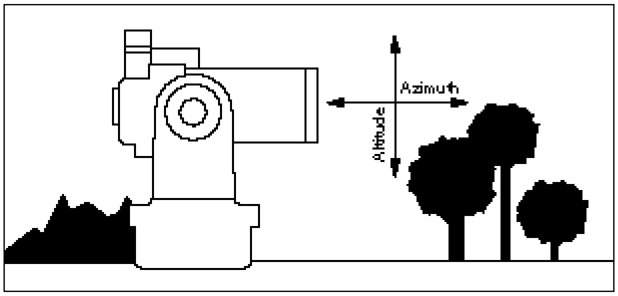


Fig. 10: Alt/Az mounting moves the telescope in vertical and horizontal directions.

Equatorial mounts are highly desirable in the operation of any telescope used for extensive astronomical applications, because celestial objects do not move in vertical or horizontal directions but in a combination of these directions. By tilting one of the telescope's mechanical axes (see Fig. 11) to point at the celestial pole (i.e., by pointing one axis of the telescope to the North Star, Polaris), you may follow (track) astronomical objects.

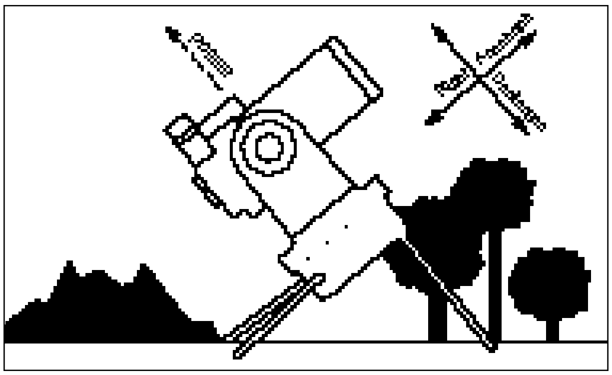


Fig. 11: Equatorial mounting aligns the telescope with the celestial sphere.

You need to turn in only one axis of the telescope instead of simultaneously turning in two axes, as required of the altazimuth mount. An equatorial mount which has one of its axes (the polar axis) pointing to the celestial pole is polar aligned. Both ETX models can be polar aligned either by using the optional #883 Deluxe Field Tripod or the table tripod specific to your model of ETX telescope (see **OPTIONAL ACCESSORIES**, page 17).

With the ETX polar aligned (see page 12) the telescope's internal motor drive may be activated (see **Modes of Operation**, page 11) to enable fully automatic hands off tracking of celestial objects. In this configuration the observer does not need to press the arrow keys of the Electronic Controller in order to track celestial objects. Notwithstanding this automatic tracking, the arrow keys of the Electronic Controller are useful in this configuration to enable the centering of objects within the telescopic field or, for example, to rove the telescope over the surface of the Moon or through a large star field.

Terrestrial Observing

Both ETX models make excellent, high-resolution terrestrial (land) telescopes. When you set the telescope on its drive base, as shown in Fig. 1, you may use it for an extremely wide range of observations. However, terrestrial images are right-side-up, but reversed left-for-right when viewed through the eyepiece. Normally, such an image orientation is not bothersome, unless you are trying to read a distant sign, for example. If the telescope is to be used for extensive terrestrial observations, a fully correctly oriented image is provided with the #932 45° Erecting Prism (see **OPTIONAL ACCESSORIES**, page 17).

Viewing terrestrial objects requires looking along the Earth's surface through heat waves. These heat waves often degrade image quality. Low-power eyepieces, like the SP26mm eyepiece, magnify these heat waves less than higher-power eyepieces. Therefore, low-power eyepieces provide a steadier, higher-quality image. If the image is fuzzy or ill-defined, reduce to a lower power. Observing in early morning hours, before the ground has built up internal heat, produces better viewing conditions than during late-afternoon hours.

Astronomical Observing

Used as an astronomical instrument, either ETX model has many optical and electromechanical capabilities. In astronomical applications, the extremely high level of optical performance of both ETX telescopes is readily visible. The range of observable astronomical objects is, with minor qualification, limited only by the observer's motivation.

Sidereal Rate

As the Earth rotates beneath the night sky, the stars appear to move from East to West. The speed at which the stars move is called the *sidereal rate*.

Never use a Meade ETX Astro Telescope to look at the Sun! Looking at or near the Sun will cause *instant* and *irreversible* damage to your eye. Eye damage is often painless, so there is no warning to the observer that damage has occurred until it is too late. Do not point the telescope or its viewfinder at or near the Sun. Do not look through the telescope or its viewfinder as it is moving.Children should always have adult supervision while observing.

If the telescope is polar aligned (enabled by mounting the telescope to one of the optional tripods), the motor drive in each ETX model is designed to rotate the telescope at the sidereal rate so that it automatically tracks the stars. This tracking makes it easy to locate objects and keep them centered in the telescope's eyepiece.

Slew Speeds

The Electronic Controller has four slew speeds that are directly proportional to the sidereal rate. These speeds are signified by the Electronic Controller indicator lights (2, Fig. 6) and have been calculated to accomplish specific functions.

Light 1: The fastest slew speed moves the telescope quickly from one point in the sky to another.

Light 2: The next fastest speed is best used for centering the object in the viewfinder.

Light 3: The third speed is set to enable centering the object in the field of a low-to-moderate power eyepiece, such as the standard SP26mm.

Light 4: The slowest slew speed is for centering an object in the field of view of a high-power eyepiece (e.g., 200X to 300X for the ETX-90EC or 400X to 500X for the ETX-125EC).

The four available speeds are:

Light 1 =	1200 x sidereal	(300 arc-min/sec *or* 5°/sec)
Light 2 =	180 x sidereal	(45 arc-min/sec *or* 0.75°/sec)
Light 3 =	32 x sidereal	(8 arc-min/sec *or* 0.13°/sec)
Light 4 =	8 x sidereal	(2 arc-min/sec *or* 0.034°/sec)

The two slowest speeds (8x and 32x sidereal) should be used for pushbutton tracking of astronomical objects while observing through the eyepiece.

THE ELECTRONIC CONTROLLER

Briefly described on page 6, the Electronic Controller is the primary device used to move ETX model telescopes. Electronic Controller functions include:

- Slewing the telescope (see **Observing with the Electronic Controller**, page 6)
- Turning on the telescope motor drive to automatically track celestial objects (when the telescope is polar aligned)
- Changing the hemisphere of operation, when required
- Changing tracking speed (see **APPENDIX A**, page 22)

Modes of Operation

The Electronic Controller can be set to operate in either of two primary modes: the **Alt/Az** mode (used when the telescope is operated in the altazimuth configuration; see page 9) and the **polar** mode (used when the telescope is polar-aligned; see page 10).

- **Alt/Az** (altitude-azimuth, or vertical-horizontal) mode should be chosen for all terrestrial operations of the telescope. In the Alt/Az mode you can use the arrow keys to slew the telescope to terrestrial or astronomical objects and, once you locate them, you can follow these objects if they move. However, in this mode astronomical tracking is not automatic and requires continuous key pushes. *The Electronic Controller is factory pre-set to the Alt/Az mode.*
- **Polar** mode should be chosen in cases where the telescope is equipped with either the optional #880 (ETX–90EC) or #881 (ETX-125EC) Table Tripod, or #883 Deluxe Field Tripod, permitting polar alignment of the telescope for extensive astronomical observations. In this mode you can use the arrow keys to slew the telescope to objects, as in the Alt/Az mode above. In addition, the telescope's internal motor drive is turned on, enabling fully automatic tracking of celestial objects.

The following two methods are available to change the Electronic Controller between the Alt/Az and polar modes:

1. Physically remove one of the mode screws (see **Using the Mode Screws**, below).
2. Use the MODE key on the Electronic Controller, as described in **Electronic Controller Modes**, opposite.

Using the Mode Screws

You can remove the two screws on the bottom rear of the Electronic Controller handbox to change the default mode of the Electronic Controller to Alt/Az or polar and, if polar, to the hemisphere in which you are located.

NOTE:Mode screws A and B are the outer screws in the recess directly under the letters A and B on the rear of the Electronic Controller. Do not remove either of the inner two screws in the recess.

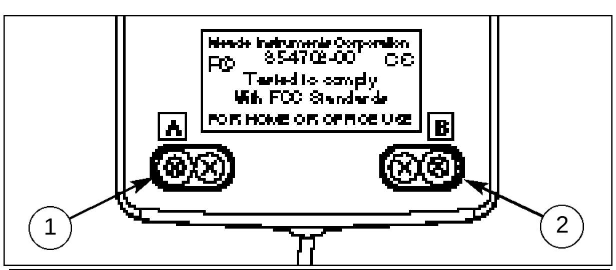


Fig.12: Mode screws on rear of Electronic Controller. (1) Mode .screw A; (2) Mode screw B.

Mode Screw A (1, Fig. 12): Remove mode screw A to make the *Northern hemisphere polar* mode the automatic default of the Electronic Controller when power is applied (i.e., the motor drive is activated for operation in the Earth's Northern Hemisphere — the U.S.A., Europe, Japan, etc.).

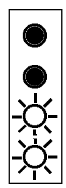
Mode Screw B (2, Fig. 12): Remove mode screw B to to make the *Southern Hemisphere polar* mode the automatic default of the Electronic Controller when power is applied (i.e., the motor drive is activated for operation in the Earth's Southern Hemisphere — Australia, South America, Africa, etc.).

NOTES:(1) Leaving both A and B screws in place (or removing both screws) keeps the telescope in its original Alt/Az mode. (2) Removing either A or B screw affects only the telescope's default *mode; you may still make mode changes at will during telescope operation using the MODE key (see* ***Electronic Controller Modes****, below).*

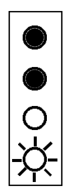
Electronic Controller Modes

The Electronic Controller is in the Alt/Az mode when activated, unless a mode screw has been removed. To use the Electronic Controller to change to Northern or Southern Hemisphere polar mode, or to use Alt/Az mode with one of the mode screws removed, use the following procedure:

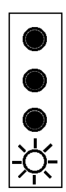
1. Complete the **Polar Alignment Procedure** on page 12.
2. Complete steps 2 through 8 in **Observing with the Electronic Controller** (page 7) to initialize the Electronic Controller.



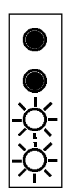
3. Press and hold the MODE key (5, Fig. 6) until lights 1 and 2 are on steady and lights 3 and 4 start blinking.



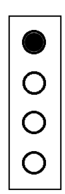
4. Press the SPEED key (3, Fig. 6) once. This changes the system to polar mode for the Earth's Southern Hemisphere, with the motor drive set to operate at the sidereal rate.



5. Press the SPEED key a second time. This changes the system to polar mode for the Earth's Northern hemisphere, with the motor drive set to operate at the sidereal rate.



6. Press the SPEEDkey a third time and the system returns to the Alt/Az mode. *In the Alt/Az mode the motor drive does not activate when exiting from the Mode function.*
7. Use the SPEED key as described in the above steps to cycle among these three modes (Alt/Az, Southern Hemisphere polar, or Northern Hemisphere polar) until the desired mode is shown by the appropriate light configuration.



8. Press and hold the MODEkey until just one light is on. This exits the Mode function. If you choose Northern or Southern Hemisphere polar mode, the motor drive starts operating at the sidereal rate.
9. Use the four arrow keys (1, Fig. 6) to slew the telescope to the desired object. To change the slew speed, press the SPEED key.

NOTE: See ***APPENDIX A*** *(page 22) for advanced functions of the Electronic Controller.*

For extensive astronomical observing, the telescope is best mounted in the polar configuration. In polar alignment the telescope is oriented so that the horizontal and vertical axes of the telescope align with the celestial coordinate system (see Fig. 11).

To polar align either ETX model you must understand how and where to locate celestial objects as they move across the sky. This section introduces the terminology of polar-aligned astronomy, and includes instructions for finding the celestial pole and for following objects in the night sky using Declination and Right Ascension.

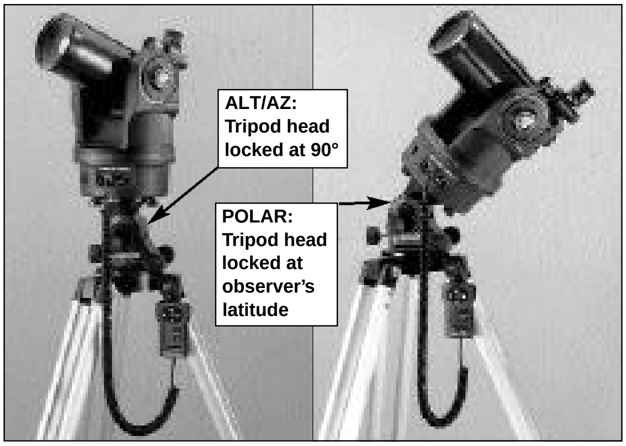


Fig. 13: Examples of Alt/Az and polar mounting of an ETX-90EC to the optional #883 Deluxe Field Tripod.

Celestial Coordinates

Celestial objects are mapped according to a coordinate system on the celestial sphere (Fig. 14), an imaginary sphere surrounding Earth on which all stars appear to be placed. This celestial object mapping system is analogous to the Earth-based coordinate system of latitude and longitude.

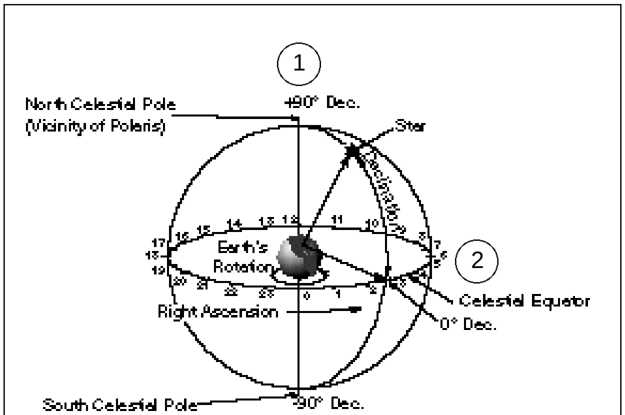


Fig.14: The Celestial Sphere.

The poles of the celestial coordinate system are defined as those two points where the Earth's rotational axis, if extended to infinity, north and south, intersect the celestial sphere. Thus, the North Celestial Pole (1, Fig. 14) is that point in the sky where an extension of the Earth's axis through the North Pole intersects the celestial sphere. This point in the sky is located near the North Star, Polaris.

In mapping the surface of the Earth, lines of longitude are drawn between the North and South Poles. Similarly, lines of latitude are drawn in an east-west direction, parallel to the Earth's equator. The celestial equator (2, Fig. 14) is a projection of the Earth's equator onto the celestial sphere.

Just as in mapping the surface of the Earth, imaginary lines have been drawn to form a coordinate grid for the celestial sphere. Object positions on the Earth's surface are specified by their latitude and longitude. For example, you could locate Los Angeles, California, by its latitude (+34°) and longitude (118°). Similarly, you could locate the constellation Ursa Major, which includes the Big Dipper, by its general position on the celestial sphere:

Right Ascension: 11hr; Declination: +50°.

- **Right Ascension:** The celestial analog to Earth longitude is Right Ascension (R.A.). It is measured in time on the 24-hour clock and shown in hours (hr), minutes (min) and seconds (sec) from an arbitrarily defined zero line passing through the constellation Pegasus. R.A. coordinates range from 0hr 0min 0sec to 23hr 59min 59sec. Thus there are 24 primary lines of R.A., located at 15-degree intervals along the celestial equator. Objects located further and further east of the prime R.A. grid line (0hr 0min 0sec) carry higher R.A. coordinates.
- **Declination:** The celestial analog to Earth latitude is called Declination (Dec.). It is measured in degrees, minutes, and seconds (*e.g.,* 15° 27' 33"). Dec. shown as north of the celestial equator is indicated with a plus (+) sign (*e.g.,* the Dec. of the North celestial pole is +90°). Dec. south of the celestial equator is indicated with a minus (–) sign (the Dec.of the South celestial pole is –90°). Any point on the celestial equator (which passes through the constellations Orion, Virgo, and Aquarius) is specified as having a Declination of zero, shown as 0° 0' 0".

All celestial objects are specified in position by their celestial coordinates of R.A. and Dec.

Locating the Celestial Pole

To get basic bearings at an observing location, take note of where the sun rises (East) and sets (West) each day. After the site is dark, face north by pointing your left shoulder toward where the sun set. To precisely point at the pole, find the North Star (Polaris) by using the Big Dipper as a guide (Fig. 17).

Polar Alignment Procedure

As the Earth rotates once on its axis every 24 hours, astronomical objects appear to move across the sky in an arc. This apparent motion (see **Sidereal Rate**, page 10) is not obvious to the unaided eye, but viewed through a serious telescope such as the ETX-90EC or ETX-125EC, this motion is rapid indeed. If the motor drive has not been engaged, objects centered in the telescope's eyepiece move entirely out of the field of view in 30 to 160 seconds, depending on the magnification employed.

For easy tracking of astronomical objects your ETX telescope should be *polar aligned*.

There are two mounting methods available to polar align the telescope: the optional #883 Deluxe Field Tripod or the table tripod specific to your model of ETX telescope.

To Polar align using the #883 Deluxe Field Tripod (Fig. 13), follow the instructions provided with the tripod. To Polar align using the #880 (ETX-90EC) or #881 Table Tripod (ETX–125EC), use the following procedure.

1. Make sure the viewfinder is aligned with your ETX telescope (see **Aligning the Viewfinder,** page 8).
2. Remove the two hole covers (13, Fig. 1) from the side of the drive base and thread the two identical fixed legs (4, Fig. 16) into these holes to a *firm feel* only.
3. Determine the latitude of the observing location from a road map, atlas, or the **Latitude Chart for Major Cities of the World**, page 23; determining the latitude within about one degree is sufficient.

4. Each table tripod is equipped with two adjustable tripod legs: The *standard tripod leg* is used at observing latitudes as shown in the box in step 5 and has a dual latitude label attached (Fig. 15). The *high-latitude tripod leg* is shorter and is used at higher observing latitudes. Based on the observing latitude determined in step 3, set aside the tripod leg that is not to be used.
5. Locate the two mounting holes on the bottom of the telescope drive base. Mount the appropriate adjustable tripod leg (as determined in step 4) to the drive base using the following latitudes:

Standard Tripod Leg (ETX-90EC)
32.5° to 48.5° uses *high-latitude* hole (2, Fig. 16).
22° to 35.5° uses *alternate* hole (3, Fig. 16).

High-Latitude Tripod Leg (ETX-90EC)
56° to 66° uses *high-latitude* hole.
44° to 55° uses *alternate* hole.

Standard Tripod Leg (ETX-125EC)
33.5° to 49.5° uses *high-latitude* hole.
23.25° to 36.5° uses *alternate* hole.

High-Latitude Tripod Leg (ETX-125EC)
56.6° to 67° uses *high-latitude* hole.
44.5° to 56.5° uses *alternate* hole.

Thread the appropriate leg into the required hole to a *firm feel* only.

6. A small thumbscrew (6, Fig. 16) is attached to both the standard and high-latitude tripod legs. Loosening the thumbscrew allows the outer section of the leg to slide over the inner section, so that the leg can be extended. If using the standard tripod leg, extend the leg so that the center of the thumbscrew head aligns with the latitude of the observing location on the scale. Retighten the thumbscrew to a firm feel. (If using the high-latitude tripod leg, complete the adjustment of the leg extension in step 9.)

Example: The latitude of New York City is 41°. The tripod leg should be extended so that the center of the thumbscrew is set next to the 41° reading on the scale.

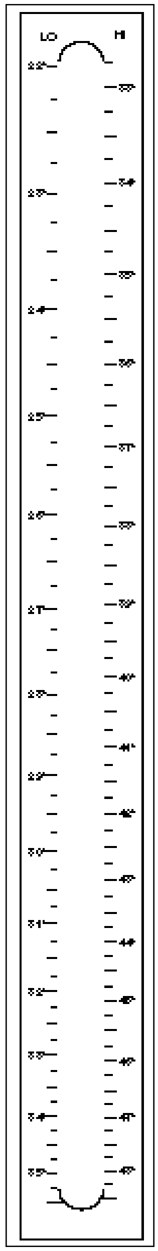


Fig.15: Example of Standard Tripod Leg Latitude Scales.

CAUTION:When using the #880 Table Tripod with the ETX-90EC, the optional #1422 Low-Latitude Balance Weight is recommended if the telescope is to be polar aligned below 30°, or if heavy accessories are attached to the eyepiece-end of the telescope. The low-latitude balance weight is recommended for the ETX-125EC at all observing latitudes and is included as standard equipment with the #881 Table Tripod.

NOTE:With the standard tripod leg threaded into the appropriate hole in the drive base, the latitude scale may be at an inconvenient position for reading (e.g., the scale faces the drive base). This situation can be remedied by unthreading the leg, removing the thumbscrew, rotating the inner leg 180°, then reinserting the thumbscrew. The scale should now be readable when threaded back into the telescope base.

7. Loosen the vertical and horizontal locks (6 and 10, Fig. 1) and rotate the telescope so that it is oriented as shown in Fig. 16. Tighten the vertical and horizontal locks. In this orientation the telescope's optical tube is lined up parallel to the tripod's adjustable leg.

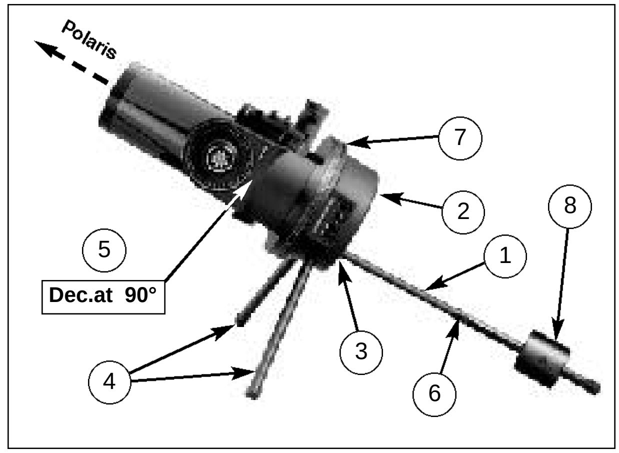


Fig.16: Example of Polar Alignment Using the #880 Table Tripod and ETX-90EC. (1) Standard tripod leg with latitude scale; (2) High-latitude hole; (3) Alternate hole; (4) Fixed tripod legs; (5) Declination pointer; (6) Thumbscrew; (7) R.A. scale pointer; (8) #1422 low-latitude balance weight.

8. Note the line and arrow extending from the telescope tube in Fig. 16. This line defines the telescope's *polar axis*. Lift the entire telescope, including tripod, and place the telescope on a firm and level surface so that this axis is pointing due North *(i.e., if the location of Polaris, the North Star, is known then point the telescope directly at Polaris).*

9. If using the high-latitude tripod leg in the Northern hemisphere, extend the leg until the telescope's polar axis points to Polaris, or due North, an alignment obtained by sighting along the telescope tube with the telescope oriented as shown in Fig. 16.

NOTE: Observer's located in the earth's Southern Hemisphere (e.g., South America, Africa, Australia, etc.) should point the telescope's polar axis due South.

10. With the telescope now polar-aligned the table tripod should not be moved, or else polar alignment will be lost. Motions of the telescope (e.g., to locate and/or track objects) should be effected only (a) by loosening the locks (6 and 10, Fig. 1), which permits the optical tube to be moved freely within the telescope mounting, or (b) more generally, with the locks in their "locked" positions, by using the arrow keys of the Electronic Controller.

NOTE: For almost all astronomical observing requirements, approximate settings of the telescope's latitude and polar axis are acceptable. Do not allow undue attention to precise polar alignment of the telescope to interfere with your enjoyment of the instrument. In those unusual cases where more precise polar alignment is desirable, refer to APPENDIX C, page 24.

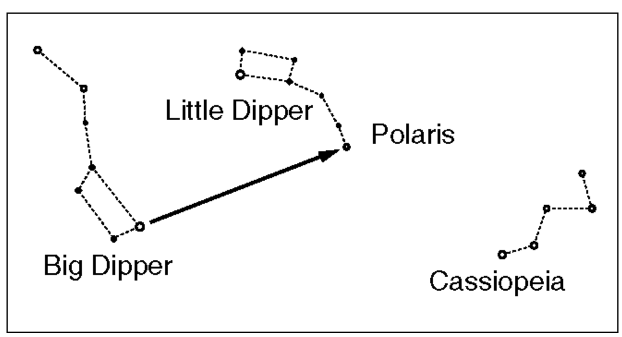


Fig. 17: Locating Polaris.

OBJECTS IN SPACE

Listed below are some of the many astronomical objects that can be seen with either ETX model telescope.

The Moon

The Moon is, on average, 239,000 miles (380,000km) from Earth. It is best observed during its crescent or half phase, when sunlight strikes its surface at an angle, casting shadows and adding depth to the view (Fig. 18).

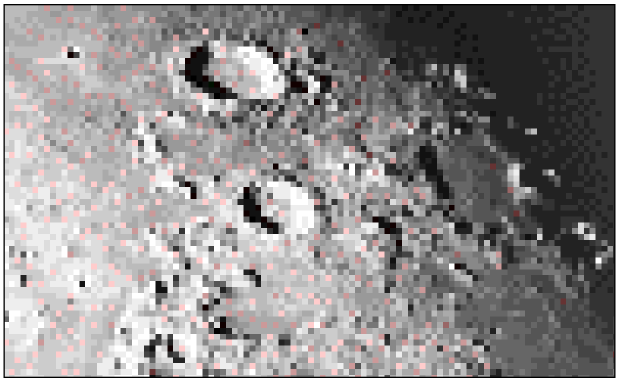


Fig. 18: This photo of the Moon shows the rich detail afforded by shadows.

No shadows are seen during a full Moon, causing the overly bright Moon to appear flat and uninteresting through the telescope. Using either ETX model, brilliant detail can be observed on the Moon, including hundreds of lunar craters and maria, described below.

Craters are round meteor impact sites covering most of the Moon's surface. With no atmosphere on the Moon, no weather conditions exist, so the only erosive force is meteor strikes. Under these conditions, lunar craters can last for millions of years.

Maria (plural for *mare,* seas**)** are smooth, dark areas scattered across the lunar surface. These areas are ancient impact basins that were filled with lava from the interior of the Moon by the depth and force of the meteor or comet impact.

12 Apollo astronauts left their bootprints on the Moon in the late 1960's and early 1970's. However, no telescope on Earth can see these footprints or any other artifacts. In fact, the smallest lunar features that may be seen with the largest telescope on Earth are about one-half mile across.

NOTE:Except during its early or late crescent phases, the Moon can be an exceptionally bright object to view through the telescope. To reduce the brightness and glare, use the #905 Variable Polarizing Filter (see ***OPTIONAL ACCESSORIES****, page18).*

Planets

Planets change positions in the sky as they orbit around the Sun. To locate the planets on a given day or month, consult a monthly astronomy magazine, such as *Sky and Telescope* or *Astronomy*. Listed below are the best planets for viewing through either ETX model telescope.

Venus is about nine-tenths the diameter of Earth. As Venus orbits the Sun, observers can see it go through phases (crescent, half, and full) much like those of the Moon. The disk of Venus appears white, as sunlight is reflected off the thick cloud cover that completely obscures any surface detail.

Mars is about half the diameter of Earth. Through the telescope it appears as a tiny reddish-orange disk. You may see a hint of white at one of the planet's polar ice caps. Approximately every two years, when Mars is closest to Earth, additional detail and coloring on the planet's surface may be visible.

Jupiter is the largest planet in our solar system, with a diameter 11 times that of Earth. Jupiter appears as a disk with dark lines stretching across the surface. These lines are cloud bands in the atmosphere. Four of Jupiter's 16 moons (Io, Europa, Ganymede, and Callisto) can be seen as star-like points of light when you use even the lowest magnification. The number of moons visible on any given night changes as they circle around the giant planet.

Saturn is nine times the diameter of Earth and appears as a small, round disk with rings extending out from either side. In 1610, Galileo, the first person to observe Saturn through a telescope, did not understand that what he was seeing were rings. Instead, he believed that Saturn had "ears." Saturn's rings are composed of billions of ice particles, ranging in size from a speck of dust to the size of a house. The major division in Saturn's rings, called the Cassini Division, is generally visible through both ETX models. Titan, the largest of Saturn's 18 moons can also be seen as a bright, star-like object near the planet.

Deep-Sky Objects

You can use star charts to locate constellations, individual stars, and deep-sky objects. Examples of various deep-sky objects are given below:

Stars are large gaseous objects that are illuminated by nuclear fusion in their core. Because of their vast distances from our solar system, all stars appear as pinpoints of light, regardless of the size of the telescope used.

Nebulae are vast interstellar clouds of gas and dust where stars are formed. Most impressive of these is the Great Nebula in Orion (M42), a diffuse nebula that appears as a faint wispy gray cloud. M42 is 1600 light years from Earth.

Open Clusters are loose groupings of young stars, all recently formed from the same diffuse nebula. The Pleiades (Fig. 19) is an open cluster 410 light years from Earth. Several hundred stars of the cluster are visible through both ETX models .

Constellations are large, imaginary patterns of stars believed by ancient civilizations to be the celestial equivalent of objects, animals, people, or gods. These patterns are too large to be seen through a telescope. To learn the constellations, start with an easy grouping of stars, such as the Big Dipper in Ursa Major. Then use a star chart to explore across the sky.

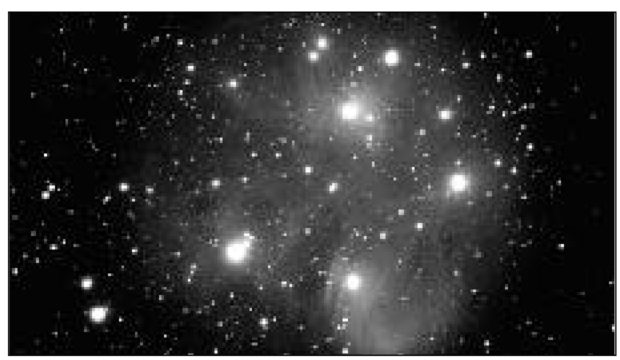


Fig. 19: The Pleiades Star Cluster (M45) in the constellation Taurus.

Galaxies are large assemblies of stars, nebulae, and star clusters that are bound by gravity. The most common shape is spiral (such as our own Milky Way), but galaxies can also be elliptical, or even irregular blobs. The Andromeda Galaxy (M31) is the closest spiral-type galaxy to our own. This galaxy appears fuzzy and cigar-shaped. It is 2.2 million light years away in the constellation Andromeda, located between the large "W" of Cassiopeia and the great square of Pegasus. Under clear, dark conditions, M31 can be seen with the naked eye and is a fascinating object through both ETX models.

PHOTOGRAPHY WITH BOTH ETX MODELS

Photography through either ETX model requires the addition of the optional #64 T–Adapter (see **OPTIONAL ACCESSORIES**, page 17). With the #64 T-Adapter attached to the telescope (Fig. 20), through-the-telescope photography is possible with any 35mm camera body with a removable lens. In this way the telescope effectively becomes the lens of the camera.

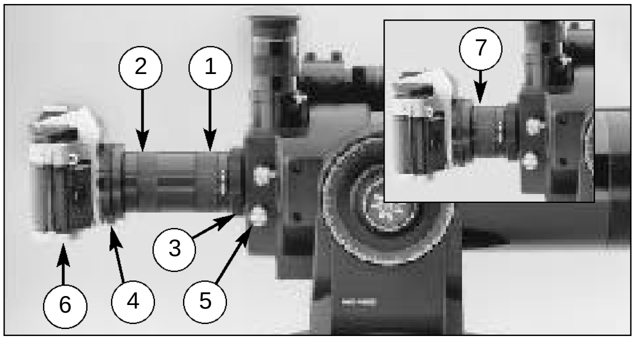


Fig.20: Example of photography through the ETX using the #64 T–Adapter. (1) Short section of #64 T-Adapter; (2) Extension section of #64 T-Adapter; (3) Knurled attachment ring; (4) T-mount; (5) Flip-mirror control in "down" position; (6) 35mm camera body; (7) Format 1.

For through-the-telescope photography, turn the flip-mirror control, (5, Fig. 20) to the "down" position, allowing light to pass straight through the telescope and out the photo port (17, Fig. 1). With the flip-mirror control in the "down" position and the photo port's dust cover removed, you can see the front lens of the telescope when you look through the photo port. The #64 T-Adapter threads onto the photo port, followed by a T-mount for the particular brand of 35mm camera being used, followed by the camera body (with the camera lens removed).

The #64 T-Adapter consists of two sections (1 and 2, Fig. 20), which are threaded together in shipment. You may use either of the following photographic mounting formats to couple the camera body to the telescope's photo port thread.

- **Format 1:** *Camera Body + T-Mount + Section (1) of the #64 T-Adapter* (7, Fig. 20).

ETX-90EC	1250mm at f/13.8
ETX-125EC	1900mm at f/15

Format 1 utilizes only the short section of the #64 T–Adapter to permit close-coupling of a camera body to the telescope. In this format vignetting will occur: the photographic image will appear on film with a slight darkening at the corners of the 35mm frame (see Fig. 21).

- **Format 2:** *Camera Body + T-Mount + Sections (1) and (2) of the #64 T-Adapter* (see Fig. 20).

Fig.21: Example of a format 1 photo.

ETX-90EC	1450mm at f/16
ETX-125EC	2310mm at f/18

Format 2 utilizes both sections of the #64 T-Adapter threaded together to form a rigid unit. In this configuration there is no field vignetting: images are illuminated to the edges of a standard 35mm frame (see Fig. 22).

Fig.22: Example of a format 2 photo.

To frame an object in the viewfinder of the 35mm camera body, slightly loosen the knurled attachment ring (3, Fig. 20), which threads the #64 T-Adapter to the telescope's photo port; rotate the camera body to achieve proper framing of the object; then re-tighten the knurled ring.

Photography through a long lens, such as the ETX requires special technique for good results. The photographer should expect to waste a roll or two of film in acquiring this technique. Long-lens photography has its own rewards, however, which short-focus lenses cannot duplicate.

A few tips on photography with both ETX models

1. Use the optional table tripod specific to your model of ETX, or the #883 Deluxe Field Tripod as a platform for the telescope. At effective focal lengths of 1250mm to 1450mm (ETX-90EC) or 1900mm to 2310mm (ETX–125EC), even small external vibrations can easily ruin an otherwise good photo.

   CAUTION: With the #64 T-Adapter and a camera body mounted to the ETX photo port, the telescope can be rotated vertically only 45°. Moving past this point may damage the telescope and camera.

2. Use a cable-operated shutter release. Touching the camera body to operate the shutter will almost certainly introduce undesirable vibrations.

3. Focus the image with extreme care. While observing the subject through the camera's reflex viewfinder, turn the ETX's focus knob (9, Fig. 1) to achieve the sharpest possible focus. Note that some 35mm cameras may have an optional focusing screen (available from the manufacturer) for use with a long telephoto lens. This screen provides a brighter and clearer image to focus and is highly recommended.

4. Correct shutter speeds vary widely, depending on lighting conditions and film used. Trial-and-error is the best way to determine proper shutter speed in any given application.

*NOTE: The camera used with either ETX model may have an **exposure meter** that is still active when the standard lens is removed and the body is connected to the telescope with the T–mount. If used for terrestrial photography, the camera meter should be acceptable. If used for astrophotography, the meter probably will not provide good results since camera meters are not made to compensate for a dark sky.*

5. Terrestrial photography through either ETX model is sensitive to heat waves rising from the Earth's surface. Long distance photography is best accomplished in the early morning hours before the earth has had time to build up heat.

6. Photography of the Moon and planets through either ETX model can be especially gratifying, but points 1 through 4 should be particularly noted in this case. Lunar or planetary photography requires that the telescope be polar aligned (see **Polar Alignment Procedure**, page 12), and that the telescope's motor drive be in operation (see **Electronic Controller Modes**, page 11).

NOTE:Long-exposure photography of deep-sky objects is not practical with either ETX model, since this type of photography requires special electronic and optical guiding devices not available for this telescope.

CHAPTER 5

A wide assortment of professional Meade accessories is available for both ETX model telescopes. Meade accessories greatly extend many important applications of the telescope, from low-power, wide-field terrestrial viewing to high-power lunar and planetary observing. The premium quality of these accessories is well suited to the quality of the instrument itself.

Meade telescopes and accessories, including optional accessories for ETX telescopes, are available at more than 2000 dealer locations in the U.S. and Canada and through Meade international distributors worldwide. Once you have identified the accessories you wish to order, contact your local Meade authorized dealer. To find a dealer near you, call (949) 451-1450 or visit the Meade website at ***www.meade.com***.

#497 Autostar™ Computer Controller: One of the most important advances in telescope control in the past 25 years, the Meade #497 Autostar Computer Controller (Fig. 23) turns either ETX model into an automatic celestial object locating system. Just plug Autostar into the telescope's HBX port in place of the standard-equipment Electronic Controller, do a quick telescope alignment, and you are ready to observe any object in the Autostar's 14,000-object database.

Fig.23: #497 Autostar Computer Controller.

Best of all, the Meade Autostar is easy to use. Even the most novice observer will locate dozens of fascinating objects the very first night out — from commonly observed objects, like the rings of Saturn, the satellites of Jupiter, and the Orion Nebula (M42), to more difficult objects, such as the Ring Nebula (M57) in Lyra, the Spiral Galaxy (M33) in Triangulum, and the Sombrero Galaxy (M104) in Virgo; to very obscure objects near the telescope's threshold of visibility, such as spiral galaxy NGC 3310 in Ursa Major.

Any of Autostar's database objects can be called up and entered on the hand controller display in seconds. The observer then simply presses the GO TO pushbutton and watches as the telescope automatically slews to the object and places it in the field of view. Autostar brings into easy access objects that were previously unreachable for all but the most dedicated of amateur astronomers.

Astro Software/Cable Connector Kit: Meade ETX–90ECand ETX-125EC Astro Telescopes equipped with the Autostar Computer Controller maybe used in conjunction with Meade astro software to operate the telescope in the GO TO mode directly from the display of a personal computer. With the Meade astro software loaded into the PC, and with the PC connected to the telescope through Autostar's RS-232 serial interface (using the **#505 Cable Connector Set,** included with each astro software package), the observer can point and click on any object shown on the PC display. The telescope then slews to the object at a speed of 5° per second on both telescope axes and places the object in the telescopic field of view.

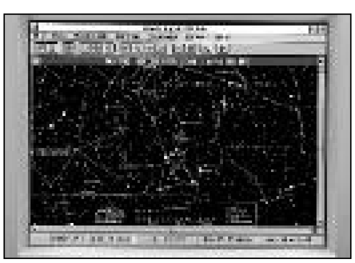


Fig.24: Astro software.

Fig. 25: Optional Eyepieces yield higher and lower magnifying powers with the telescope.

Eyepieces: Meade Super Plössl (SP), Super Wide Angle (SWA), and Ultra Wide Angle (UWA) eyepieces in the standard American-size (1.25") barrel diameter (Fig. 25) permit a wide range of magnifying powers with both ETX models. Powers obtained with each eyepiece are shown in the following table.

	ETX-90EC		ETX-125EC	
Eyepiece	**Power**	**2X Barlow**	**Power**	**2X Barlow**
SP6.4mm	195X	390X	297X	594X **
SP9.7mm	129X	258X	196X	392X
SP 12.4mm	101X	202X	153X	306X
SP 15mm	83X	166X	127X	253X
SP 20mm	63X	126X	95X	190X
SP 26mm *	48X	96X	73X	146X
SP 32mm	39X	78X	59X	119X
SP 40mm	31X	62X	48X	96X
SWA 13.8mm	91X	182X	138X	275X
SWA 18mm	69X	138X	106X	211X
SWA 24.5mm	51X	102X	78X	155X
UWA 4.7mm	266X	N/A	404X	N/A
UWA 6.7mm	187X	374X **	284X	567X **

* Included as standard-equipment with both ETX models.
** Use these eyepieces only under extremely steady atmospheric conditions.

Meade SP and SWA eyepieces are ideal for general-purpose astronomical or terrestrial observing. The typical ETX user may wish to add two or three of these eyepieces to his or her telescope. An introductory selection might include the SP 9.7mm and SP 15mm eyepieces. The more advanced observer might select the SP 9.7mm, SP 12.4mm, and SWA 18mm. Meade SWA eyepieces yield extremely wide fields of view, perfect for the examination of star fields or diffuse nebulae, or for terrestrial applications. Under steady viewing conditions, Meade UWA 4.7mm and 6.7mm eyepieces present the widest fields of view obtainable at high powers and are excellent eyepieces for viewing the Moon and planets.

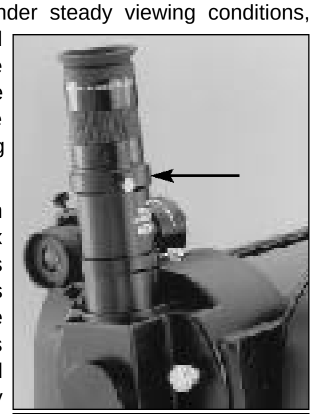


Fig. 26: Use the #126 2x Barlow Lens to double the magnification of the eyepiece employed.

#126 2x Barlow Lens: An amplifying lens, the #126 2x Barlow Lens (Fig. 26) doubles the powers of all eyepieces with which it is used. Insert the #126 into the telescope's eyepiece holder first, followed by an eyepiece. *Example:* By itself the SP 26mm eyepiece yields a power of 73X with the ETX-125EC; when used with the #126 2X Barlow Lens, this eyepiece yields 146X.

The Meade #126 2x Barlow lens is an achromatic, high-performance, short-focus Barlow Lens, perfectly suited to the low-profile design of both ETX models. Lens surfaces are multi-coated for maximum image contrast and light transmission.

#825 8 x 25mm Right-Angle Viewfinder: Included as standard-equipment on ETX-125EC models, the 8 x 25mm Right-Angle Viewfinder (Fig. 27) permits a comfortable 90° viewing position with 90mm ETX models as well. The #825 fits into the same bracket as the 8x21mm viewfinder supplied with ETX-90EC telescopes. The finder's wide-angle 7.5° actual field facilitates object location and a helicoid mechanism allows precise focusing.

Fig. 27: #825 Right-Angle Viewfinder.

#64 T-Adapter: The basic means of photography through any ETX telescope, the #64 T-Adapter (1,Fig. 28) threads to the rear cell of the telescope, followed by a T-Mount appropriate to the user's brand of 35mm camera. In this way, the camera body is rigidly coupled to the telescope's optical system, which in effect becomes the camera's lens (see **PHOTOGRAPHYWITHBOTH ETX MODELS**, page 15).

#880 and #881 Table Tripods: ETX-90EC and ETX-125EC models permit pushbutton tracking of astronomical objects from their standard-equipment Electronic Controllers. For fully automatic tracking a table tripod (Fig. 28), or the #883 Deluxe Field Tripod may be added allowing for polar alignment of the telescope.

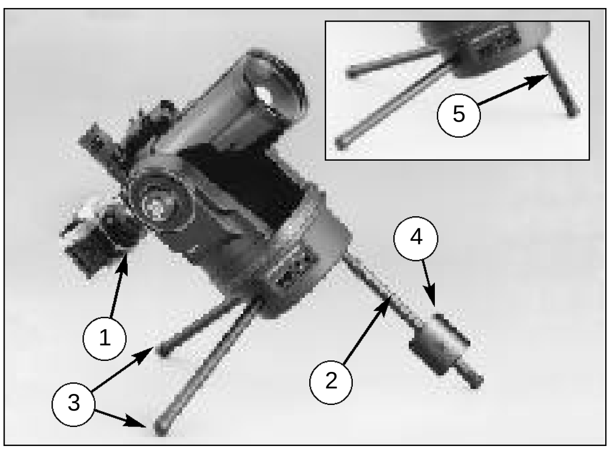


Fig.28: Example of astronomical photography using the #880 Table Tripod with an ETX-90EC. (1) #64 T-Adapter; (2) Standard tripod leg; (3) Fixed tripod legs; (4) Balance weight; (5) High-latitude tripod leg.

Each table tripod includes two fixed legs and two variable-length legs inscribed with a range of latitude settings for quick polar alignment. The #880 Table Tripod (for the ETX–90EC) and #881 Table Tripod (for the ETX-125EC) attach quickly to the telescope drive base.

Two identical fixed tripod legs (3, Fig. 28) mount to holes on the side of the drive base. The adjustable standard tripod leg (2, Fig. 28), with its two latitude scales, is mounted to one of two holes on the bottom of the drive base. It permits the telescope to be polar aligned for latitudes between 22° and 48.5° (ETX-90EC) or between 23.25° and 49.5° (ETX-125EC). The shorter high-latitude tripod leg (5, Fig. 28) is substituted for the standard tripod leg at latitudes between 44° and 66° (ETX-90EC) or 44.5° and 67° (ETX-125EC).

#1422 Low-Latitude Balance Weight (for ETX-90EC): If the ETX-90EC is to be used with the #880 Table Tripod and polar-aligned at latitudes below 30°, the telescope can become unbalanced, particularly if heavier accessories (*e.g.,* a camera body) are attached to the eyepiece-end of the telescope. The low-latitude balance weight (4, Fig. 28) slides onto the standard tripod leg and enables rock-solid stability of the telescope even at lower latitudes.

NOTE:The low-latitude balance weight for the ETX-125EC is supplied with the #881 Table Tripod and is recommended for use at all latitudes covered by the standard tripod leg.

#883 Deluxe Field Tripod: Manufactured of strong, lightweight extruded aluminum, the #883 Deluxe Field Tripod (Fig. 29) allows standing or seated observations through both ETX models. Tripod height is continuously adjustable from 34" to 54". Micrometric controls in both azimuth and elevation-angle permit precise polar alignment of the telescope's fork mount for astronomical applications (inset, Fig. 29).

Fig. 29: The #883 Deluxe Field Tripod shown with an ETX-90EC Astro Telescope, set up in the Alt/Az configuration (tripod head locked at 90°), for terrestrial applications. (Inset) Tripod head tilted for polar alignment.

Designed exclusively for both ETX model telescopes, the #883 Deluxe Field Tripod includes all the rigidity and stability required for high-power observing through the telescope. For terrestrial observing, where altazimuth orientation of the telescope is desirable, the tripod head tilts and locks at 90°.

#932 45° Erecting Prism: All ETXmodels include an internal optically-flat mirror to reflect light to the telescope's 90° astronomical observing position. In this position the telescope's image is upright, but reversed. For terrestrial observing with either ETX model, the #932 45° Erecting Prism (1, Fig. 30) gives a fully correctly oriented image and a convenient 45° observing angle. The #932 prism threads onto the telescope's photo port (17, Fig. 1). An eyepiece of any focal length (magnifying power) may be inserted into the #932 prism. Note that the flip-mirror control (4, Fig. 30) must be in the "down" position for use with the #932 prism.

CHAPTER
5

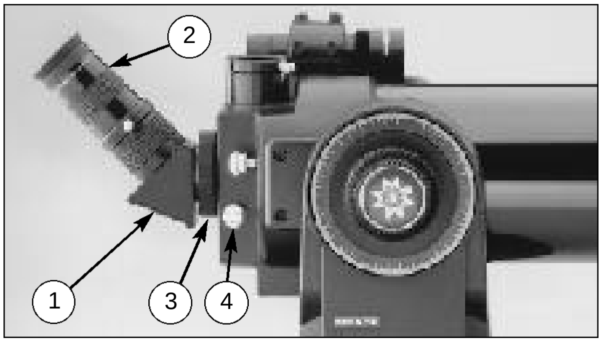


Fig.30: The #932 45° Erecting Prism shown threaded to the rear cell of an ETX-90EC. (1) #932 45° Erecting Prism; (2) Eyepiece; (3) Knurled lock-ring; (4) Flip-mirror control.

Important Note: *In the most discriminating applications, such as long-distance observing of delicate bird feather-structure, both ETX models' internal, optically-flat mirror yields a higher-resolution image than is possible with any prism, including the #932. In these special cases users of both ETX models are advised to observe with the eyepiece in the standard 90° eyepiece holder (as shown in Fig.1), with the flip-mirror control in the "up" position. This admonition applies only to situations requiring extraordinarily high optical resolution and where the observer's eye is well trained to observe very fine detail. In typical terrestrial applications, no image differences between the two eyepiece locations can generally be noted.*

#765 Soft Carry Bag: The Meade soft-padded carry bag (Fig. 31) is well suited to travel with the ETX-90EC. Each carry bag includes a shoulder strap and permits ready transport of the complete telescope, including accessories.

Fig.31: The #765 Soft Carry Bag for the ETX-90EC.

Power Adapters and Cords: In addition to their internal battery packs, ETX-90ECand ETX-125EC telescopes may be powered from standard 115vAC home electricity with the **#541 AC Adapter**. The #541 plugs into any standard home outlet and includes a 25 ft. cord connecting to the telescope's control panel. Input voltage to the telescope is 12vDC. Alternately, either telescope may be powered in the field from an automobile cigarette lighter plug by using the **#607 Power Cord** (Fig. 32), a 25-ft. cord that plugs into the telescope's control panel and supplies 12vDC directly from the car battery.

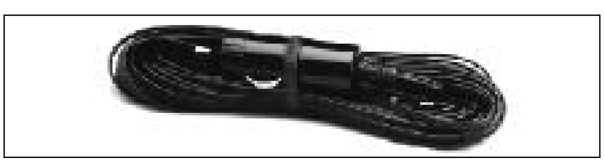


Fig.32: #607 Power Cord.

#1244 and #1247 Electric Focusers:

Meade-engineered for smooth, rapid focusing with both ETX models, each electric focuser (Fig. 33) includes coarse and micro-fine speeds. The standard-equipment hand controller accepts one (user-supplied) 9-volt battery. On both ETX models, the focuser plugs into, and is powered by, the telescope's control panel, with operation effected through either the Electronic Controller or the optional #497 Autostar Computer Controller: the **#1244** for ETX-90EC and the **#1247** for ETX-125EC.

Fig.33: #1244 Electric Focuser.

Hard Carrying Cases: For secure portability of the ETX-90EC (**#774 Hard Case**) or ETX-125EC (**#775 Hard Case**) in the field, Meade hard carrying cases (Fig. 34) are fully lined with fitted foam inserts. They accept the complete telescope and accessories *(e.g.,* additional eyepieces, table tripod, the Electronic Controller, Autostar, and much more).

Fig.34: #775 Hard Carrying Case shown with an ETX-90EC.

#905 Variable Polarizing Filter: For glare reduction in observing the Moon, the #905 Variable Polarizer (Fig. 35) includes two polarizer filters, mounted in a specially machined cell. The #905 filter permits variable settings of light transmission, between 5% and 25%, to account for varying lunar-surface brightness according to the phase of the Moon. The #905 accepts 1.25" barrel-diameter eyepieces of any focal length.

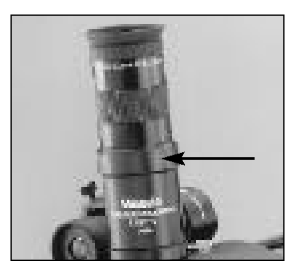


Fig.35: #905 Variable Polarizing Filter.

General Maintenance

Both ETX model telescopes are precision optical instruments designed to yield a lifetime of rewarding applications. Given the care and respect due any precision instrument, the telescopes will rarely require factory servicing or maintenance. Use the following guidelines:

1. Avoid cleaning the telescope's optics: a little dust on the front surface of the telescope's correcting lens causes virtually no degradation of image quality and should not be considered reason to clean the lens.
2. When absolutely necessary, remove dust from the front lens with gentle strokes of a camel-hair brush or blow it off with an ear syringe (available at any pharmacy). *Do not use a commercial photographic lens cleaner.*
3. You may remove organic materials (*e.g.,* fingerprints) from the front lens with a solution of 3 parts distilled water to 1 part isopropyl alcohol. A single drop of biodegradable dishwashing soap may be added per pint of solution. Use soft, white facial tissues and make short, gentle strokes. Change tissues often.

CAUTION: Do not use scented, colored, or lotioned tissues or damage could result to the optics.

4. In the very rare situation where cleaning the inside surface of the corrector lens becomes necessary, unthread the lens cell located at the front of the main tube. The entire correcting lens and secondary mirror system are mounted in this cell. You may use the lens-cleaner solution described in step 3 to clean the inside surface of the lens.

CAUTION: Do not touch the aluminized circular surface of the secondary mirror with a finger, a tissue, or any other object.This will almost certainly scratch the mirror surface.

NOTE:When cleaning the inside surface of the correcting lens, leave the lens mounted in its metal cell throughout the process. Do not remove the lens from its metal housing or optical alignment of the lens will be lost, necessitating a return of the telescope to the Meade factory.

5. If either ETX model is used outdoors on a humid night, telescope surfaces may accumulate water condensation. While such condensation does not normally cause any damage to the telescope, it is recommended that the entire telescope be wiped down with a dry cloth before being packed away. *Do not, however, wipe any of the optical surfaces.* Rather, simply allow the telescope to sit for some time in warm indoor air, so that the wet optical surfaces can dry unattended. In addition, the dust cap should not be placed back on to the optical tube until the telescope is thoroughly dry.
6. If either ETX model is not to be used for an extended period, perhaps for one month or more, it is advisable to remove the eight AA-size batteries from inside the drive base. Batteries left installed for prolonged periods may leak, causing damage to the telescope's electronic circuitry (see Assembly Instructions, page 5).
7. The super-gloss anodized finish of both ETX model's deep-violet optical tube fades if left in direct sunlight for prolonged periods.
8. Do not leave either ETX model outdoors on a warm day or inside a sealed car for an extended period of time; excessive ambient temperatures can damage the telescope's internal lubrication and electronic circuitry.
9. A set of two (English-format) hex wrenches is provided with both ETX models. These wrenches are used as follows:

- Small wrench (.05"): Use the small wrench to tighten the set-screws of any knobs that may loosen (e.g., the focus knob or flip-mirror control knob).
- Medium wrench (1/16"): This wrench is used to detach the viewfinder bracket from the telescope's rear cell.

Storage and Transport

When the telescope is not in use, store it in a cool, dry place. Do not expose the instrument to excessive heat or moisture. It is best to store the telescope in its original box with the vertical and horizontal locks (6 and 10, Fig. 1) in the *unlocked* positions. If shipping the telescope, use the original box and packing material to protect the telescope during shipment.

When transporting the telescope, take care not to bump or drop the instrument; this type of abuse can damage the optical tube and/or the objective lens. It is highly recommended to use an optional carry case to transport the telescope (see OPTIONAL ACCESSORIES, page 18).

Inspecting the Optics

A Note About the "Flashlight Test: If a flashlight or other high-intensity light source is pointed down the main telescope tube, the view (depending upon the observer's line of sight and the angle of the light) may reveal what appear to be scratches, dark or bright spots, or uneven coatings, giving the appearance of poor quality optics. These effects are only seen when a high intensity light is transmitted through lenses or reflected off the mirrors, and can be seen on any high-quality optical system, including giant research telescopes.

The optical quality of a telescope cannot be judged by the "flashlight" test; the true test of optical quality can only be conducted through careful star testing.

Troubleshooting

The following suggestions may be helpful with operation of the ETX-90EC and ETX-125EC.

The power indicator light on the telescope does not come on or there is no response when pressing the Electronic Controller arrow keys:

- Verify that the computer control panel power switch (1, Fig. 5) is in the ON position.
- Verify that the Electronic Controller cord (4, Fig. 6) is firmly connected to the HBX port (3, Fig. 5).
- If using internal power (batteries), verify that the batteries are installed correctly and that they have sufficient charge (see Assembly Instructions, page 5).

NOTE: If the batteries are getting low on charge, there will be a marked difference in the slew speed. The speed indicator lights may also flash and the speed may change. If any of these symptoms occurs, turn the power off and replace the batteries.

- If using an external power source, verify that it is properly connected between the 12-volt connector (4, Fig. 5) and either a wall plug (AC source) or a car cigarette lighter (DC source).
- If the Electronic Controller does not respond to commands, move the power switch to OFF and then back to ON.
- If the telescope does not slew after power is applied or if the motor quits or stalls, verify that there are no physical obstructions that would impede telescope movement.
- If all physical obstacles are removed and the telescope still does not move properly, turn off the power and unplug the Electronic Controller. Plug the Electronic Controller back in and turn the power back on.

Unable to see an image through the eyepiece:

- Confirm that the lens cover has been removed from the telescope.
- Confirm that the flip-mirror control (16, Fig. 1) is in the "up" position if using the eyepiece holder (4, Fig. 1) so that light is directed to the eyepiece (1, Fig. 1). Confirm that the flip-mirror control is in the "down" position if using the #932 Erecting Prism or doing photography with either ETX model (see Telescope Controls, page 6 and PHOTOGRAPHY WITH BOTH ETX MODELS, page 15).

Object appears in the viewfinder but not in the eyepiece:

- The viewfinder is not properly aligned with the telescope (see THEVIEWFINDER page 8).

Slew speed does not change when you press the SPEED key, or the telescope moves slowly even though the fast slew speed is chosen:

- Verify that only one light is illuminated on the Electronic Controller. If more than one light is on or blinking, the Mode function is active. Exit the Mode function by pressing and holding the MODE key until only one light is on (see Electronic Controller Modes, page 11).
- The battery power may be low (see Assembly Instructions, page 5).

Telescope does not track a celestial object:

- The telescope tracks celestial objects automatically only if it is placed in the polar mode (see Modes of Operation, page 11) and the telescope is polar aligned (see Polar Alignment, page 12) using the #880 (ETX-90EC), #881 (ETX-125EC) Table Tripod, or #883 Deluxe Field Tripod (see OPTIONAL ACCESSORIES, page 17). The more accurate the polar alignment, the longer the telescope's motor drive holds an object in the field of view of the eyepiece. If using the Alt/Az mode, track celestial objects by using the directional arrows on the Electronic Controller. Automatic racking of objects in the Alt/Az mode requires the optional #497 Autostar Computer Controller.

Images through the eyepiece appear unfocused or distorted:

- The magnification may be too high for the viewing conditions. Back off to a lower power eyepiece (see Understanding Magnification, page 9).
- If inside a warm house or building, move outside. Interior air conditions may distort terrestrial or celestial images, making it difficult, if not impossible, to obtain a sharp focus. For optimal viewing, use the telescope outside in the open air instead of observing through an open or closed window or screen.
- If viewing a land object on a warm day, heat waves will distort the image (see Terrestrial Observing, page 10).
- For clear viewing of objects, turn the focus knob (9, Fig. 1) slowly since the "in-focus" point of a telescope is precise. Turning the focus knob too quickly may cause the focus point to pass without notice.
- The optics within the telescope need time to adjust to the outside ambient temperature to provide the sharpest image. To cool down the optics, set the telescope outside for 10 to 15 minutes before observing begins.

Telescope moves off a terrestrial object while observing:

- The motor drive may be activated (see Modes of Operation, page 11).
- Verify that the vertical and horizontal locks are tight (see Telescope Controls, page 6).

Telescope does not move past a certain point:

- The built-in vertical or horizontal rotational "stops" may have been reached (see Rotational Limits, page 6).

Telescope pauses when changing slew direction:

- This pause is normal (see Arrow Keys, page 6).

A terrestrial object appears reversed left-for-right:

- An eyepiece in the standard 90° observing position (4, Fig. 1) reverses an object left-for-right:. To view a correctly oriented image requires the optional #932 Erecting Prism (see OPTIONALACCESSORIES, page 17).

Meade Customer Service

If you have a question concerning either ETX model, call the Meade Instruments Customer Service Department at (949) 451-1450, or fax at (949) 451-1460. Customer Service hours are 8:30 AM to 4:30 PM, Pacific Time, Monday through Friday. In the unlikely event that the ETX requires factory servicing or repairs, *write or call the Meade Customer Service Department first, before returning the telescope to the factory,* giving full particulars as to the nature of the problem, as well as your name, address, and daytime telephone number. The great majority of servicing issues can be resolved by telephone, avoiding return of the telescope to the factory.

Specifications: ETX-90EC Astro Telescope

Optical design . . . . Maksutov-Cassegrain
Primary mirror diameter . . . . 96mm (3.78”)
Clear aperture . . . . 90mm (3.5”)
Focal length. 1250mm
Focal ratio (photographic speed). f/13.8
Near focus (approx) . . . . 11.5 ft (3.5m)
Resolving power. . . . . 1.3 arc secs
Super multi-coatings (EMC). . . . . standard
Limiting visual stellar magnitude (approx.). 11.7
Image scale. . . . . 1.16°/inch
Maximum practical visual power 325X
Optical tube dimensions
(dia. x length) . . . . 10.4cm x 27.9cm (4.1” x 11”)
Eyepiece. . . . . Super Plössl 26mm
Viewfinder . . . . 8 x 21mm
Secondary mirror obstruction (dia.; %) . . 27.9mm (1.1”); 9.6%
Telescope mounting . . . . fork type; double tine
Setting circle diameters . . . . Dec: 3.5”; RA: 7”
Input voltage. . . . . 12 volts DC
Motor DriveSystem DCservo motors with encoders, both axes
Slow-Motion Controls . . . . electric, 4 speed, both axes
Optional Autostar Capability. . . . . yes
Hemispheres of operation . . . . . North and South, switchable
Bearings:
Altitude. . . . . UHMW polyethylene
Azimuth . . . . PTFE
Materials:
Tube body . . . . aluminum
Mounting . . . . . . high-impact ABS, aluminum-reinforced
Primary mirror . . . . Pyrex® glass
Correcting lens. . . . . BK7 optical glass, Grade-A
Telescope dimensions:
. . . . 38cm x 18cm x 22cm (15” x 7” x 9”)
Telescope net weight:
(incl. Electronic Controller & batteries) . . 3.5kg (7.8 lbs)
Telescope shipping weight. . . . . 5.8kg (12.8 lbs)
Battery Life (approx.):
with Electronic Controller . . . . 45 hrs
with Autostar . . . . 20 hrs

Specifications: ETX-125EC Astro Telescope

Optical design . . . . Maksutov-Cassegrain
Primary mirror diameter . . . . 138mm (5.43”)
Clear aperture . . . . 127mm (5.0”)
Focal length . . . . 1900mm (74.8”)
Focal ratio (photographic speed) f/15
Near focus (approx). . . . . 5.5m (18 ft)
Resolving power. . . . . 0.9 arc secs
Super multi-coatings (EMC). . . . . standard
Limiting visual stellar magnitude (approx.). 12.5
Image scale. . . . . 0.76°/inch
Maximum practical visual power 500X
Optical tube dimensions
(dia. x length) . . . . 14.6cm x 36cm (5.75” x 14.2”)
Eyepiece. . . . . Super Plössl 26mm
Viewfinder. . . . . 8 x 25mm right-angle
Secondary mirror obstruction (dia.; %). . 39.4mm (1.6”); 9.6%
Telescope mounting . . . . fork type; double tine
Setting circle diameters. . . . . Dec: 4.3”; RA: 9”
Input voltage. . . . . 12 volts DC
Motor Drive System . . DCservo motors with encoders, both axes
Slow-Motion Controls . . . . electric, 4 speed, both axes
Optional Autostar Capability. . . . . yes
Hemispheres of operation . . . . . North and South, switchable
Bearings:
Altitude . . . . Acetal
Azimuth . . . . radial ball bearing
Materials:
Tube body . . . . aluminum
Mounting . . . . high-impact ABS, zinc-reinforced
Primary mirror . . . . Pyrex® glass
Correcting lens. . . . . BK7 optical glass, Grade-A
Telescope dimensions:
. . . . 48cm x 23cm x 27cm (19” x 8.9” x 10.8”)
Telescope net weight:
(incl. Electronic Controller & batteries) . . 7.9kg (17.4 lbs)
Telescope shipping weight. . . . . 12.4kg (27.4 lbs)
Battery Life (approx.):
with Electronic Controller . . . . 45 hrs
with Autostar . . . . 20 hrs

APPENDIX **A**

In the polar mode the Electronic Controller normally tracks objects at the sidereal rate (see Sidereal Rate, page 10). For most observing sessions (once the telescope has been polar aligned and the tracking motor activated), there is little need to change this speed.

For objects, like the Moon or a comet, that move at slightly different rates, the Electronic Controller arrow keys (1, Fig. 6) are sufficient to move the telescope slightly as the object very slowly moves off-center through the eyepiece field.

To change the tracking rate, for extended observations of an object not moving at the sidereal rate, follow the procedure for the appropriate hemisphere:

Indicator Light Key	Light No.	Light Status
The procedures in this manual identify the status of the four indicator lights in a box to the left of the appropriate step. They are depicted as *on*, *blinking* or *off*, depending on the mode at that point.	Light 1 Light 2 Light 3 Light 4	On Blinking Off

Northern Hemisphere Polar:

1. Press and hold the MODE key (5, Fig. 6) until the Mode function is active (i.e., lights 1 and 2 are on steady; lights 3 and 4 signify whatever tracking mode was last chosen).

2. Press the SPEED key (3, Fig. 6) until lights 1, 2, and 3 are on steady with light 4 blinking. The telescope is now in the Northern Hemisphere Polar mode.

3. Press the INkey and light 4 comes on steady. The tracking rate is now 0.5% *faster* than sidereal. Continue pressing IN until the desired speed is reached.

NOTE:The tracking rate can be increased by up to 65% (127 presses of the IN key).

4. To use a rate slower than sidereal, press the OUT key until light 4 blinks again (sidereal rate). Press the OUT key again and light 4 goes out, signifying a tracking rate 0.5% *slower* than sidereal. Pressing an additional 3 to 4 times will slow the tracking rate to the lunar rate.

NOTE:The tracking rate can be decreased by up to 65% (127 presses of the OUT key).

5. Press and hold the MODE key until only a single light is on. This exits the Mode function. If Northern or Southern Hemisphere polar mode was chosen, the motor drive starts operating at the sidereal rate.

6. Use the four arrow keys (1, Fig. 6) to slew the telescope to the desired object. To change the slew speed, press the SPEED key.

Southern Hemisphere Polar:

1. Press and hold the MODE key (5, Fig. 6) until the Mode function is active (i.e., lights 1 and 2 are on steady; lights 3 and 4 signify the tracking mode last chosen).

2. Press the SPEED key (3, Fig. 6) until lights 1 and 2 are on steady, light 3 is off, and Light 4 is blinking.

3. Press the INkey and light 4 comes on steady. The tracking rate is now 0.5% *faster* than sidereal. Continue pressing INuntil the desired speed is reached.

NOTE:The tracking rate can be increased by up to 65% (127 presses of the IN key).

4. To use a rate slower than sidereal, press the OUT key until light 4 blinks again (sidereal rate). Press the OUT key again and light 4 goes out, signifying a tracking rate 0.5% *slower* than sidereal. Pressing an additional 3 to 4 times will slow the tracking rate to the lunar rate.

NOTE:The tracking rate can be decreased by up to 65% (127 presses of the OUT key).

5. Press and hold the MODE key until only a single light is on. This exits the Mode function. If Northern or Southern Hemisphere polar mode was chosen, the motor drive starts operating at the sidereal rate.

6. Use the four arrow keys (1, Fig. 6) to slew the telescope to the desired object. To change the slew speed, press the SPEEDkey.

Latitude Chart for Major Cities of the World

To aid in the polar alignment procedure (see page 12), latitudes of major cities around the world are listed below. To determine the latitude of an observing site not listed on the chart, locate the city closest to your site. Then follow the procedure below:

Northern hemisphere observers (N): If the site is over 70 miles (110 km) north of the listed city, add one degree for every 70 miles. If the site is over 70 miles south of the listed city, subtract one degree per 70 miles.

Southern Hemisphere observers (S): If the site is over 70 miles north of the listed city, subtract one degree for every 70 miles. If the site is over 70 miles south of the listed city, add one degree per 70 miles.

UNITED STATES

City	State	Latitude
Albuquerque	New Mexico	35° N
Anchorage	Alaska	61° N
Atlanta	Georgia	34° N
Boston	Massachusetts	42° N
Chicago	Illinois	42° N
Cleveland	Ohio	41° N
Dallas	Texas	33° N
Denver	Colorado	40° N
Detroit	Michigan	42° N
Honolulu	Hawaii	21° N
Jackson	Mississippi	32° N
Kansas City	Missouri	39° N
Las Vegas	Nevada	36° N
Little Rock	Arkansas	35° N
Los Angeles	California	34° N
Miami	Florida	26° N
Milwaukee	Wisconsin	46° N
Nashville	Tennessee	36° N
New Orleans	Louisiana	30° N
New York	New York	41° N
Oklahoma City	Oklahoma	35° N
Philadelphia	Pennsylvania	40° N
Phoenix	Arizona	33° N
Portland	Oregon	46° N
Richmond	Virginia	37° N
Salt Lake City	Utah	41° N
San Antonio	Texas	29° N
San Diego	California	33° N
San Francisco	California	38° N
Seattle	Washington	47° N
Washington	District of Columbia	39° N
Wichita	Kansas	38° N

EUROPE

City	Country	Latitude
Amsterdam	Netherlands	52° N
Athens	Greece	38° N
Bern	Switzerland	47° N
Copenhagen	Denmark	56° N
Dublin	Ireland	53° N
Frankfurt	Germany	50° N
Glasgow	Scotland	56° N
Helsinki	Finland	60° N
Lisbon	Portugal	39° N
London	England	51° N
Madrid	Spain	40° N
Oslo	Norway	60° N
Paris	France	49° N
Rome	Italy	42° N
Stockholm	Sweden	59° N
Vienna	Austria	48° N
Warsaw	Poland	52° N

SOUTH AMERICA

City	Country	Latitude
Asuncion	Paraguay	25° S
Brasilia	Brazil	24° S
Buenos Aires	Argentina	35° S
Montevideo	Uruguay	35° S
Santiago	Chili	34° S

ASIA

City	Country	Latitude
Beijing	China	40° N
Seoul	South Korea	37° N
Taipei	Taiwan	25° N
Tokyo	Japan	36° N
Victoria	Hong Kong	23° N

AFRICA

City	Country	Latitude
Cairo	Egypt	30° N
Cape Town	South Africa	34° N
Rabat	Morocco	34° N
Tunis	Tunisia	37° N
Windhoek	Namibia	23° S

AUSTRALIA

City	State	Latitude
Adelaide	South Australia	35° S
Brisbane	Queensland	27° S
Canberra	New South Wales	35° S
Alice Springs	Northern Territory	24° S
Hobart	Tasmania	43° S
Perth	Western Australia	32° S
Sydney	New South Wales	34° S
Melbourne	Victoria	38° S

Star Locator

Following is a list of bright stars with their R.A. and Dec. coordinates, along with the Northern hemisphere season when these stars are prominent in the night sky. This list will aid the observer to find alignment stars at various times of the year. For example, if it is a midsummer evening in the Northern hemisphere, Deneb in the constellation Cygnus, would be an excellent alignment star, while Betelgeuse could not be used because it is in the winter constellation Orion and thus below the horizon.

Season	Star Name	Constellation	R.A.	Dec.
Spring	Arcturus	Bootes	14h16m	19° 11"
Spring	Regulus	Leo	10h09m	11° 58"
Spring	Spica	Virgo	13h25m	-11° 10"
Summer	Vega	Lyra	18h37m	38° 47"
Summer	Deneb	Cygnus	20h41m	45° 17"
Summer	Altair	Aquilla	19h51m	08° 52"
Summer	Antares	Scorpius	16h30m	-26° 26"
Fall	Markab	Pegasus	23h05m	15° 12"
Fall	Fomalhaut	Pisces Austrinis	22h58m	-29° 38"
Fall	Mira	Cetus	02h19m	-02° 58"
Winter	Rigel	Orion	05h15m	-08° 12"
Winter	Betelgeuse	Orion	05h55m	07° 25"
Winter	Sirius	Canis Major	06h45m	-16° 43"
Winter	Aldebaran	Taurus	04h35m	16° 31"

Precise Polar Alignment

Important note: *For almost all astronomical observing requirements, approximate settings of the telescope's latitude and polar axis are acceptable. Do not allow undue attention to precise polar alignment of the telescope to interfere with your enjoyment of the instrument.*

If desired, you may obtain more precise polar alignment by first accomplishing basic polar alignment as detailed in Polar Alignment Procedure, page 12, then returning to this procedure:

NOTE:This procedure moves the telescope physically to line up precisely with the celestial pole. Do not use the Electronic Controller arrow keys *to move the telescope electronically or polar alignment will be lost.*

1. Orient the entire telescope, including tripod or tripod legs, so that the polar axis is pointing toward Polaris (Fig. 16).
2. While observing through the SP 26mm eyepiece of the telescope, adjust the length of the adjustable tripod leg until Polaris is visible in the eyepiece. Use a combination of (a) *lifting and turning the entire telescope* (or nudging the position of one of the fixed tripod legs) and (b) *adjusting the length of the adjustable tripod leg to place Polaris in the center of the telescope's field*.
3. Repeat step 2 of this procedure in about 15 minutes to see how much drift has taken place and to make the alignment more precise.

Although the above procedure is somewhat tedious (since the field of view of the telescope with the SP26mm eyepiece is only about 1°), it is a worthwhile effort if *precise* polar alignment is desired (*e.g.,* if photography of the Moon or a planet is to be performed). With Polaris placed in the center of the telescope's eyepiece, the telescope is now polar aligned within about one or two degrees, a level of alignment precision more than sufficient for almost any observing application.

To provide the most stable platform from which to polar align both ETX models, it is recommended to purchase the #883 Deluxe Field Tripod. The tripod head tilts easily to the local latitude angle for quick polar alignment, and it locks in a 90° position to facilitate Alt/Az viewing (see OPTIONALACCESSORIES, page 17).

Setting Circles

Both ETX models are equipped with R.A. and Dec setting circles (14 and 18, Fig. 1) to aid in locating faint celestial objects *when the telescope has been polar aligned*. Setting circles emulate the celestial coordinates found on star charts or in sky catalogs. Any charted object is easily located by coordinates in R.A. (in hours, minutes, and seconds, from 0h 0m 0s to 23h 59m 59s) and Dec. (in degrees from 0° to ±90°).

With either ETX model polar aligned, use the Electronic Controller arrow keys (1, Fig. 6) to move the telescope in R.A. (left and right keys) and Dec. (up and down keys).

NOTE:The Dec setting circle is located on the left arm of the telescope fork mount. The right arm of the mount contains a graduated circle (mounted behind the knurled knob of the vertical lock), without Dec. numbers.

- **Right Ascension Setting Circle:** Since celestial objects move in R.A., the R.A. setting circle (Fig. 36) must be reset as each object is located during an observing session. The R.A. pointer is located on the drive base 90° *counterclockwise* from the telescope's computer control panel (11, Fig. 1) immediately under the R.A. circle.

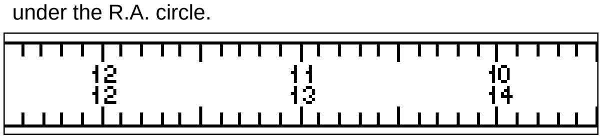


Fig.36: Section of Right Ascension setting circle.

NOTE: The R.A. circle has two rows of numbers from 0 to 23, corresponding to the hours of a 24-hour clock.The upper row of numbers is used by observers in the Earth's Northern hemisphere, the lower row by observers in the Earth's Souther n Hemisphere.

- **Declination Setting Circle:** The Dec. setting circle (Fig. 37) has been factory set to read the correct Declination of sky objects.

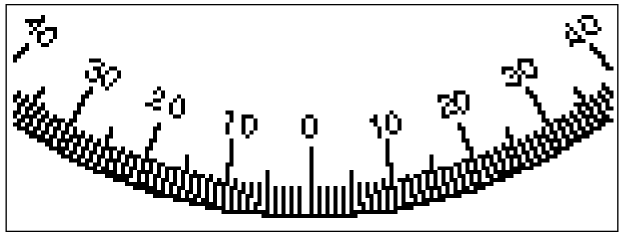


Fig.37: Section of Declination setting circle.

Because the smooth knob on this fork mount arm need never be loosened, the Dec setting circle should always remain calibrated. If for some reason this knob becomes loose and the Dec. setting circle must be recalibrated, level the optical tube (5, Fig. 1) so that it is parallel to the drive base. Loosen the smooth knob covering the Dec. setting circle until the setting circle moves freely. Reposition the setting circle so that the 0 setting aligns with the Dec. pointer (5,Fig.16). Retighten the Dec. knob.

To use the setting circles to find astronomical objects, the ETX must first be polar aligned. It is advisable that the motor drive be turned on (see Modes of Operation, page 11) and that a low-power eyepiece (*e.g.,* the SP 26mm eyepiece) be employed. Then use the following procedure:

1. Identify the celestial coordinates (R.A. and Dec) of a bright, easy-to-find object, such as a bright star. (Avoid using Polaris or any object near Polaris.) Coordinates of some bright stars are listed in the Star Locator (page 23), or use a star chart. Center this object in the telescope's field of view.
2. Manually turn the R.A. circle (14, Fig. 1) to read the R.A. of the object at the R.A. pointer (7, Fig. 16).
3. The R.A. circle is now calibrated to read the correct R.A. of any object at which the telescope is pointed. The Dec. circle is already calibrated through polar alignment.
4. To find another object, again identify the R.A. and Dec. coordinates. Then, *without touching the setting circles*, move the telescope (manually, by unlocking the vertical and horizontal locks, or by slewing the telescope using the Electronic Controller arrow keys) so that the R.A. and Dec. pointers read the coordinates of the second object.
5. If the above procedure has been followed carefully, the second object will now be in the telescope's field of view.

NOTE:Since the second object (i.e., the object to be located) is in constant motion, once the R.A. circle is calibrated (step 2, above) the telescope should be moved rapidly to read the coordinates of the second object. Otherwise the second object will no longer be in the position indicated by the R.A.circle.

Using setting circles requires a developed technique. When using the circles for the first time, try hopping from one bright star (the calibration star) to another bright star of known coordinates. Practice moving the telescope from one easy-to-find object to another. In this way the precision required for accurate object location becomes familiar.

The night sky is filled with wonder and intrigue. You too can enjoy exploring the universe simply by following a few pointers on a *roadmap to the stars*.

First, find the **Big Dipper,** which is part of the constellation Ursa Major. (It is in the center of Fig. 38.) The Big Dipper is usually easy to locate year round in North America due to its proximity to the North Star, Polaris.

Extending directly out from the far side of the Big Dipper's cup is the constellation **Orion.** One of the most exquisite areas of the winter sky, Orion is distinguished by two bright stars, Rigel and Betelgeuse, and Orion's belt, which is marked by three stars in a row. The **Orion Nebula** is located south of the belt and is one of the deep-sky objects most observed by amateur astronomers.

Extending from the pointer stars (end stars) of the Big Dipper's cup is Polaris, the closest star to the northernmost point of the celestial sphere. Extending from Polaris is the **Great Square** shared by the constellation Pegasus and Andromeda. Within Andromeda is the Andromeda Galaxy, the closest large galaxy to our solar system at about 2.2 million light-years away.

The **Summer Triangle** is a notable region in the sky to the left of the handle of the Big Dipper. The triangle is made up of three very bright stars: Vega, Deneb, and Altair.

By drawing an imaginary line outward from the handle of the Big Dipper you reach the southern constellation **Scorpius.** Scorpius curves to the left like the tail of a scorpion in the sky, or like letter "J."

Amateur astronomers commonly use the phrase ***"Arc to Arcturus and spike to Spica"*** to refer to the area directly off the *arc* in the handle of the Big Dipper. Follow the *arc to Arcturus,* the second brightest star in the Northern Hemisphere, then *spike down to Spica*, the 16th brightest star in the sky. Now follow the arc in the handle of the Big Dipper in the opposite direction and you reach another famous arc called **The Sickle,** in the constellation **Leo.**

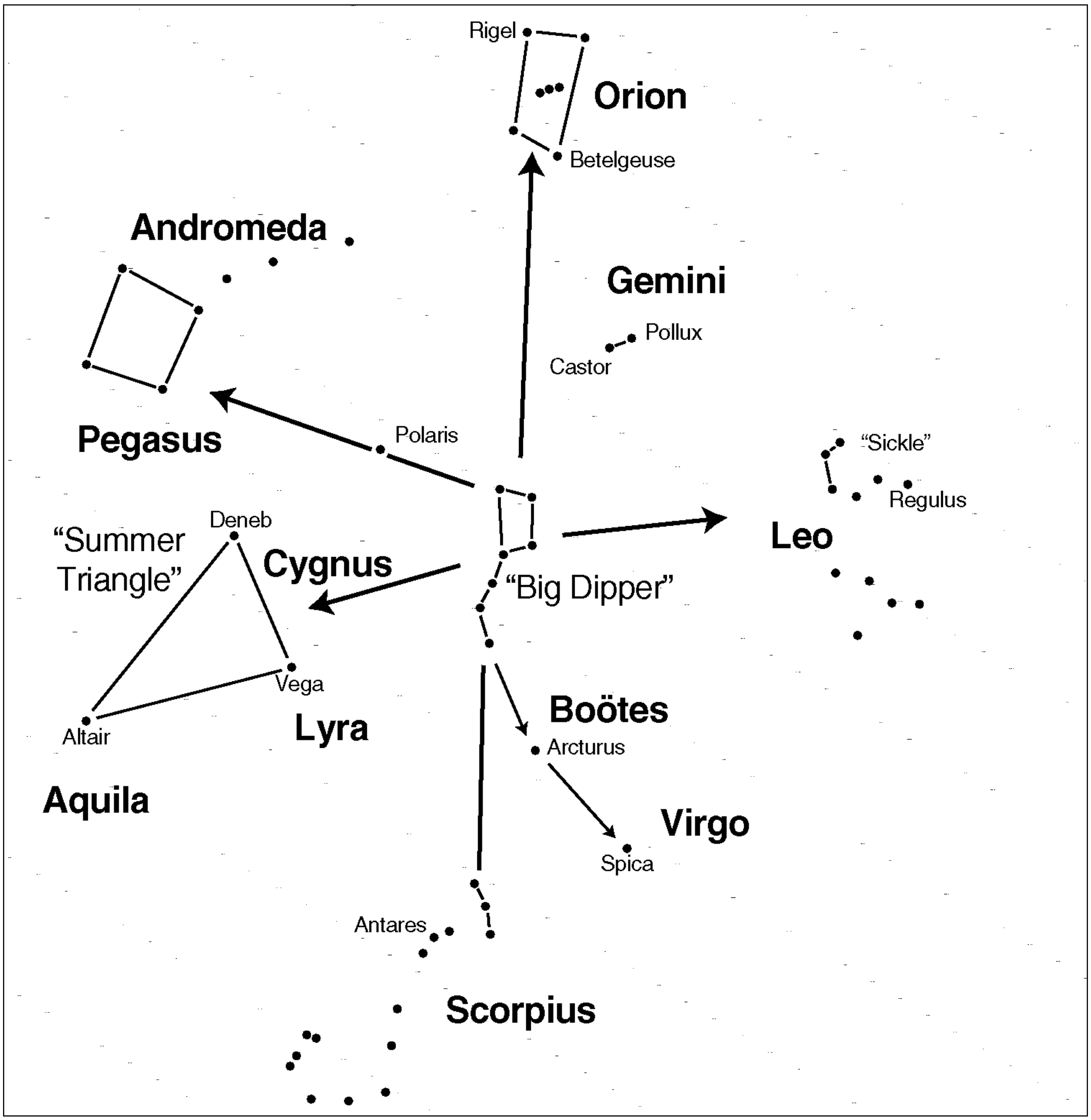
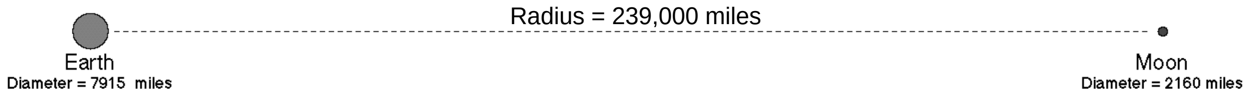


Fig. 38: Road Map to the Stars.

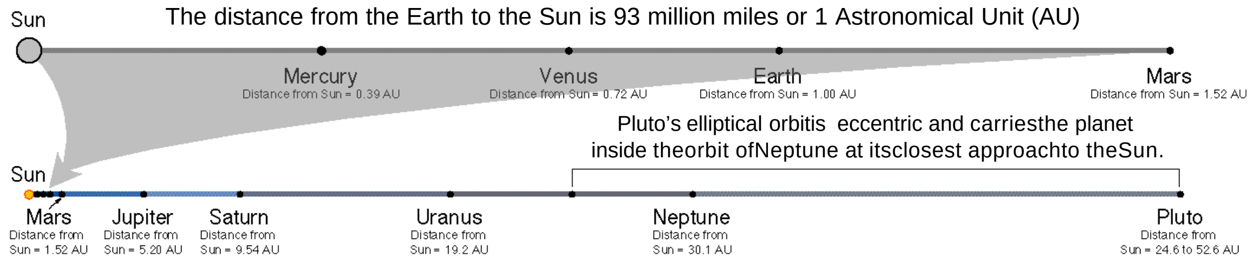
APPENDIX
E

The distance from the Earth to the Moon



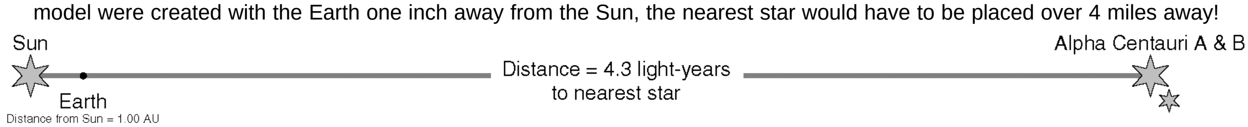
The distances between the planets

The distance from the Earth to the Sun is 93 million miles or 1 Astronomical Unit (AU)



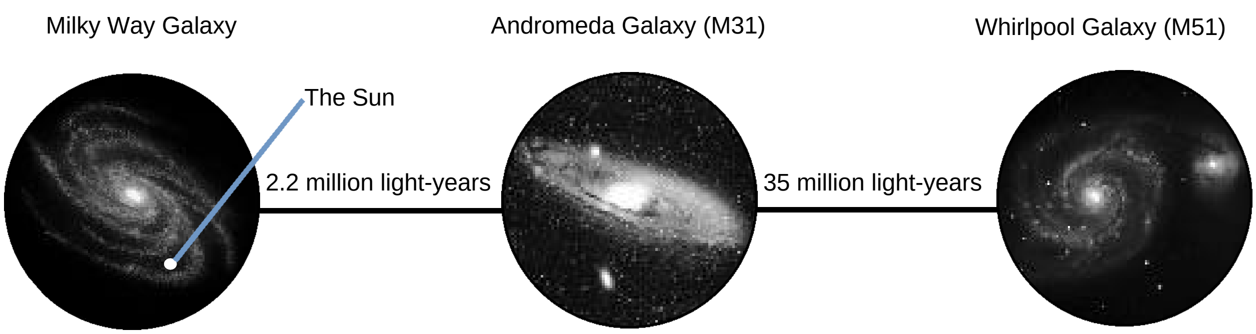
The distance between stars

The distance from the Sun to the nearest star is about 4.3 light-years, or 25 trillion miles. This distance is so large that if a scale model were created with the Earth one inch away from the Sun, the nearest star would have to be placed over 4 miles away!



Approximately one hundred billion stars, including the Sun, comprise the Milky Way Galaxy, which is a spiral-shaped collection of stars believed to be more than 100,000 light years in diameter.

The distances between galaxies



WARNING

This equipment has been tested and found to comply with the limits for a CLASS B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions contained in this manual, may cause harmful interference to radio and television communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that of the receiver.
- Consult the dealer or an experienced audio television technician.

NOTE: Connecting this device to peripheral devices that do not comply with CLASS B requirements or using an unshielded peripheral data cable could also result in harmful interference to radio or television reception.

The user is cautioned that any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

To ensure that the use of this product does not contribute to interference, it is necessary to use shielded I/O cables.

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