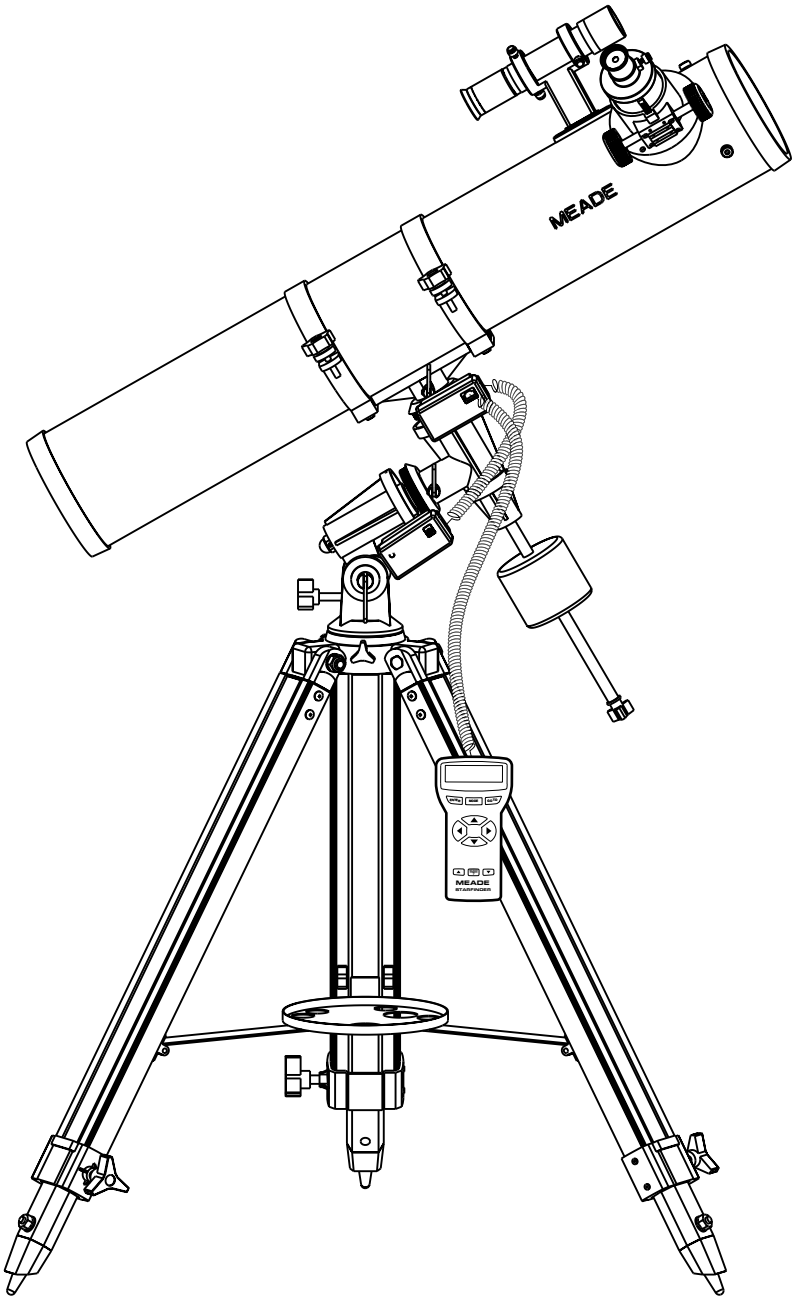
Instruction Manual

Meade Model 4504
4.5" (114mm) Equatorial Reflecting Telescope
With Starfinder Electronic Hand Controller



Meade Instruments Corporation

WARNING

NEVER USE A MEADE® 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.

How This Manual is Organized

This manual is divided into three major sections.

Part One, "The Basics," presents several "Lessons" that will teach you how to assemble and use your telescope and Starfinder. If you follow all the Lessons in this section, you will become familiar with the basic operation of your telescope and the Starfinder handbox by the end of Part One. This section covers the following procedures:

Lesson 1: Unpacking and Assembly.

How to unpack and assemble the basic telescope and tripod unit.

Lesson 2: Balancing the Telescope.

How to balance the telescope.

Lesson 3: Aligning the Viewfinder.

How to align the viewfinder and insert the eyepiece into the focuser.

Lesson 4: Observing by Moving the Telescope Manually.

How to focus an eyepiece. How to move your telescope manually to make observations.

Lesson 5: Observing using Starfinder's Arrow keys.

How to install the motor drives. How to change the slew speeds. How to observe using Starfinder's Arrow keys.

Lesson 6: Tracking Objects.

How to Polar align your telescope. How to observe using automatic tracking.

Lesson 7: Observing using Starfinder's Go To Capabilities.

How to initialize Starfinder and train the drive. How to move around in Starfinder's menus. How to observe using Starfinder and how to take a Guided Tour of the night sky.

Part Two, "Starfinder's Controls and Menus," provides more information about Starfinder's databases and menus.

Part Three, "Caring for Your Telescope," provides information that explains how to properly maintain your telescope.

The Appendices provide advanced information about your telescope, explain how objects move through the skies, and teach how to locate objects not listed in the Starfinder database.

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PART ONE: The Basics

PART TWO: Starfinder Controls and Menus

PART THREE: Caring for Your Telescope

***Fig. 1**: Parts included in the Meade Model 4504 Giftbox.*

PART ONE: The Basics

LESSON 1: Unpacking and Assembly

As you unpack your telescope, carefully note the following parts. The bolded numbers in parentheses on this page refer to the photos on page 4.

Telescope Assembly

- Equatorial mount (**1**) with a pre-attached heavy duty, continuously adjustable aluminum tripod with leg braces
- 3 tripod leg lock knobs (**7**)
- Complete optical tube assembly (**2**) including a 4.5" (114mm) diameter primary mirror with dust cover and a 0.965" rack-and-pinion focuser with dust cap
- 2 Cradle rings (**3**) with attached lock knobs
- Counterweight (**8**) and counterweight shaft (**9**)
- 5 x 24 viewfinder with rubber eyecup (**5**) and viewfinder bracket (**10**)

Motor Assembly

- Dual electronic motor drive assembly: The Right Ascension (R.A.) electronic motor drive (**12**) has a connector for the battery pack, marked "15v." The Declination (Dec) electronic motor drive (**13**) has a connector for the Starfinder handbox, marked "HBX." The motors are connected with a coiled cord.
- Starfinder handbox (**14**)
- Battery pack (**16**) and battery pack case (**15**) with adhesive backing

Accessories

- 3 Eyepieces (**11**) (0.965" optical diameter): SR 4mm, H 12.5mm, H 25mm
- 3x Barlow lens (**4**)
- Accessory shelf with mounting knob (**6**)
- 2 Hex Keys, 1.5mm, 5mm (not depicted)
- Astronomical software (not depicted)

You will need a #1 or #2 Phillips screwdriver to assemble this telescope.

Key to the photos, Fig. 1, page 4.

1. Tripod assembly with equatorial mount
2. Optical tube
3. Cradle rings
4. 3x Barlow lens
5. Viewfinder tube
6. Accessory shelf
7. Tripod leg adjustment knobs
8. Counterweight
9. Counterweight shaft
10. Viewfinder bracket
11. Eyepieces
12. R.A. motor drive
13. Dec motor drive
14. Starfinder handbox
15. Battery pack case
16. Battery pack

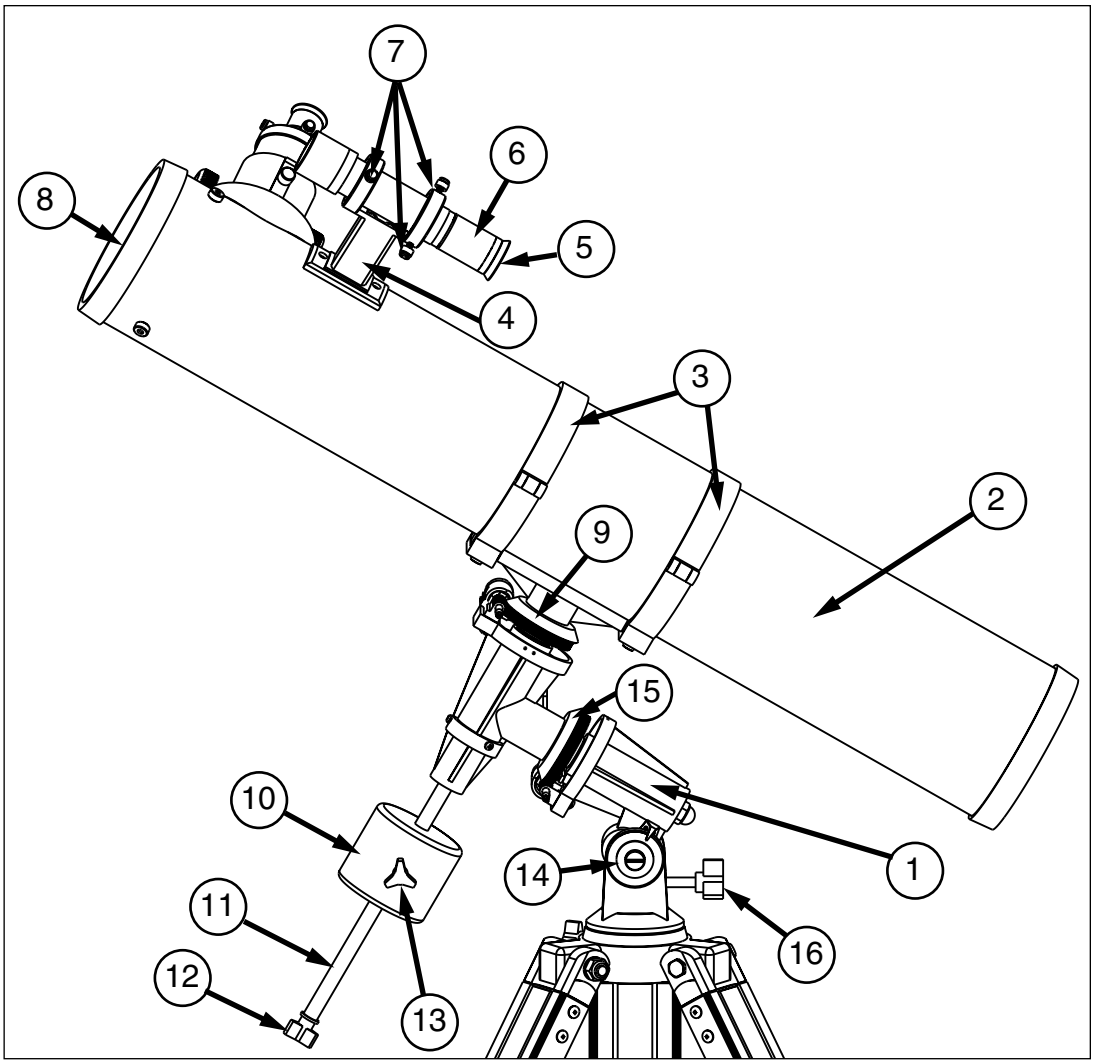

Fig. 2a: *The Meade Model 4504 4.5" Equatorial Reflecting Telescope.*

Key to Figures 2a, 2b, and 2c

1. Equatorial mount
2. Optical tube assembly
3. Cradle rings
4. Viewfinder bracket
5. Viewfinder rubber eyepiece
6. 5 x 24 viewfinder
7. Viewfinder bracket thumbscrews
8. Telescope front dust cover
9. Dec setting circle
10. Counterweight
11. Counterweight shaft
12. Safety washer/thumbscrew
13. Counterweight lock
14. Latitude dial
15. R.A. setting circle
16. Latitude adjustment knob
17. Focuser, Focus knobs
18. Eyepiece thumbscrew
19. Eyepiece
20. Cradle ring lock knobs
21. Optical tube saddle plate
22. Dec motor drive assembly
23. Latitude lock
24. Azimuth lock
25. R.A. motor drive assembly
26. R.A. lock
27. Dec lock
28. Tripod legs brace support
29. Tripod legs lock knobs
30. Accessory shelf

NOTE: *The coiled cord that connects to the two motor drives has been omitted from the illustration for the sake of clarity.*

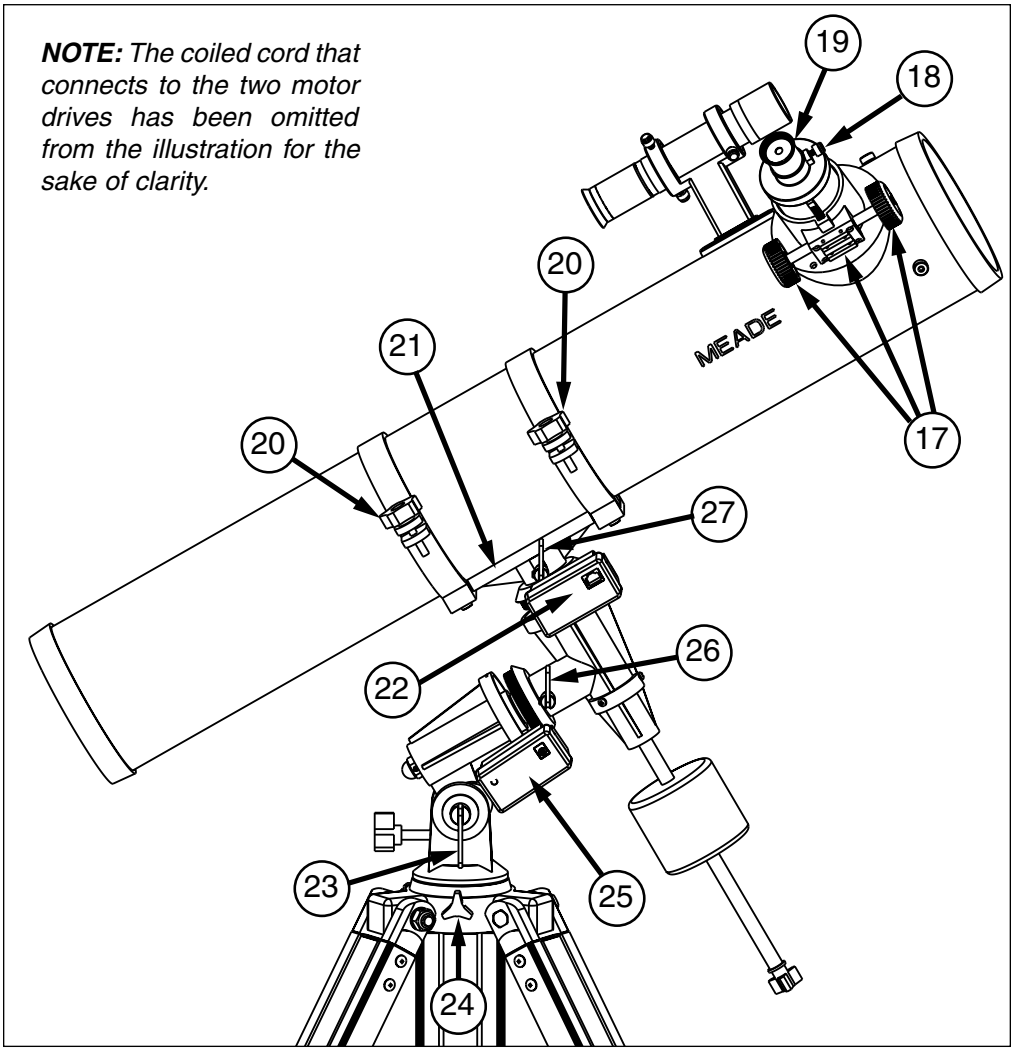

Fig. 2b: *The Meade Model 4504 4.5" Equatorial Reflecting Telescope.*

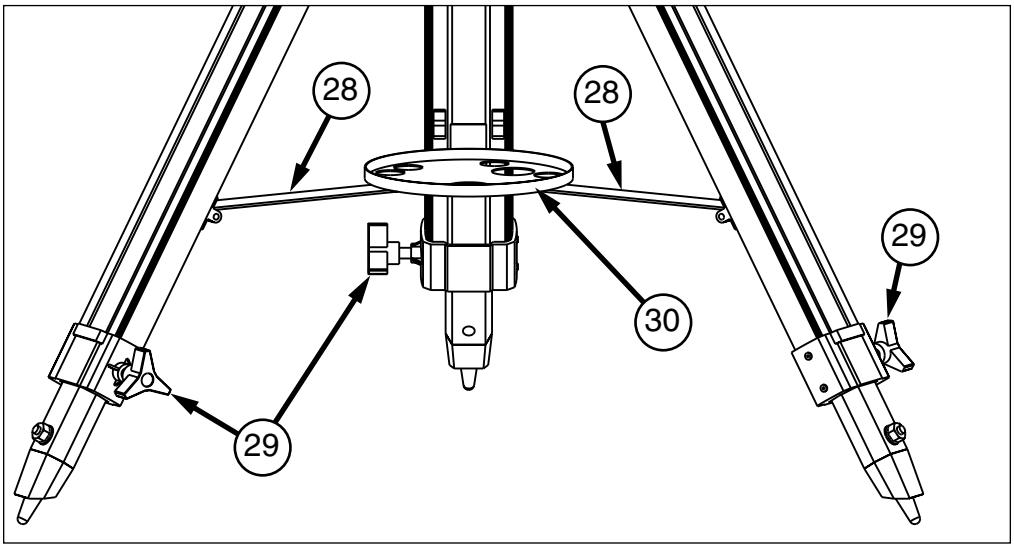

Fig. 2c: *The Meade Model 4504 4.5" Equatorial Reflecting Telescope.*

How to Assemble Your Telescope

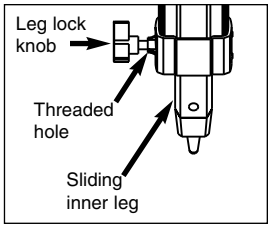

***Fig. 3**: Tripod leg lock knob.*

***Fig. 4**: Accessory shelf installation.*

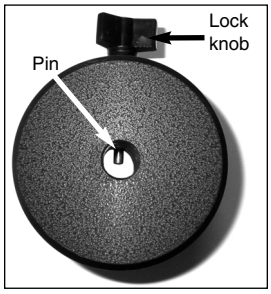

***Fig. 5**: Counterweight and pin.*

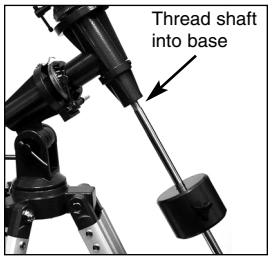

***Fig. 6**: Attach counterweight assembly to the mount.*

The giftbox contains the optical tube assembly and the tripod with the equatorial mount. The accessories are located within compartments custom-cut into the styro-foam block inserts. Refer to **Figures 1, 2a, 2b, and 2c** for images of the parts and the overall assembly of the 4504 telescope.

1. **Remove the components from the giftbox**: Remove and identify the telescope's standard equipment. For a listing of parts that are included in the giftbox, see pages 4 and 5. When removing the tripod from the giftbox, hold the assembly parallel (horizontal) to the ground or the inner tripod leg extensions will slide out as they are not locked in place.
2. **Install the lock knobs on the tripod:** Place the tripod in a horizontal position on the floor before performing this step. The three tripod lock knobs (**7, Fig. 1**) have been removed from the bottom section of each tripod leg to insure safe arrival of the tripod assembly. To install, thread each tripod lock knob into the threaded hole located at the right side of each of the three gray-colored castings at the bottom of each tripod leg. See **Fig. 3,** and **29, Fig. 2c**. Tighten the tripod lock knob to a "firm feel" only to avoid damage to the tripod caused by overtightening.
3. **Stand the tripod**: Hold the mount for support (the mount will be loose) and stand the tripod in a vertical position. Slide the cardboard sheath upward to allow it to come free when the tripod legs are spread out during the next step.
4. **Adjust the tripod legs**. Spread the tripod legs as far as they will open, so that the leg braces (**28, Fig. 2c**) are taut. Should one of the leg braces slip out of the center triangle fastener, reposition the brace and slide it back into the triangle fastener.
5. **Attach the accessory shelf to the tripod**: Remove the mounting knob from the round accessory shelf (**6, Fig. 1**). Place the accessory shelf on top of the center triangle leg brace fastener so that the threaded stud protruding from the bottom of the shelf (**Fig. 4**) passes through the hole in the center of the triangle fastener. Next, thread the mounting knob shaft into the threaded stud. Tighten to a firm feel.
6. **Attach the counterweight to the counterweight shaft:** Look through the hole in the counterweight and note the pin blocking the hole (**Fig. 5**). Tilt the counterweight slightly and the pin moves out of position, clearing the hole. If the pin does not move, slightly unscrew the counterweight lock knob (**Fig. 5**) until the pin moves. Holding the counterweight (**8, Fig. 1**) firmly in one hand, tilt the counterweight to move the pin from the hole and slip the counterweight onto the counterweight shaft (**9, Fig. 1**). Tighten the counterweight lock knob (**Fig. 5**) to a firm feel.
7. **Attach the counterweight assembly to the mount:** Attach the counterweight shaft assembly by supporting the counterweight firmly in one hand, while threading the counterweight shaft into the base (**Fig. 6**) of the Declination axis of the telescope's equatorial mount with the other. Once firmly attached, loosen the counterweight lock knob, slide the counterweight to the midpoint of the counterweight shaft, and re-tighten the lock knob firmly in place (**Fig. 5**).

   NOTE:** If the counterweight ever slips, the secured threaded safety washer/knob (**12, Fig. 2a**) prevents the counterweight from sliding entirely off the shaft. The safety washer/knob is pre-attached at the factory. **Make sure that this safety washer/knob always remains in place.

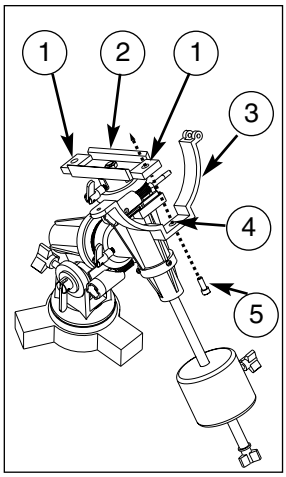

***Fig. 7**: Attach cradle rings to the saddle plate with attachment screws.*

1. Threaded screw hole (saddle plate)
2. Saddle plate
3. Cradle ring
4. Threaded screw hole (cradle ring)
5. Attachment screw

8. **Tilt the assembly:** Unlock the R.A. lock (**26, Fig. 2b**) and the Dec lock (**27, Fig. 2b**) so that the telescope turns freely on both axes. Tilting these axes makes it easier for you to perform the following steps. Turn the latitude adjustment knob (**16, Fig. 2a**) until approximately 1 1/2 inches of thread is showing. This will adjust the equatorial mount (**1, Fig. 2a**) to a comfortable angle for tube attachment.
9. **Attach the cradle rings to the saddle plate:** Remove the attachment screws from the saddle plate (these screws come attached in the threaded screw holes of the saddle plate, **1, Fig. 7**). Position the threaded screw hole of a cradle ring (**4**, **Fig. 7)** under one of the threaded screw holes of the saddle plate (**1, Fig. 7**). Thread one of the attachment screws (**5, Fig. 7**) through the bottom side of the cradle ring and through the saddle plate, tightening it with the provided 5mm hex wrench (so that it is only "fingertight," that is, just loose). Repeat for the second cradle ring. Remove the cradle ring lock knobs (**20, Fig. 2b**) and open the cradle rings.
10. **Position optical tube:** While firmly holding the optical tube (**2, Fig. 2a**), position it onto the cradle rings (**3, Fig. 2a**) with the mid-point of the optical tube's length lying roughly in the center of the saddle plate. Point the tube so that the front end (this end comes shipped with the dust cover (8, Fig. 2a) over it) is oriented as depicted in **Fig. 2a**. Then close the cradle rings (**3, Fig. 2a**) over the optical tube and loosely tighten *one* of the cradle ring lock knobs (**20, Fig. 2b**) just to hold the tube in place so you can perform the next step of this procedure.
11. **Secure the optical tube:** Tighten the cradle ring attachment hex screws to a firm feel. Then tighten *both* cradle ring lock knobs (**20, Fig. 2b**) to a firm feel; do not overtighten these knobs as you may wish loosen them frequently in order to rotate the optical tube and position the eyepiece (**19, Fig. 2b**) in a more comfortable observing position. This adjustment may be performed several times in one observing session, if so desired.
12. **Attach viewfinder:** The viewfinder holder has two restrained screws, *i.e.*, they cannot be removed from the holder. Position the two screws over the threaded holes in the viewfinder mounting plate and tighten the screws using a #1 or #2 Phillips screwdriver. It does not matter which way you orient the holder lengthwise. Loosen the viewfinder's thumbscrews (**7, Fig. 2a**), but do not remove them. Remove the viewfinder tube's rubber eyecup (**5, Fig. 2a**) and slide the tube (**6, Fig. 2a**) through the bracket rings of the holder. Then center the tube by adjusting the thumbscrews (**7, Fig. 2a**) on each bracket ring. Re-attach the eyecup. Make sure that the viewfinder is oriented so that the rubber eyecup is pointing away from front end of the optical tube (**5, Fig. 2a**).

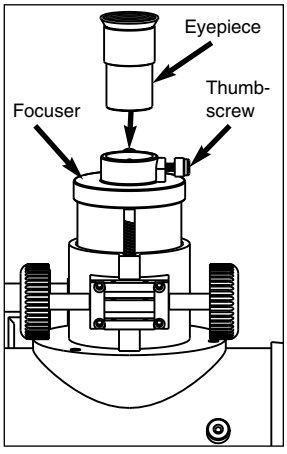

***Fig. 8**: Insert eyepiece into the focuser assembly.*

13. **Insert the eyepiece:** Lift to remove the dust cap from the focuser assembly (**17, Fig. 2b**). Put the dust cap aside in a safe place and replace it when you have finished observing to protect the eyepiece assembly. Loosen the eyepiece thumbscrews (**18, Fig. 2b**) and insert the H 25mm eyepiece (**Fig. 8**) into the focuser. Tighten the focuser thumbscrews to secure the eyepiece.
14. **Adjust the height of the tripod:** Adjust the height of the tripod by loosening the tripod lock knobs (**29, Fig. 2c**) and extending the sliding inner section of each tripod leg to the desired length; then tighten each knob. Adjust the tripod to a height that is comfortable for viewing.

Lesson 5 presents a procedure that explains how to attach the motor drive assemblies. However, that procedure is not necessary at this time. The following lesson demonstrates how to balance your telescope.

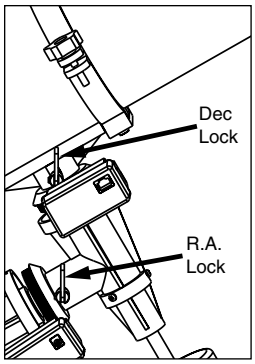

***Fig. 9a**: Balancing the telescope: the axes locks.*

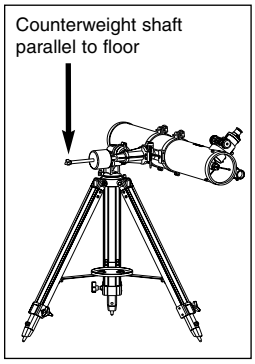

***Fig. 9b**: Balancing the telescope.*

LESSON 2: Balancing the Telescope

In order for the telescope to be stable on the tripod and also for it to move smoothly, it must be balanced. To balance the telescope, you will unlock the Right Ascension or R.A. lock (**26, Fig. 2b and Fig. 9a**). When this axis is unlocked, the telescope pivots more or less horizontally on the mount. This is called the R.A. axis. Later in the procedure, you will also unlock the Declination or Dec lock (**27, Fig. 2b and Fig. 9a**). When unlocked, the telescope pivots more or less vertically on the mount. This is called the Dec axis. Most of the motion of the telescope takes place by moving about these two axes, separately or simultaneously. To obtain a fine balance of the telescope, follow the method below:

1. Firmly hold the optical tube secure so that it cannot accidentally swing freely. Loosen the R.A. lock (**26, Fig. 2b**). The optical tube now turns freely about the R.A. axis. Rotate the telescope so that the counterweight shaft (**11, Fig. 2a**) is parallel (horizontal) to the ground (**Fig. 9b**).
2. Unlock the counterweight lock knob (**13, Fig. 2a**) and slide the counterweight (**10, Fig. 2a**) along the counterweight shaft until the telescope remains in one position without tending to drift down in either direction. Then re-tighten the counterweight lock knob (**13, Fig. 2a**), locking the counterweight in position.
3. Again, hold onto the optical tube so that it cannot accidentally swing freely. Lock the R.A. lock (**26, Fig. 2b**), and unlock the Dec lock (**27, Fig. 2b**). The telescope now is able to move freely about the Dec axis. Loosen the cradle ring lock knobs (**20, Fig. 2b**) so that the main tube slides easily back and forth in the cradle rings. Move the main tube in the cradle rings until the telescope remains in one position without tending to drift down in either direction. Re-lock the Dec lock (**27, Fig. 2b**).

The telescope is now properly balanced on both axes. Next, the viewfinder must be aligned.

LESSON 3: Aligning the Viewfinder

The wide field of view of the 5 x 24mm viewfinder provides an easier way to initially sight objects than the main telescope's eyepiece, which has a much narrower field of view. If the 5 x 24 mm viewfinder (**6, Fig. 2a**) is not already attached to the telescope tube assembly, follow the procedure described in **Lesson 1**, step 7.

In order for the viewfinder to be functional, it must be aligned to the main telescope, so that both the viewfinder and main telescope point at the same position in the sky. This alignment makes it easier to find objects – first locate an object in the wide-field viewfinder, then look into the eyepiece of the main telescope for a detailed view.

To align the viewfinder, follow these steps. Perform steps 1 through 4 during the daytime; perform step 5 at night.

1. Remove the telescope front dust cover (**8, Fig. 2a**).
2. If you have not already done so, insert the low-power H 25mm eyepiece (**19, Fig. 2b**) into the focuser of the main telescope. See **Lesson 1**, step #11.
3. Unlock the R.A. lock (**26, Fig. 2b**) and the Dec lock (**27, Fig. 2b**) so that the telescope turns freely on both axes. Then point the main telescope at some well-defined and stationary land object (*e.g.,* the top of a telephone pole) at least 200 yards distant and center the object in the telescope's eyepiece. Re-tighten the R.A and Dec locks.
4. Look through the viewfinder and loosen or tighten, as appropriate, one or more of the viewfinder bracket ring thumbscrews (**7, Fig. 2a**) until the viewfinder's crosshairs are precisely centered on the object you previously centered in the main telescope's eyepiece.

NEVER point the telescope directly at or near the Sun at any time! Observing the Sun, even for the smallest fraction of a second, will result in instant and irreversible eye damage, as well as physical damage to the telescope itself.

5. Check this alignment on a celestial object, such as a bright star or the Moon, and make any necessary refinements, using the method outlined above in steps 3 and 4.

With this alignment performed, objects first located in the wide-field viewfinder will also be centered in the main telescope's field of view. You are now ready to make your first observations with your telescope.

NOTE: *The viewfinder and telescope present an upside-down image.*

LESSON 4: Observing by Moving the Telescope Manually

This method describes how to make observations by manually moving the telescope.

After the telescope is assembled and balanced as described previously, you are ready to begin manual observations. View easy-to-find terrestrial objects such as street signs or traffic lights to become accustomed to the functions and operations of the telescope. For the best results during observations, follow the suggestions below:

IMPORTANT NOTE:

*Whenever you move your telescope, either manually or with Starfinder, position the levers of the R.A. and Dec locks so that they point upwards (see **Fig. 10**). An incorrectly positioned lever may strike and damage another piece of the telescope assembly while the telescope is moving.*

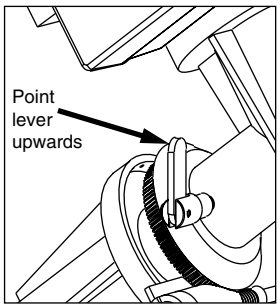

***Fig. 10**: Correctly positioned lever.*

- When you wish to locate an object to observe, first loosen the telescope's R.A. lock (**26, Fig. 2b**) and Dec lock (**27, Fig. 2b**). The telescope can now turn freely on its axes. Also unlock the Azimuth lock (**24, Fig. 2b**). Unlock each axis separately and practice moving your telescope. Then practice with two or more unlocked axes at the same time. **It is very important to practice this step** to understand how your telescope moves, as the movement of an equatorial mount is not intuitive.
- Use the aligned viewfinder to sight-in on the object you wish to observe. When the object is centered in the viewfinder's crosshairs, re-tighten the R.A. and Dec locks.
- A telescope's eyepiece magnifies 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. *For example*, an eyepiece with a focal length of 4mm has a higher magnification than an eyepiece with a focal length of 25mm. See "APPENDIX A," page 38 for more information.

  Low-power magnification eyepieces offer a wide field of view, bright, high-contrast images, and relief of eye strain during long observing sessions. To observe an object with a telescope, always start with a low power eyepiece such as the H 25mm supplied with the 4504. When the object is centered and focused in the eyepiece, switch to a higher power eyepiece to enlarge the image as much as practical for prevailing viewing conditions.

  NOTE: *Viewing conditions vary widely from night-to-night and site-to-site. 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 low-power eyepiece for a more well-resolved image.*
- The Barlow lens included with your telescope triples the eyepiece magnification. See "APPENDIX A," page 38 for more information.
- Once centered, an object can be focused by turning one of the knobs of the focusing mechanism (**17, Fig. 2b**). Notice that when observing astronomical objects, the field of view begins to slowly drift across the eyepiece field. This motion is caused by the rotation of the Earth on its axis. Objects appear to move through the field more rapidly at higher powers. See "APPENDIX B," page 39, for detailed information. Lesson 6 will explain how you can counteract the drift in the field of view.

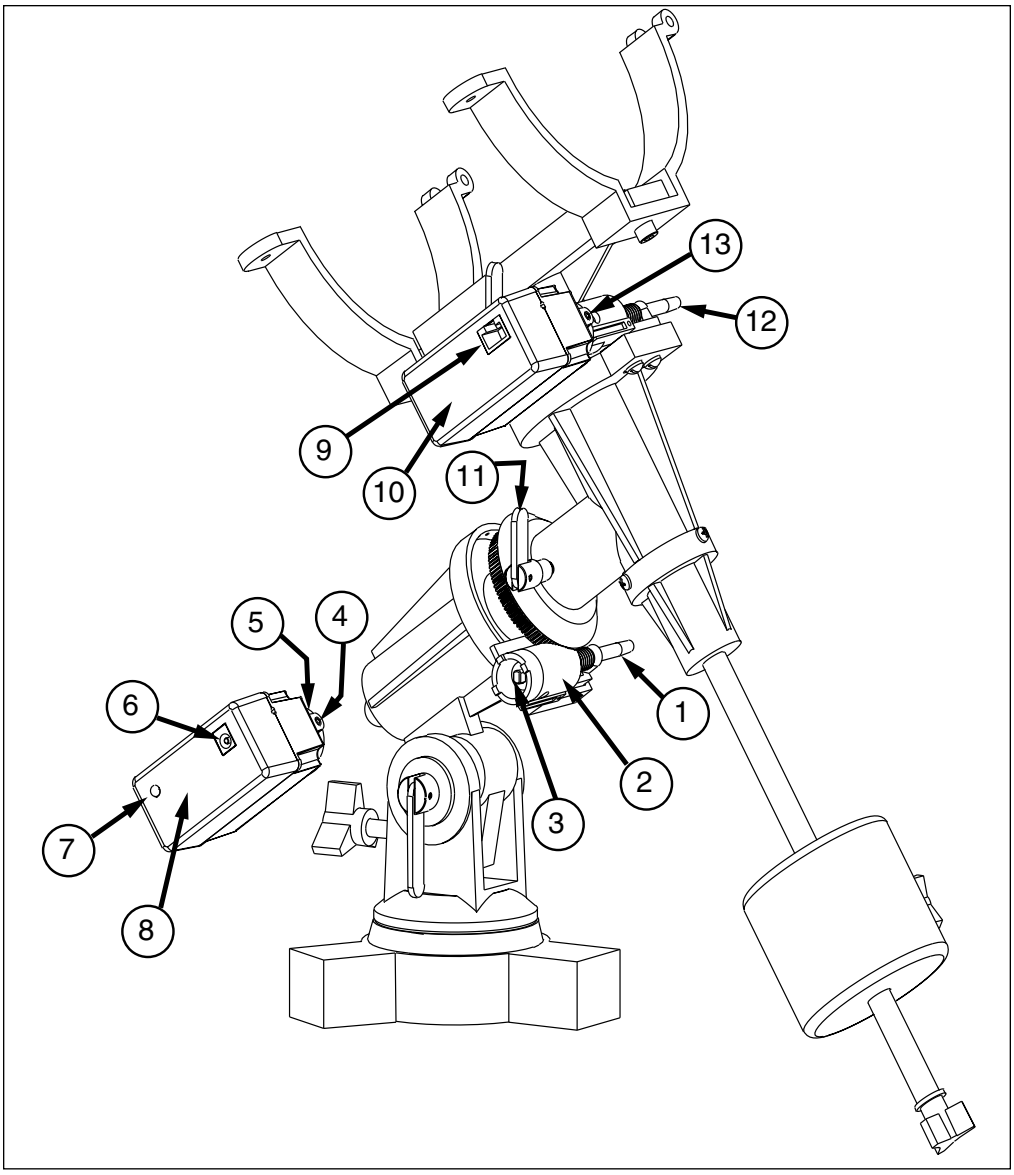

Fig. 11: *Motor drive system assembly.*

Key to Figure 11

1. R.A. Worm Shaft
2. (R.A. Axis) Plastic Adapter
3. Aluminum Shaft
4. Set Screw
5. Circular Housing containing notched plastic shaft
6. Battery Pack Connector
7. LED
8. R.A. Motor Drive
9. Handbox (HBX) Port
10. Dec Motor Drive
11. R.A. Lock
12. Dec Worm Shaft
13. Set Screws

Observe the World Around You

Practice observing during the day, when it is easier to become familiar with the controls of your telescope.

1. Loosen the telescope's R.A. lock (**26, Fig. 2b**) and Dec lock (**27, Fig. 2b**).
2. Move your telescope to observe distant street signs, mountains, trees, and other structures. Use your viewfinder to to help site-in an object.
3. When the object is centered in the viewfinder's crosshairs, remember to re-tighten the R.A. and Dec locks.
4. Center the object in your eyepiece. Practice focusing with your eyepieces.
5. Once you get a feel for how your telescope moves and focuses, try to view something more challenging, like a bird or a distant moving train.

LESSON 5: Observing Using Starfinder's Arrow Keys

Before you can observe using Starfinder's Arrow keys, the motor drive assemblies and the Starfinder handbox must be attached to the telescope.

Motor Drive System and Starfinder Handbox Installation

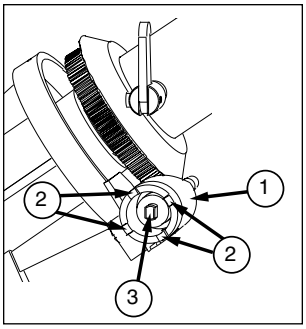

***Fig. 12a**: Plastic adapter assembly.*
1. Plastic adapter
2. Protrusions
3. Aluminum shaft

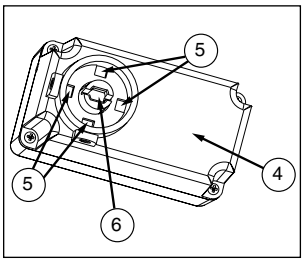

***Fig. 12b**: Motor drive assembly.*
4. Motor drive
5. Recesses
6. Notched shaft

To attach the Electronic Motor Drive System to the telescope, follow this procedure:

1. **Locate the plastic adapter** (**2, Fig. 11**) on the R.A. axis (**1, Fig. 11**). Note the aluminum shaft (**3, Fig. 12a**) inside the adapter and the four small protrusions (**2, Fig. 12a**) on the adapter's circular edge.
2. **Locate the components of the R.A. motor drive** (**8, Fig. 11**). Note the notched plastic shaft (**6, Fig. 12b**) inside the circular housing on the side of the motor drive. Also note the four small recesses (**5, Fig. 12b**) inside this housing.

   ***NOTE:** The R.A. motor drive has a connector for the battery pack that is marked "15v."*

3. **Attach the R.A. motor drive to the R.A. axis**: Align and slide the notch (**6, Fig. 12b**) of the plastic shaft of the R.A. motor drive over the aluminum shaft (**3, Fig. 12a**) inside the plastic adapter on the R.A. axis. Orient the R.A. motor drive box as depicted in 8, Fig. 11.
4. **Rotate the R.A. motor drive** until you feel the four protrusions (**2, Fig. 12a**) on the plastic adapter slide into the four matching recesses (**5, Fig. 12b**) inside the motor drive.
5. **Tighten the set screws**: Tighten the two set screws (**4, Fig. 11**) to a firm feel only with the supplied 1.5mm hex key. The set screws come attached to the motor drive.
6. **Repeat the process** to attach the Dec electronic motor drive to the Dec axis (**10, Fig. 11**). Orient the Dec motor drive box as depicted in 10, Fig. 11.
7. **Attach Starfinder**: Plug Starfinder's coiled cord into the connector (**9, Fig. 11**) on the Dec motor box.
8. **Install batteries:** Install ten (user-supplied) AA-size batteries into the separate battery pack and plug the battery pack into the connector (**16, Fig. 1**) on the R.A. motor box (**6, Fig. 11**). The battery pack case has a strip of adhesive attached to it. Remove the protective covering from the adhesive and attach the case to the tripod, if so desired.

The Electronic Motor Drive System is now ready for operation.

Activate the Arrow Keys

This procedure describes how to activate Starfinder's Arrow keys:

1. After Starfinder's cord is plugged in and the batteries are installed, a copyright message lights on the Starfinder LCD display (**1, Fig. 13**).
2. A message warning not to look at the Sun scrolls across the display. Press the key prompted by Starfinder to acknowledge that the Sun warning has been read and understood.
3. Press the ENTER (**2, Fig. 13**) key repeatedly until "Country/State" appears on the display. (Ignore the prompts requesting Date and Time – these functions will be explained in Lesson 7, but are not necessary for the current lesson.)

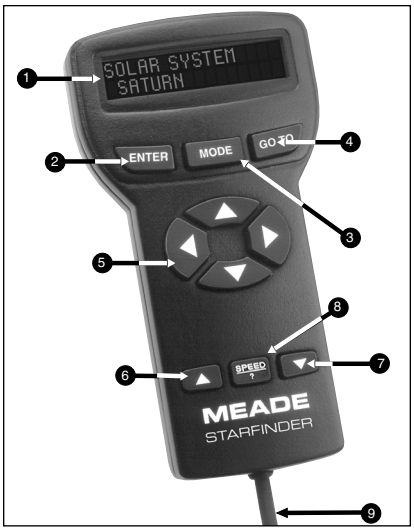

Fig. 13: *The Starfinder handbox.*

4. Use the Scroll keys (**6 and 7, Fig. 13**) to cycle through the database of countries, states, and provinces. Press ENTER when the correct location displays.
5. Starfinder then prompts you to enter the nearest city (listed alphabetically) to the observing site. Use the Scroll keys to cycle through the database of cities. Press ENTER when the correct city appears on screen. The display then reads "Align: One Star." You now can use Starfinder's Arrow keys to move the telescope to observe.

   NOTE: *If you go past the "Align: One Star" (or any other menu display you wish to select), press MODE to return to the previous display(s).*

6. Press the Arrow keys (**5, Fig. 13**) to slew (move) the telescope up, down, right, or left. You can slew (move) the telescope at different speeds.

NOTE:

Press and hold the Up Arrow key to speed up the scroll speed of the display or press and hold the Down Arrow key to slow down the scroll speed. When the display is scrolling at a speed that is comfortable for reading, release the key.

NOTE: *Starfinder only prompts you to enter Country (or State) and City as described in steps 3, 4, and 5, the first time it is activated. These prompts do not appear again, unless you reset Starfinder (see "RESET," page 32).*

However, if you need to enter this information (e.g., you change your geographic location), you need not perform a Reset, which erases user entered data, such as Landmarks and User Objects. You can change the location information by using the Site option of the Setup menu. See "SITE," page 32, for detailed information.

Slew Speeds

Starfinder has seven slew (move) speeds. Each speed has been calculated to accomplish specific functions. Pressing the Speed/? key (**8, Fig. 13**) briefly changes the slew speed, which is shown briefly on Starfinder's display as the key is pressed. Each press decreases the slew speed down one level and then cycles back to the fastest speed.

NOTE: *Pressing the Speed/? key briefly changes the slew speed. Holding down the Speed/? key longer (one to two seconds) accesses the Help function.*

The seven available speeds are:

Speed 1	Max	=	240 x sidereal (60 arc-min/sec or 1°/sec)
Speed 2	0.5°	=	120 x sidereal (30 arc-min/sec or 0.5°/sec)
Speed 3	64X	=	64 x sidereal (16 arc-min/sec or 0.27°/sec)
Speed 4	32X	=	32 x sidereal (8 arc-min/sec or 0.13°/sec)
Speed 5	16X	=	16 x sidereal (4 arc-min/sec or 0.067°/sec)
Speed 6	8X	=	8 x sidereal (2 arc-min/sec or 0.033°/sec)
Speed 7	2X	=	2 x sidereal (0.5 arc-min/sec or 0.008°/sec)

Speed 1: Fastest speed to move the telescope from one point in the sky to another.

Speeds 2 or 3: Best used for the rough centering of an object in the eyepiece.

Speeds 4 or 5: Enables the centering an object in the field of a low-to-moderate power eyepiece such as the standard H 25mm

Speeds 6 or 7: Best used for the fine centering of an object in the field of view of a high-power eyepiece such as the standard SR 4mm.

Observe the Moon

Point your telescope at the Moon (note that the Moon is not visible every night) and practice using the Arrow keys and the slew speeds to view different features. The Moon contains many interesting features, including craters, mountain ranges, and fault lines. The best time to view the Moon is during its crescent or half phase. Sunlight strikes the Moon at an angle during these periods and adds a depth to the view. No shadows are seen during a full Moon, causing the overly bright surface to appear flat and rather uninteresting. Consider the use a neutral density Moon filter when observing the Moon. Not only does it cut down the Moon's bright glare, but it also enhances contrast, providing a more dramatic image.

> ***NOTE:*** *Do not look through the telescope's eyepiece or viewfinder while it is rapidly moving. Children should always have adult supervision while observing.*

LESSON 6: Tracking Objects

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. You can setup your telescope to move at the sidereal rate so that it automatically tracks the stars and other objects in the night sky. The tracking function automatically keeps an object more or less centered in the telescope's eyepiece.

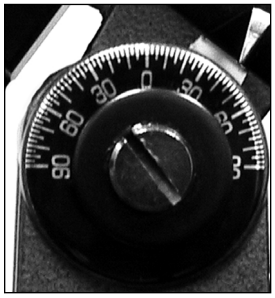

Fig. 14*: Latitude dial.*

To automatically track objects, you must first Polar align the telescope and then select "Targets: Astronomical" from the Starfinder Setup menu.

To Polar Align the Telescope:

1. Level the mount, if necessary, by adjusting the length of the three tripod legs.
2. Release the Azimuth lock (**24, Fig. 2b**) of the tripod, so that the entire telescope may be rotated in a horizontal direction. Rotate the telescope until it points due North. Then re-tighten the lock. Use a compass or locate Polaris, the North Star (see **Fig. 31, page 40**), as an accurate reference for due North.
3. Determine the latitude of your observing location. See "APPENDIX D: HELPFUL CHARTS," page 43, for a list of latitudes of major cities around the world. Release the latitude lock (**23**, **Fig. 2b**) and tilt the telescope mount with the latitude adjustment knob (**16, Fig. 2a**) so that the pointer indicates the correct latitude of your viewing location on the latitude scale (**Fig. 14**). Re-tighten the latitude lock (**23, Fig. 2b**).

Fig. 15: *Dec setting circle.*

4 Unlock the Dec Lock (**27, Fig. 2b**). Rotate the Optical Tube Assembly until the Dec setting circle pointer (**Fig. 15**) points at 90°.

5. If steps 1 through 4 above were performed with reasonable accuracy, your telescope is now sufficiently well-aligned to Polaris, the North Star, for you to begin making observations.

Once the mount has been Polar-aligned as described above, the latitude angle need not be adjusted again, unless you move to a different geographical location (*i.e.*, a different latitude). The only Polar Alignment procedure that needs to be performed each time you observe is to point the telescope due North, as described in step 2 above.

> ***IMPORTANT NOTE:*** *For almost all astronomical observing requirements, approximate settings of the telescope's latitude and azimuth axis are acceptable. Do not allow undue attention to precise Polar Alignment of the telescope to interfere with your basic enjoyment of the instrument.*

Observe a Star using the Automatic Tracking Feature

In this example, Starfinder's Arrow keys are used to find a star, and then Starfinder's tracking capability automatically keeps the star centered in your telescope's eyepiece.

1. If you have just completed Lesson 5, Starfinder's display now reads "Align: One Star." *Go to Step 2*.

   If you have not used Starfinder yet or have just plugged it into the HBX port, *perform the procedure described in "ACTIVATE THE ARROW KEYS," page 14. Then go to Step 2 of this procedure.*

   If you have been using Starfinder to perform other functions and the display does not read "Align: One Star," follow these steps:

   a. Press MODE (**3, Fig. 13**) repeatedly until "Select Item: Object" displays.

   b. Press the Scroll Up key (**6, Fig. 13**) once. "Select Item: Setup" displays.

   c. Press ENTER (**2, Fig. 13**). "Setup: Align" displays. *Go to Step 3*.

2. Press MODE (**3, Fig. 13**). "Setup: Align" displays.
3. Press the Scroll Down key repeatedly until "Setup: Targets" displays. Press ENTER (**2, Fig. 13**).
4. "Targets: Terrestrial" displays. Press one of the Scroll keys once (**6 or 7, Fig. 13**). "Targets: Astronomical" now displays.
5. If you have not already done so, Polar align your telescope as described on page 15.
6. Use the Arrow keys (**5, Fig. 13**) to locate a bright star in the night sky. Use the viewfinder to help line up on the star. You may choose any unobstructed, bright star for the purposes of this example. Use Starfinder's Arrow keys to center the star in the eyepiece. Once the star is centered, press ENTER to select "Astronomical." The telescope's tracking motors then engage. It may take the tracking motors several seconds to begin tracking. When they do, it may be necessary to once again center the star in the eyepiece. The tracking motors will then keep the star you have chosen in the center of the eyepiece.
7. Press and hold the ENTER key for a few seconds and then release to stop tracking. You may repeat the procedure, if so desired, to locate another star or object using the Arrow keys. Then press ENTER to re-engage the tracking motors.

LESSON 7: Using Starfinder's GO TO Capabilities

This lesson describes how to make observations using various Starfinder features and menus. But before you can use Starfinder's GO TO capabilities, you must first:

- Learn how Starfinder's keys move through the menus
- Initialize Starfinder
- Train the drive
- Polar align the telescope, if you have not already done so (see Lesson 6)
- Select "Align: One Star" from Starfinder's menus

Moving Through Starfinder's Menus

Starfinder's menus are organized for quick and easy navigation.

- Press ENTER to go deeper into Starfinder menu levels.
- Press MODE to move back toward the top menu level.
- Press the Scroll keys to move up and down through the options available for each level.
- Press the Arrow keys to enter characters and digits.

Initializing Starfinder

This exercise describes how to initialize Starfinder.

Initialization is a procedure that enables Starfinder to operate correctly. When you first use Starfinder, it doesn't yet "know" the location of the observing site or the time or date of the observation session. During the Initialization procedure, you will enter this information. Starfinder then uses the information to calculate the location of celestial objects (such as stars and planets) and to move your telescope correctly for various operations.

> ***NOTE:*** *Normally, you will enter the Time and Date at the beginning of each observing session, but you will only perform the full Initialization procedure (i.e., entering the Location information as well as the Time and Date) the first time you use Starfinder or after performing a Reset.* ***Fig. 16*** *depicts an example of Starfinder Initialization procedure.*

> ***NOTE:*** *See "STARFINDER CONTROLS," page 23, for a detailed description of Starfinder's Keys.*

1. Make sure that the telescope is assembled correctly, and that the batteries and the motor drives are installed as described previously.
2. Plug Starfinder's cord into the HBX port, as previously described, or if Starfinder is already plugged in, unplug it briefly and then plug it back in again.
3. A copyright message lights on Starfinder's LCD display and a message warning not to look at the Sun scrolls across the display. Press the key prompted by Starfinder to acknowledge the message has been read and understood.
4. The Getting Started menu displays a scrolling message with two choices:
   a. Press and hold down the Speed/? key (**8, Fig. 13**) for about 2 seconds for information on Starfinder functions and controls. When finished, press MODE (**3, Fig. 13**) to exit Help, or,
   b. Press ENTER (**2, Fig. 13**) to bypass the Help tutorial and continue with Initialization.
5. Starfinder then prompts you to enter the current date:
   a. To enter numbers, press either the Up or Down Arrow key (**5, Fig. 13**) to scroll through numbers 0 through 9. After the desired number is displayed, use the Right Arrow key (**5, Fig. 13**) to move the cursor from one number to the next in the day display (or use to Left Arrow key to move in the other direction across the display, if necessary).
   b. Use the Right Arrow key (**5, Fig. 13**) to move the cursor to the month. Use the Scroll keys (**8, 9, Fig. 13**) to cycle through the list of months. When the current month is displayed, use the Right Arrow (**5, Fig. 13** to move the cursor to the year.
   c. Use the Up and Down Arrow keys to enter all four digits of the current year. Use the Right Arrow key to move the cursor from one number to the next.
   d. Press ENTER (**2, Fig. 13**) when the entire date has been entered.
6. Starfinder then prompts you to enter the current time. Use the Up and Down Arrow keys to enter digits and the Right and Left Arrow keys move the cursor across the screen as described in the previous step. Enter the current time (use a "0" for the first digit if less than 10). Use the Up Arrow key (**7, Fig. 13**) to scroll through "AM," "PM,'" or "blank." The "blank" option selects the 24-hour (*i.e.*, military time) clock. Then press ENTER to start the clock.

   > ***NOTE:*** *When multiple choices are available within a menu option, the option that is currently selected is usually displayed first and highlighted by a right pointing arrow (>).*

7. Starfinder then prompts you to enter the status of Daylight Savings Time. Press one of the Scroll keys to toggle between the YES/NO settings. Select the desired setting by pressing ENTER.

   NOTE: *Daylight Savings Time may be referred to by a different name in various areas of the world.*

8. If you have previously entered the Country/State and City of your observing site (as described in "ACTIVATE THE ARROW KEYS," page 14), *go to step 9*. If you have not entered this information, perform the following steps:
   a. Starfinder prompts you to enter the Country or State (listed alphabetically) of the observing site. Use the Scroll keys to cycle through the database of countries, states, and provinces. Press ENTER when the correct location displays.
   b. Starfinder then prompts you to enter the nearest city (listed alphabetically) to the observing site. Use the Scroll keys to cycle through the database of cities. Press ENTER when the correct city appears on screen.

   NOTE: *Starfinder only prompts you to enter Country/State and City the first time it is activated. These prompts do not appear again, unless you reset Starfinder (see "RESET," page 32). However, if you change your geographic location, you can change the location information by using the Site option of the Setup menu. See "SITE," page 32, for detailed information.*

9. System Initialization is complete and the display reads "Align: One Star." After performing the Initialization procedure, you MUST train your drive. Continue to page 19.

Note:

The following parameters are used in the example depicted in Fig. 16:

Date: *March 26, 2001*

Time: *11:47 PM*

Location: *Irvine, California*

In this example, it is assumed that the Country/State and City data has not yet been entered into Starfinder.

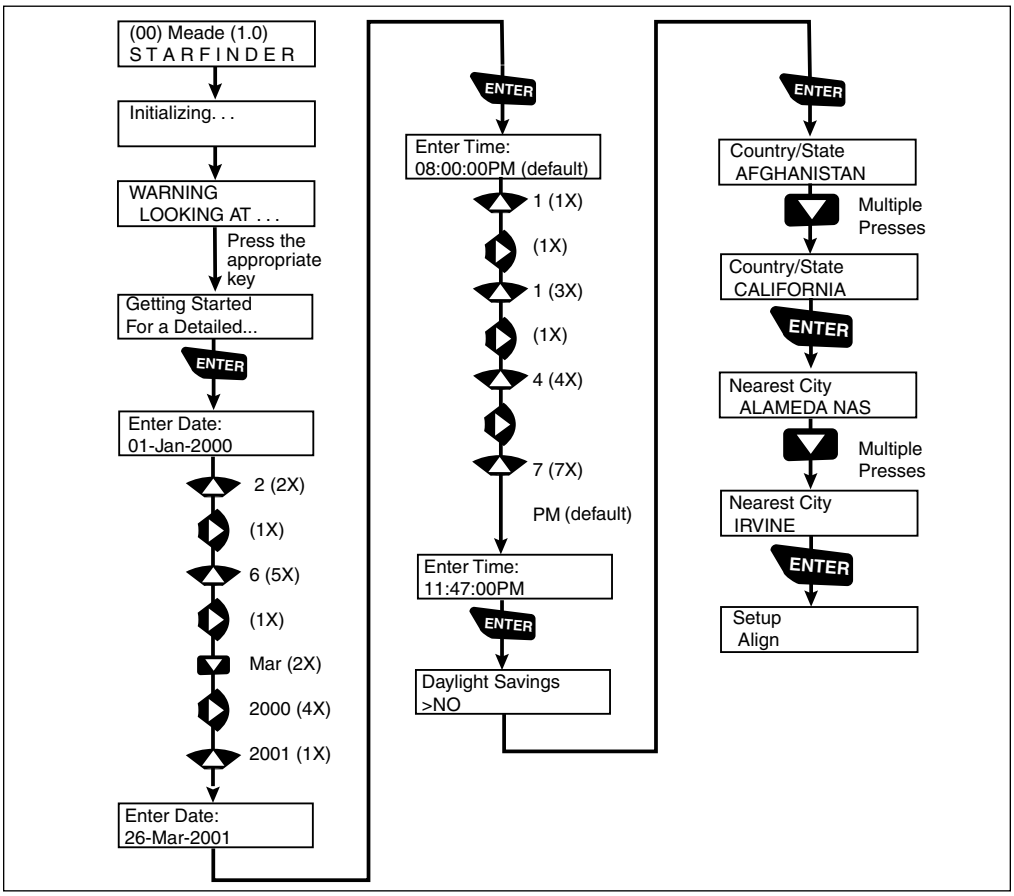

Fig. 16: *Example of the Initialization procedure.*

Training the Drive

Next, train the drive using Starfinder. Perform this procedure the first time you use Starfinder with your telescope, after a Reset, or if you are experiencing any pointing accuracy problems. Training the drive gives your telescope a higher degree of pointing accuracy.

> ***NOTE:*** *Use a terrestrial object, such as a telephone pole or lamp post, to train the drive. It is best to perform this procedure during the daytime. Complete this exercise once every 3 to 6 months to maintain the highest level of telescope pointing accuracy.*

1. If you have just performed "INITIALIZING STARFINDER," *go to step 2*.

   If you have not yet initialized Starfinder, *go to page 17 and follow the procedure described in "INITIALIZING STARFINDER." Then go to to step 2 of this procedure*.
2. Keep pressing MODE until "Select Item: Object" displays.
3. Press the Scroll Up key once. "Select: Item: Setup" displays.
4. Press ENTER to access the Setup menu. "Setup: Align" displays.
5. Keep pressing the Scroll Up key until "Setup: Telescope" displays.
6. Press ENTER to access the Telescope menu. "Telescope: Focal Length" displays.
7. Keep pressing the Scroll Down key until "Telescope: Train Drive" displays.
8. Press ENTER to choose the Train Drive option. "Train Drive: RA Train" displays.
9. Press ENTER to begin RA (Right Ascension or horizontal) training.
10. "Drive Setup: For this...." begins to scroll across the display. This is a reminder to point your telescope at a terrestrial object. Press ENTER when the telescope is pointing at the desired terrestrial object.
11. "Center reference object" displays. Center your target object using the Arrow keys. When centered, press ENTER.
12. The telescope slews and "Press > until it is centered" displays. Press the Right Arrow key until the target is centered again. Then press ENTER.

    > ***NOTE:*** *If you pass the object when pressing the Arrow key, you cannot slew the telescope back in the other direction. Press MODE until "Train Drive: RA Train" displays and begin the procedure over again.*

13. The telescope slews and "Press < until it is centered" displays. Press the Left Arrow key until the target is centered again. Then press ENTER.
14. "Train Drive: RA Train" displays again. Press the Scroll Down key and "Train Drive: Dec Train" displays. Press ENTER to begin Dec (Declination or vertical) training.
15. "Drive Setup: For this...." begins to scroll across the display. This is another reminder to point your telescope at a terrestrial object. Press ENTER when the telescope is pointing at the desired terrestrial object.
16. "Center reference object" displays. Center your target object using the Arrow keys. When centered, press ENTER.
17. The telescope slews and "Press ∧ until it is centered" displays. Press the Up Arrow key until the target is centered again. Then press ENTER.
18. The telescope slews and "Press ∨ until it is centered" displays. Press the Down Arrow key until the target is centered again. Then press ENTER. "Train Drive: Dec Train" displays again. You have now completed this procedure. Continue onto the next procedure, "Align Your Telescope Using Starfinder."

Align Your Telescope Using Starfinder

After completing the "Train the Drive" procedure, align your telescope using Starfinder. The fastest and easiest way to start observing with Starfinder's Go To capabilities is to align your telescope using One-Star (Polar) Alignment. An alternate method, Two-Star alignment, is described later in this manual.

1. With "Train Drive: Dec Train" displayed (or scroll to this menu, if necessary), keep pressing MODE until "Select Item: Setup" is displayed. Press ENTER.
2. "Setup: Align" displays. Press ENTER. "Align: One Star" displays. Press ENTER.
3. "German North" displays and a scrolling message prompts you to Polar align your telescope. See "TO POLAR ALIGN THE TELESCOPE," page 15, for a description of how to Polar align your telescope. Press ENTER after you finish the alignment procedure.
4. "Ctr. Polaris" displays and the telescope begins to slew. Starfinder beeps and "Adjust Mount" displays after the telescope finishes slewing.
5. A scrolling message prompts you to unlock both the Latitude Lock (**23, Fig. 2b**) and the Azimuth Lock (**24, Fig. 2b**).
6. Manually rotate (do NOT use Starfinder's Arrow keys!) the telescope until Polaris is centered once again in the eyepiece. Then re-lock both the Latitude and Azimuth Locks and press ENTER.
7. Starfinder then chooses another star from its database and the telescope slews to the star for alignment. It may not appear in the field of view in the eyepiece. The alignment star should be easily recognized and be the brightest star in the area of the sky where the telescope is pointing. Use the Arrow keys to move the telescope until the star is visible and centered in the eyepiece. When the star is centered, press ENTER.

   Another method to find the alignment star if it does not appear in the eyepiece is to perform a **"spiral search."** If the alignment star is not visible in the eyepiece when the telescope finishes its search, press GO TO and the telescope starts slewing in a spiral pattern at a very slow speed around the search area. Look through the eyepiece and when the object does become visible, press MODE to stop the spiral search. Then use the Arrow keys to center the object and press ENTER to complete the alignment procedure.

   NOTE: *Starfinder locates alignment stars based on the date, time, and location entered. The alignment stars may change from night to night. All that is required is for the observer to center the selected star in the eyepiece when prompted.*

Check Mount

It is possible for the 4504 telescope to move in such a way that the telescope tube might interfere with the mount while slewing. Starfinder has a feature called "Check Mount" to alert you of this possibility.

If "Check Mount" displays, inspect the assembly to see if it's moving in such a way that the mount, tube, levers, motors, *etc.*, might catch on or collide with each other. Also inspect the cable to see if it might become tangled. If any of these possibilities seem likely to occur, press MODE to abort the current operation of the telescope. If they do not seem likely, press GO TO to continue with the current operation. Press any key during slewing to stop the telescope.

If "Check Mount" displays during alignment, and interference seems likely, press MODE. Select another alignment star by pressing one of the Scroll keys to select the next alignment star in the database. Repeat this procedure as necessary to align the telescope. To abort the alignment procedure, press and hold MODE for about two seconds.

Which One's the Alignment Star?

If Starfinder has chosen an alignment star that you are unfamiliar with, how can you be sure if the star in your eyepiece is really the alignment star?

The rule of thumb is that an alignment star is usually the brightest star in that area of the sky. When you view an alignment star in an eyepiece, it will standout dramatically from the rest of the stars in that portion of the sky.

If you have an obstruction, such as a tree or a building blocking your view of the alignment star, or if you have any doubts at all about the star that has been chosen, no problem. Just press the Scroll Down key and Starfinder will find another star to align upon.

Go To Saturn

After performing the Train the Drive and the One-Star alignment procedures, the motor drive begins operating and the telescope is aligned for a night of viewing. Objects in the eyepiece should maintain their position even though the Earth is rotating beneath the stars.

> ***IMPORTANT NOTE:*** *Once aligned, only use the Starfinder menus or Arrow keys to move the telescope. Do not loosen the telescope locks, or move the base manually, or alignment will be lost.*

This exercise demonstrates how to select an object for viewing from Starfinder's database, *i.e.*, Saturn. Note that Saturn is not visible all year long and it may be necessary for you to choose another object from Starfinder's database. However, the procedure is identical to the one used for observing Saturn.

1. After the telescope is aligned, "Select Item: Object" displays. Press ENTER. If "Select Item: Object" is not currently displayed, press MODE repeatedly until it displays, then press ENTER.
2. "Object: Solar System" displays. Press ENTER.
3. "Solar System: Mercury" displays. Use the Scroll Down key until "Solar System: Saturn" displays.
4. Press ENTER. "Calculating" displays. Then "Saturn" and a set of coordinates displays. Saturn's (and other planets') coordinates change throughout the year.
5. Press GO TO. "Saturn: Slewing..." displays and the telescope slews until it finds Saturn. You may need to use the Arrow keys to center Saturn precisely in the eyepiece. Starfinder then automatically slews (moves) the telescope so that it tracks Saturn (or whatever other object you may have chosen). Saturn remains centered in the eyepiece.

Using the Guided Tour

This example demonstrates using "Tonight's Best" Guided Tour.

1. After observing Saturn, press MODE twice so that "Select Item: Object" displays again. If "Select Item: Object" is not currently displayed, press MODE repeatedly until it displays.
2. Press the Scroll Down key twice. "Select Item: Guided Tour" displays.
3. Press ENTER. "Guided Tour: Tonight's Best" displays. Press ENTER to select this tour.

> ***NOTE:*** *If you wish to try out other Guided Tours, press the Scroll Down key to scroll through other tour choices. When the tour you wish to select displays, press ENTER.*

4. “Tonight’s Best: Searching...” displays. After calculating, “Tonight’s Best: Jupiter” displays.

   NOTE: *Different objects may be displayed on a tour list on any given night.*

   Press ENTER and then use the Scroll keys to display information about the object. Press Mode to exit the information display. Press GO TO to move the telescope to the object.
5. Press MODE to return to the Tour list. Press the Scroll keys to scroll through the list. Press ENTER when you find the next object you wish to observe.
6. Press MODE and hold for about two seconds to leave the Guided Tour menu.

Some Observation Tips

- Avoid touching the eyepiece while observing through the telescope. Vibrations resulting from such contact will cause the image to move. Likewise, avoid observing sites where ground-based vibrations may resonate the tripod. Viewing from the upper floors of a building may also introduce image movement.
- Allow your eyes a few minutes to become adapted to the dark before attempting any serious astronomical observations. Use a red filtered flashlight to protect your night vision when reading star maps or inspecting the components of the telescope.
- Avoid setting up the telescope inside a room and observing through an open window (or worse yet, a closed window). Images viewed in such a manner may appear blurred or distorted due to temperature differences between inside and outside air. Also, it is a good idea to allow your telescope a chance to reach the ambient (surrounding) outside temperature before starting an observing session.
- Avoid viewing objects low on the horizon. Objects will appear better resolved with far greater contrast when viewed higher in the sky. If images appear to “shimmer” in the eyepiece, reduce eyepiece power until the image steadies. This condition is caused by air turbulence in the upper atmosphere.

You have now completed all the Lessons for the basic operation of your 4504 telescope. All of Starfinder's features perform in the same way as the features covered in Part 1. Practice these procedures so you can apply them to the more advanced Starfinder menu features presented in Part 2 of this manual.

PART TWO: Starfinder Controls and Menus

This section describes how Starfinder operates, including:

- Starfinder's controls
- How to move through Starfinder's menus
- Alignment setups
- Starfinder's Menus

Control of the 4504 is through the operation of the standard-equipment Starfinder handbox (Fig. 17). Nearly all functions of the telescope are accomplished with just a few pushes of Starfinder's buttons. Some of the major features of Starfinder are:

- Automatically move the telescope to any of the more than 1400 objects stored in its database, or manually enter coordinates of any celestial object.
- Take a guided tour of the best celestial objects to view on any given night of the year.
- Access a glossary of astronomical terms.
- Calculate which eyepiece to use for optimal viewing of a celestial object.

Starfinder provides control of virtually every telescope function within a compact handbox. Starfinder has soft-touch keys designed to have a positive feel. The LCD (Liquid Crystal Display) is backlit with a red LED (Light Emitting Diode) for easy viewing in the dark. The backlit display, key arrangement, and sequential database make Starfinder extremely user-friendly.

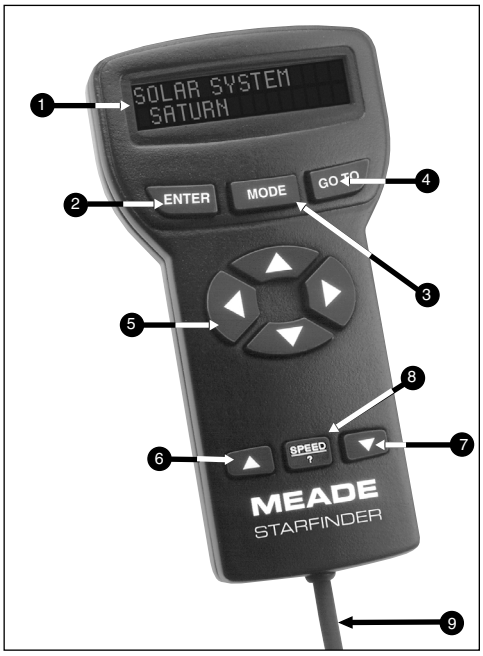

Fig. 17: *Starfinder controls.*

> ***NOTE****: Starfinder does not require batteries; the telescope's battery pack supplies power to Starfinder.*

Starfinder Controls

❶ **2-Line LCD Display:** Provides an interface between Starfinder and the telescope.

Top line: lists the primary category or menu item.

Bottom line: contains a menu option or information about an object or subject, depending on which function is being performed.

❷ **ENTER Key:** Accesses, in a sequential manner, the next menu or data level in the Starfinder database (see "HOW STARFINDER'S MENUS WORK," page 26).

> ***NOTE:*** *If ENTER is pressed for two seconds or more and then released, Starfinder emits a beep and "ENTER to Sync" is displayed. "ENTER to Sync" is relevant only after the telescope has been aligned and is pointing at an object. If the "ENTER to Sync" feature is accessed by mistake, press MODE to return to the previous screen. See "HIGH PRECISION," page 32 for more details about this feature.*

❸ **MODE Key:** Returns to the previous menu or data level in the Starfinder database until the top level, “Select Item," is reached. The MODE key is similar to the ESCAPE key on a computer.

NOTE: *Pressing MODE while in the Select Item level moves Starfinder to the topmost screen: "Select Item: Object."*

NOTE: *If MODE is pressed and held for two seconds or more, the following information is then available using the Scroll keys (**6 and 7, Fig. 17**):*

- *Right Ascension and Declination coordinates*
- *Altitude and Azimuth coordinates*
- *Local Time and Local Sidereal Time (LST)*
- *Timer and Alarm Status*

Press MODE again to return to the previous menu.

❹ **GO TO Key:** Slews the telescope to the coordinates of the currently selected object. While the telescope is slewing, the operation may be aborted at any time by pressing any key except GO TO. Pressing GO TO again resumes the slew to the object.

The GO TO key also allows you to perform a **"spiral search."** A spiral search is useful when the telescope slews to an object, but that object is not visible in the eyepiece after the telescope finishes it search. (This sometimes occurs during an alignment procedure. See "ALIGN YOUR TELESCOPE USING STARFINDER," page 20.) Press GO TO when the slew is finished and the telescope starts slewing in a spiral pattern at a very slow speed around the search area. Look through the eyepiece and when the object does become visible, press MODE to stop the spiral search. Then use the Arrow keys to center the object.

❺ A**rrow Keys:** Slew the telescope in a specific direction (up, down, left, and right), at any one of seven different speeds (speed selection is explained in “SLEW SPEEDS,” page 14). The following functions are also available with the Arrow keys:

- **Data Entry:** Use the Up and Down Arrow keys to Scroll through the letters of the alphabet and numerical digits. The Down Arrow key starts with the letter "A" and the Up Arrow key starts with the digit "9." Use the Left and Right Arrow keys to move the blinking cursor left and right across the LCD display.
- **Polar Alignment:** Use the Left and Right Arrow keys to move the telescope. The Left Arrow key rotates the telescope counterclockwise on the Right Ascension axis, while the Right Arrow key rotates it clockwise.

❻ ❼ **Scroll Keys:** Access database options within a selected menu. The menu is displayed on the first line of the screen. Options within the menu are displayed, one at a time, on the second line. Press the Scroll keys to move through the options. Press and hold a Scroll key to move quickly through the options.

The Scroll keys also scroll through the letters of the alphabet and numerical digits.

NOTE: *The Scroll Down key and the Down Arrow key move forward through the alphabet & digits (A to Z, 0-9) and the Scroll Up key and the Up Arrow key move backward (Z to A, 9-0).*

Press and hold the Up Arrow key to speed up the rate at which a message scrolls across the display. Press and hold the Down Arrow key to slow down the scrolling speed. When the display is scrolling at a speed that is comfortable for reading, release the Scroll key.

8 **Speed/? Key:** Briefly pressing the Speed/? key cycles through the seven slew speeds that move the telescope (see “Slew Speeds,” page 14).

> ***NOTE:*** *Pressing the Speed/? key briefly changes the slew speed. Holding down the Speed/? key longer (one to two seconds) accesses the Help function.*

The Speed/? key also accesses the "Help" file. "Help" provides on-screen information on how to accomplish whatever task is currently active.

Hold down the Speed/? key and then follow the prompts on the display to access details of Starfinder functions in the Help feature. The Help system is essentially an on-screen instruction manual.

If you have a question about a Starfinder operation (*i.e.*, INITIALIZATION, ALIGNMENT, *etc.*), hold down the Speed/? key and follow the directions that scroll on the second line of the LCD screen. When a word appears in [brackets], press ENTER to access the word in the Starfinder Glossary. A definition or more detailed information is displayed. Press MODE to return to the scrolling Starfinder Help display.

When satisfied with the Help provided, press MODE to return to the original screen and continue with the chosen procedure.

9 **Coil Cord**: To operate, the Starfinder coil cord must be plugged into the HBX port (**9, Fig. 11**) of the Dec motor box.

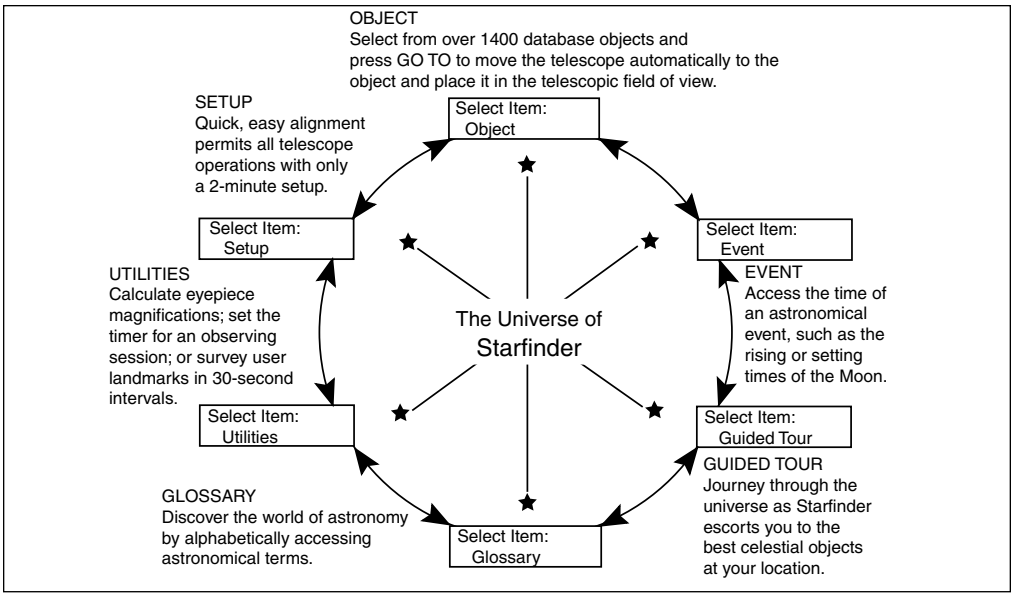

Fig. 18: *The Starfinder universe.*

How Starfinder's Menus Work

It is important to understand that Starfinder's menu selections are set in a loop. This means that pressing the Scroll Down key cycles down through all the available options within a given category and then returns to the first option. The Scroll Up key cycles up through the options in the opposite order. Note that this capability is a quick way to get to an option that is near the bottom of the list. The following example demonstrates this capability.

To navigate to the "Select Item: Setup" menu option when the "Select Item: Object" menu is displayed:

1. Press the Scroll Down key four times or the Scroll Up key once.

The screen in **Fig. 19** displays two lines of information. The top line shows the current menu level. The second line displays an option which may be selected within that menu level. Some options are choices that select the next menu level down. The Scroll keys move up and down within the list of available options, showing one option at a time.

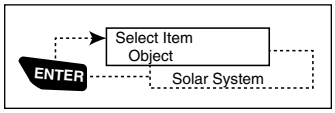

Fig. 19: *Starfinder levels.*

When the desired option is displayed on the second line, press the ENTER key to choose that option and move down one menu level.

To leave a level (*e.g.,* the wrong menu option is chosen), press the MODE key.

> ***IMPORTANT NOTE:*** *No matter how many menu levels of Starfinder are traveled, each press of the MODE key moves up a level, until the top menu level, "Select Item," is reached. Once in the Select Item level, press MODE to return to the topmost available screen: "Select Item: Object."*

Starfinder Navigation Exercise

To demonstrate how the Starfinder menu structure works, the following exercise calculates the Sunset time so an evening observing session can be planned.

NOTE: *To perform an accurate calculation, Starfinder must be properly initialized with the current date, time, and location of the observing site.*

To enter the current date, time, and location information of your observing site, see " INITIALIZE STARFINDER" page 17, before proceeding with this exercise.

To Calculate Sunset time:

1. Press the MODE key several times, until "Select Item: Object" displays.
2. Press the Scroll Down key once to display the Event option in the Select Item menu.
3. Press the ENTER key to choose the Event option and move down a menu level. "Event: Sunrise" displays.
4. Press the Scroll Down key once to display the Sunset option in the Event menu.
5. Press the ENTER key to choose the Sunset option and move down another menu level.
6. Starfinder calculates the Sunset time based on the current date, time, and location. Starfinder then displays the time of Sunset.
7. Press MODE once to start moving back up through the Starfinder menu levels. The first menu level up is Event.
8. Press MODE again to move up another menu level. This is the top menu level, Select Item.
9. Press MODE again to return to the starting point of "Select Item: Object."

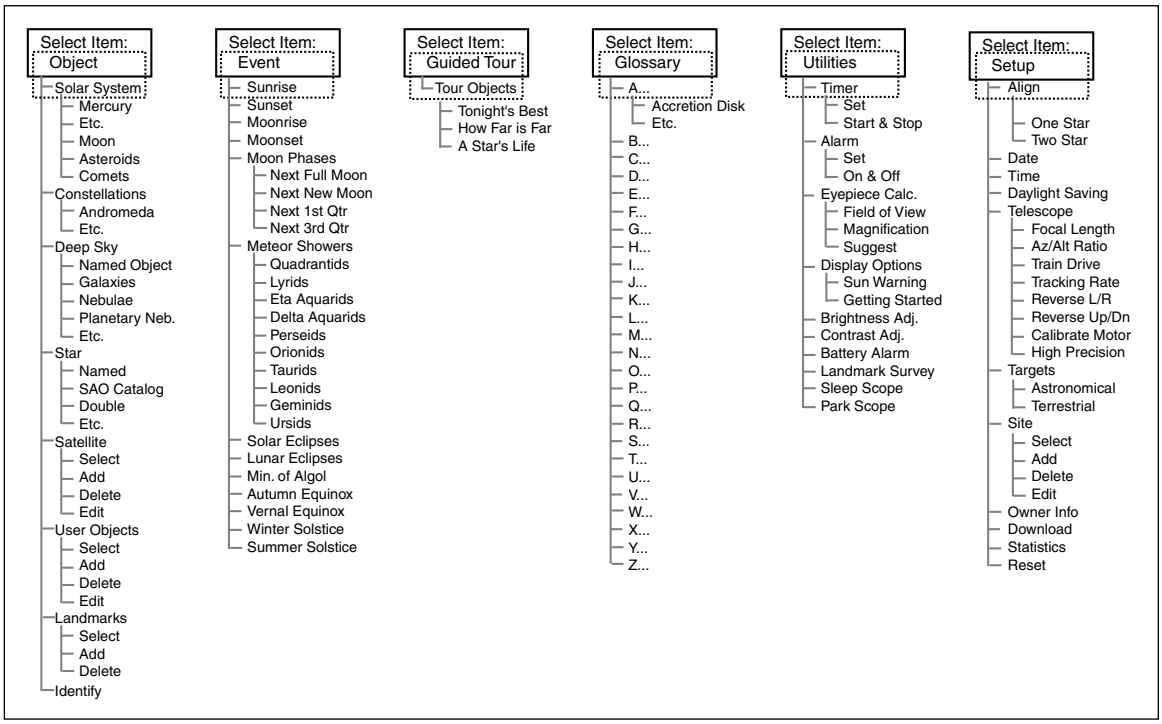

Fig. 20: *The complete Starfinder menu structure.*

Starfinder Menus

Object Menu

Almost all observing with Starfinder is performed using the Object menu. (***Note:*** *Exceptions include Guided Tour and Landmark Survey.*) See “GO TO SATURN,” page 20, for an example of observing using the Object menu. Also see “USING THE GUIDED TOUR,” page 21.

Many Starfinder menu categories contain databases. A Starfinder database is a list of viewable objects. When one of these objects is selected, Starfinder moves your telescope (if properly aligned) and points it at the selected object.

Object Menu Options:

Solar System is a database of the eight planets (Earth is not included) in order out from the Sun, followed by the Moon, asteroids, and comets.

Constellation is a database of all 88 Northern and Southern Hemisphere constellations. When this menu option is chosen and a constellation name appears on the first line of the screen, press GO TO once to change the second line to the name of the brightest star in the constellation. Press GO TO a second time to slew the telescope to that star. Use the Scroll keys to cycle through the list of stars in the constellation, from brightest to dimmest.

Deep Sky is a database of objects outside our Solar System such as nebulae, star clusters, galaxies, and quasars.

Star is a database of stars listed in different categories such as named, double, variable, or nearby.

User Objects allows the user to define deep-sky objects of specific interest that are not currently in the Starfinder database. See "APPENDIX C," page 42, for detailed information.

Landmarks stores the location of terrestrial points of interest in the permanent Starfinder database.

> ***IMPORTANT NOTE:*** *To use the Landmark function, the telescope must be located and aligned exactly as when the landmark was added to the database.*

- **Select**: To select a landmark already in the database, choose the Select option and scroll through the list. Press ENTER to select a landmark, then press GO TO and the telescope slews to the object.
- **Add:** To add a landmark, choose the Add option. Enter the name of the landmark. Locate the object with the Arrow keys (the telescope must be aligned) and center the landmark. Press ENTER.

Use the Landmark Survey option in the Utilities menu to sequentially view all landmarks entered into Starfinder. See "LANDMARK SURVEY," page 32.

Identify is an exciting feature for an observer who wants to scan the night sky and start exploring.

After the telescope has been properly aligned, use the Starfinder Arrow keys to move about in the sky, and then follow this procedure:

> ***IMPORTANT NOTE:*** *Only use the Arrow keys to move the telescope during the Identify procedure. Do not loosen the telescope locks, or move the base, or alignment will be lost.*

1. When a desired object is visible in the eyepiece, press MODE until the "Select Item: Object" menu is displayed.
2. Scroll through the Object menu options until "Object: Identify" displays.
3. Press ENTER to search the database for the identity of the object being observed.
4. If the telescope is not directly on a Starfinder database object, the nearest database object is located and displayed on the screen. Press GO TO and the telescope slews to that object.

Event Menu

The Event menu provides access to dates and times of astronomical events. The Event database includes:

Sunrise and **Sunset** calculates the time that the Sun rises or sets on the current date. Find rise and set times for other dates (*e.g.,* a date three months in the past or future) by entering the new date into the "Setup: Date" menu.

Moonrise and **Moonset** calculates the time that the Moon rises or sets on the current date. Find rise and set times for other dates by entering a new date into the "Setup: Date" menu.

Moon Phases displays the date and time of the next Full, New, 1st Quarter, and 3rd Quarter Moon.

Meteor Showers provides information on upcoming meteor showers (*e.g.,* the Perseids, the Leonids, *etc.*), the dates of the showers, and when they reach maximum.

> ***NOTE:*** *Meteors are fast moving objects that cover large areas of the sky and are usually best observed with the naked eye.*

NEVER point the telescope directly at or near the Sun at any time! Observing the Sun or an eclipse of the Sun, even for the smallest fraction of a second, will result in instant and irreversible eye damage, as well as physical damage to the telescope itself.

Solar Eclipse lists upcoming Solar Eclipses, including the date and type (total, annular, or partial) of eclipse, and the location and time of the first and last contacts of the Moon's shadow. Use the Scroll Up and Down keys to display the available data.

Lunar Eclipse lists upcoming Lunar Eclipses, including the date and type (total, partial, penumbral) of eclipse. Use the Scroll Up and Down keys to display the available data.

Min. (Minimum) of Algol is the minimum brightness of the dramatic eclipsing binary star system, Algol. It is relatively close at a distance of 100 light years. Every 2.8 days during a 10-hour period, Algol undergoes a major change in apparent magnitude as one of the two stars passes behind the other. The combined magnitude of the two stars thus dips from +2.1 to a minimum of +3.4 halfway through the eclipse as the second star is hidden. Starfinder calculates minimum magnitude time at mid-eclipse.

Autumn and **Vernal Equinox** calculates the time and date of the fall or spring equinox of the current year.

Winter and **Summer Solstice** calculates the time and date of the winter or summer solstice of the current year.

Glossary Menu

The Glossary menu provides an alphabetical listing of definitions and descriptions for common astronomical terms and Starfinder functions. Access directly through the Glossary menu or through hypertext words embedded in Starfinder.

A hypertext word is any word in [**brackets**], usually found when in the Starfinder Help function or in a scrolling message such as a description of a planet or star. Press ENTER whenever a hypertext word is displayed and Starfinder links directly to the glossary entry for that word.

To access a hypertext word directly from the Glossary menu, use the Scroll keys to scroll through the alphabet. Press ENTER on the desired letter. Scroll to the desired entry, then press ENTER to read the description.

Utilities Menu

The Utilities menu provides access to several extra features within Starfinder, including a countdown timer and an alarm. The Utilities functions include:

Timer selects a countdown timer. This feature is useful for functions such as astrophotography. To use the Timer, press ENTER, then choose "Set" or "Start/Stop."

- **Set:** Enter the time to be counted down (in hours, minutes, and seconds), then press ENTER.
- **Start/Stop:** Activates the timer set previously. Use the Scroll keys to toggle between ON and OFF. When ON is displayed, press ENTER to activate the timer. When the timer runs out, four beeps sound and the timer is deactivated.

Alarm selects a time for an alarm signal as a reminder. To use the Alarm, press ENTER, then choose "Set" or "Start/Stop."

- **Set:** Enter the time of day for the alarm to sound (in hours, minutes, and seconds), then press ENTER.
- **Start/Stop:** Activates the alarm set previously. Use the Scroll keys to toggle between ON and OFF. When ON is displayed, press ENTER to activate the alarm. When the alarm time arrives, Starfinder beeps. Press ENTER to deactivate the alarm.

Eyepiece Calc calculates information about an eyepiece for the specific telescope to which Starfinder is connected:

- **Field of View:** Scroll through a list of available eyepieces. When an eyepiece is selected, the field of view is calculated.
- **Magnification:** Scroll through a list of available eyepieces. When an eyepiece is selected, the magnification is calculated.
- **Suggest:** Starfinder calculates and suggests the best eyepiece for viewing, based on the telescope and the object being viewed.

Display Options enables or disables Starfinder's two initial displays. If both displays are disabled, Starfinder begins with the Date display.

- **Sun Warning:** Turns the Sun warning message on or off.
- **Getting Started:** Turns the "Getting Started" message on or off.

Brightness Adj: Adjusts the brightness of the display using the Scroll keys. When complete, press ENTER.

Contrast Adj: Adjusts the contrast of the display using the Scroll keys. When complete, press ENTER.

NOTE: *This feature is usually only required in very cold weather.*

Landmark Survey automatically slews the telescope to all user-defined landmarks with a short pause at each location. Press ENTER to start the survey. While a slew is in progress, press any key to skip that object and go to the next landmark on the list. To observe a landmark for a longer period, press MODE when paused on the object to stop the survey. Press ENTER to restart the survey at the first object on the list.

Sleep Scope is a power saving option that shuts down Starfinder and the telescope without forgetting its alignment. Press ENTER to activate the Sleep function. Starfinder goes dark, but the internal clock keeps running. Press any key, except ENTER, to re-activate Starfinder and the telescope.

Park Scope is designed for a telescope that is not moved between observing sessions. Align the telescope one time, then use this function to park the telescope. Next time it is powered up, enter the correct date and time – and no alignment is required. Pressing ENTER causes the telescope to move to its pre-determined Park position. Once parked, the screen prompts you to turn off the power (*i.e.*, unplugging the battery pack).

> ***IMPORTANT NOTE:*** *When the Park Scope option is chosen and the display prompts to turn off the telescope power, Starfinder is unable to be returned to operation without unplugging the battery pack and then plugging it back in.*

Setup Menu

The Setup menu's primary function is to align the telescope (see "ALIGN YOUR TELESCOPE USING STARFINDER," page 20). However, there are numerous other features available within Setup. These options include:

Date changes the date used by Starfinder. This function is useful to check events in the past or future. *Example:* set the Date for a day three months in the future and then check the" Select Item: Event" menu for the Sunset time or Moon phase on that date. See "EVENT MENU," page 29.

Time changes the time entered into Starfinder. Setting the correct time is critical for Starfinder to properly calculate locations and events.

Daylight Saving is used to set the status of Daylight Savings time.

> ***NOTE:*** *Daylight Savings Time may be referred to by a different name in various areas of the world. Check local time to verify.*

Telescope accesses the following options:

- **Focal Length**: Displays the focal length of the selected telescope.
- **Az Ratio** and **Alt Ratio**: The Az (Azimuth or horizontal) ratio and Alt (Altitude or vertical) ratio refers to the gears installed in the telescope motors. Do not alter these numbers.
- **Train Drive**: Trains the motors to locate objects with more precision.

  > ***NOTE:*** *If you are experiencing any problems with pointing accuracy, follow the procedure described in "TRAINING THE DRIVE," page 19, to insure accurate pointing and tracking.*

Tracking Rate: Changes the speed at which the telescope tracks targets in the sky.

  a. **Sidereal**: The default setting for Starfinder; sidereal rate is the standard rate at which stars move from East to West across the sky due to the rotation of the Earth.

  b. **Lunar:** Choose this option to properly track the Moon over long observing sessions.

  c. **Custom**: Allows entry of user-defined tracking rates.

- **Reverse L/R:** Reverses the functions of the Left and Right Arrow keys (*i.e.*, the Right key moves the telescope to the left).
- **Reverse UP/DOWN:** Reverses the functions of the Up and Down Arrow keys (*i.e.*, the Up key moves the telescope down).

- **Calibrate Motor:** If the telescope motors appear to have a problem, use this option to retest the motors before doing a Reset. This option is also used if a Starfinder unit is moved between telescopes to match Starfinder to the telescope.
- **High Precision:** If High Precision is turned on when looking for a faint celestial object (*i.e.*, a nebula or galaxy), Starfinder first slews to a nearby bright star and requests "ENTER to Sync." Center the star in the eyepiece, then press ENTER. At that point the telescope has a high precision alignment to that part of the sky and it then slews to the object that was originally requested.

Targets switches between astronomical targets and terrestrial targets. If "Astronomical" is selected, the telescope tracking motor is activated. If "Terrestrial" is selected, the tracking motor is turned off. See "OBSERVE A STAR USING THE AUTOMATIC TRACKING FEATURE," page 16, for more information.

Site provides access to the following options:

- **Select:** Displays the currently selected observing site and also allows you to select other sites you have entered into a user-defined database (see "Add" below). Use the Scroll keys to cycle through all available sites in this database. Press ENTER when the site you wish to select displays. Use this option when you move to a different geographic location.

  NOTE: *Only the site that is entered during Initialization (see page 17) will be displayed in this database until other sites are entered with the "Add" option.*

- **Add:** Allows you to add new observing sites to the database (up to six sites may be stored). Scroll through the list of Countries/States. Press ENTER when the site you wish to add displays. Then choose the desired city in the same manner.
- **Delete:** Deletes a stored site from the database.
- **Edit:** Edits a selected site, including: the name, latitude, longitude, and time zone. Time zone refers to the Greenwich Mean Time (GMT) time zone shift. Users West of Greenwich, England, use “-” hours, East of Greenwich use “+” hours. For the United States, look up the time zone shift in Table 1.

  NOTE: *Starfinder compensates for daylight savings time, if selected (see "DAYLIGHT SAVING," page 31).*

Time Zone	Shift
Atlantic	-4 Hours
Eastern	-5 Hours
Central	-6 Hours
Mountain	-7 Hours
Pacific	-8 Hours
Hawaii	-10 Hours

Table 1: *Time Zone Shift.*

Owner Info accesses the owner information menu options, including:

- **Name:** A user may enter both his or her first and last names using the Up and Down Arrow keys to cycle through the alphabet. Use the Right and Left Arrow keys to move across the text. Press ENTER when the entry is complete.
- **Address:** Use the Up and Down Arrow keys to enter your street address, city, state, and zip code. Press ENTER when the entry is complete.

Download transfers information from a personal computer or another Starfinder.

NOTE: *The Download function requires the optional Cable Set. See the instruction sheet for the optional cable set for more information on how to download.*

Statistics provides basic statistical data about Starfinder, including:

- Characters Free: Shows how much room is available in user-defined object memory.
- Version: Shows the current version of the Starfinder software.

Reset completely resets Starfinder. Starfinder requires initialization again after a Reset before proceeding with observations. See “ INITIALIZING STARFINDER,” page 17. You will also need to perform “TRAINING THE DRIVE,” page 19, after a Reset.

PART 3: Caring for Your Telescope

Cleaning

The lens or mirror surfaces should be cleaned as *infrequently* as possible. Front surface aluminized mirrors, in particular, should be cleaned only when absolutely necessary. In all cases, avoid touching any mirror surface. A little dust on the surface of a mirror or lens causes negligible loss of performance and should not be considered reason to clean the surface. When lens or mirror cleaning does become necessary, use a camel's hair brush or compressed air gently to remove dust. If the telescope's dust cover is replaced after each observing session, cleaning of the optics will rarely be required.

Mount and Tripod Adjustments

Every Meade 4504 Telescope equatorial mount and tripod is factory inspected for proper fit and function prior to shipment. It is unlikely that you will need to adjust or tighten these parts after receipt of the telescope. However, if the instrument received unusually rough handling in shipment, it is possible that some of these assemblies can be loose. To make adjustments you will need a 1/2" or 11/16" socket or adjustable end wrench, a 5/64" hex wrench, and a Phillips-head screwdriver.

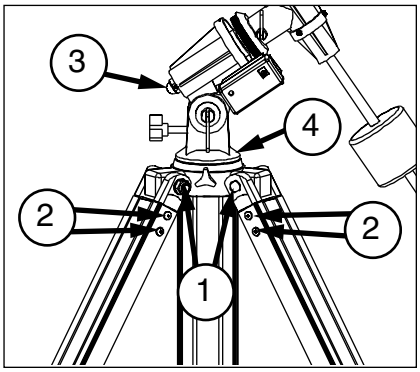

***Fig. 21**: Maintenance adjustments.*

The equatorial mount has four main areas that can be adjusted: A loose polar shaft can be tightened by releasing a 5/64" hex set-screw that is on the side of the 11/16" polar shaft acorn cap nut (**3, Fig. 21**), and then turning the 11/16" acorn cap nut clockwise to a firm feel, and then tightening the 5/64" hex set-screw. A loose Azimuth base (**4, Fig. 21**), can be tightened by turning the 11/16" Azimuth shaft bolt, located underneath the mount and in between the three tripod legs, clockwise to a firm feel. The R.A. (**1, Fig. 11**), and Dec (**12, Fig. 11**) worm block assemblies can have backlash removed by releasing the two Phillips-head screws on each assembly, applying pressure to the worm block against the worm gear, and then tightening the Phillips-head screws. Note that overtightening of any of the nuts, bolts, or screws can inhibit the smooth rotating action of the axes and gears, and may result in stripping the threads.

The tripod legs have 1/2" nuts (**1, Fig. 21**), and Phillips-head screws (**2, Fig. 21**) that may have backed off. Tighten to a firm feel for the most sturdy performance of the telescope.

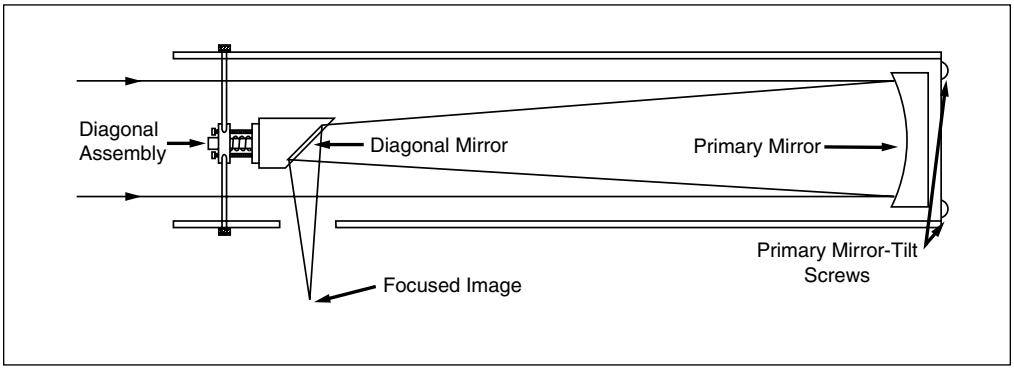

***Fig. 22:** The Newtonian reflecting telescope.*

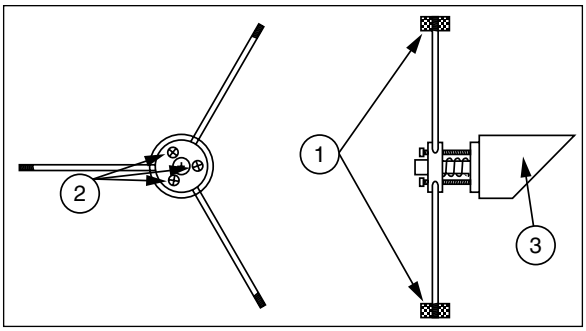

Fig. 23: *Diagonal assembly.*

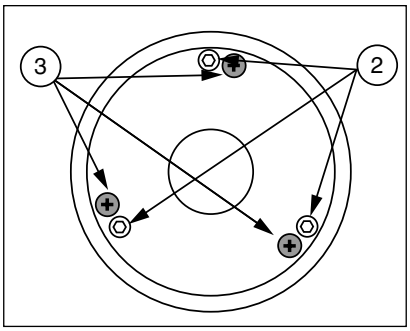

Fig. 24: *Primary mirror cell.*

Collimation (Alignment) of the Optics

Your telescope is optically aligned at the factory prior to shipment. It is unlikely that you will need to align, or collimate, the optics after receipt of the instrument. However, if the telescope received unusually rough handling in shipment, it is possible that the optics must be re-aligned for best optical performance. Take the time to familiarize yourself with the following collimation procedure, so that you will recognize a properly collimated instrument and can adjust the collimation yourself, if necessary.

Correct collimation

The properly collimated (aligned) mirror system in the Meade 4504 Telescope assures the sharpest images possible. This occurs when the primary mirror and diagonal mirror are tilted so that the focused image (**Fig. 22**) falls directly through the center of the focuser drawtube. These mirror tilt adjustments are made with the diagonal assembly (**Fig. 22**) and the primary mirror cell (**Fig. 22**), and will be discussed later.

To inspect the view of the mirror collimation, look down the focuser drawtube with the eyepiece removed. The edge of the focuser drawtube will frame the reflections of the primary mirror with the 3 mirror clips (**2, Fig. 25**), the diagonal mirror (**3, Fig. 25**), the spider vanes (**4, Fig. 25**), and your eye (**5, Fig. 25**). Properly aligned, all of these reflections will appear concentric (*i.e.* centered) as illustrated in Fig. 25. Any deviation from the concentric reflections will require adjustments to the diagonal assembly (**Fig. 23**), and/or the primary mirror cell (**Fig. 24**).

Spider vane adjustments

If the diagonal mirror (**1, Fig. 26**) is left or right of center within the drawtube (**2, Fig. 26**), loosen the spider vane adjustment/lock knobs (**1, Fig. 23**) located on the outside surface of the main tube and slide the entire diagonal assembly up or down the tube along the slotted holes, until the diagonal mirror is centered in the drawtube. If the diagonal mirror (**1, Fig. 26**) is above or below of center within the drawtube, thread in one of the spider vane adjustment/ lock knobs while unthreading the other. Only make adjustments to two knobs at a time until the diagonal mirror is in the drawtube. When the spider vane is correctly positioned, it will look like **Fig. 27** (the diagonal mirror is misaligned).

Diagonal holder adjustments

If the diagonal mirror (**1, Fig. 27**) is centered in the drawtube (**2, Fig. 27**), but the primary mirror is only partially visible in the reflection (**3, Fig. 27**), the three Phillips-head diagonal tilt screws (**2, Fig. 23**) must be unthreaded slightly to the point of where you can rotate the diagonal holder (**3, Fig. 23**) from side-to-side by grasping the diagonal holder with your hand and rotating until you see the primary mirror become as centered in the reflection of the diagonal mirror as possible. Once you are at the best position, thread in the three Phillips-head diagonal tilt screws to lock the rotational position. Then, if necessary, make adjustments to these three Phillips-head screws to

refine the tilt-angle of the diagonal mirror until the entire primary mirror can be seen centered within the diagonal mirror reflection. When the diagonal mirror is correctly aligned, it will look like **Fig. 28** (the primary mirror is shown out of alignment).

Primary mirror adjustments

If the diagonal mirror (**1, Fig. 28**) and the reflection of the primary mirror (**2, Fig. 28**) appear centered within the drawtube (**3, Fig. 28**), but the reflection of your eye and the reflection of the diagonal mirror (**4, Fig. 28**) appear off-center, you will need to adjust the primary mirror tilt Phillips-head screws of the primary mirror cell (**3, Fig. 24**). These primary tilt screws are located behind the primary mirror, at the lower end of the main tube (**Fig. 22**). To adjust the primary mirror tilt screws, first unscrew several turns the three hex-head primary mirror cell locking screws (**2, Fig. 24**) that are next to each primary mirror tilt Phillips-head screw. Then by trial-and-error, turn the primary mirror tilt Phillips-head screws (**3, Fig. 24**) until you develop a feel for which way to turn each screw to center the reflection of your eye. Once centered, as in **Fig. 25**, turn the three hex-head primary mirror cell locking screws (**2, Fig. 24**) to relock the tilt-angle adjustment.

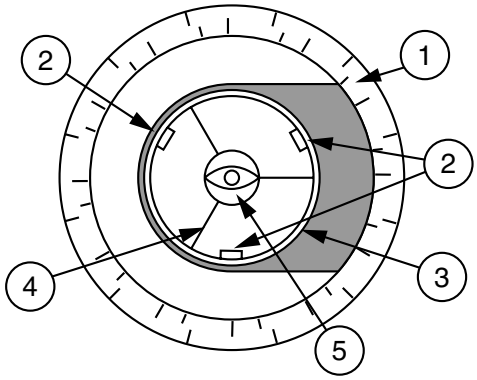

Fig. 25: *Correct collimation.*

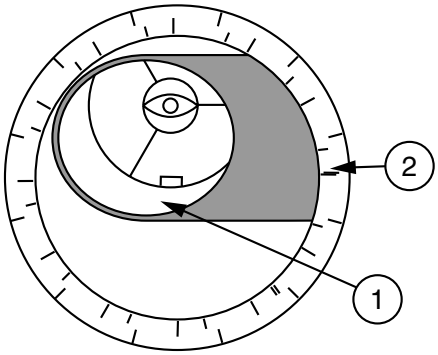

Fig. 26: *Spider vane misalignment.*

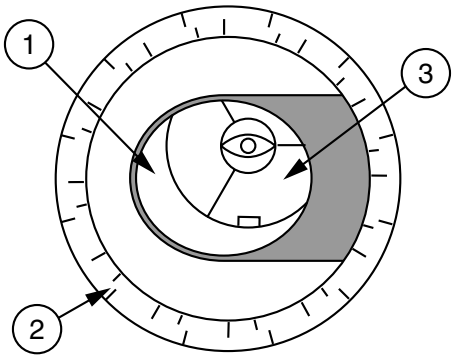

Fig. 27: *Diagonal mirror misalignment.*

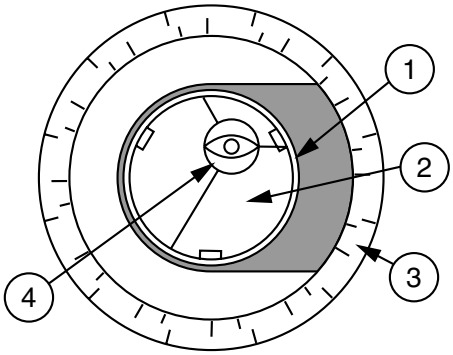

Fig. 28: *Primary mirror misalignment.*

Star testing the collimation

With the collimation performed, you will want to test the accuracy of the alignment on a star. Use the H 25mm eyepiece and point the telescope at a moderately bright (second or third magnitude) star, then center the star image in the telescope's field-of-view. With the star centered, follow the method below:

- Bring the star image slowly out of focus until one or more rings are visible around the central disc. If the collimation was performed correctly, the central star disk and rings will be concentric circles, with a dark spot dead center within the out-of-focus star disk (this is the shadow of the secondary mirror), as shown in **C, Fig. 29**. (An improperly aligned telescope will reveal elongated circles (**A, Fig. 29**), with an off-center dark shadow.)
- If the out-of-focus star disk appears elongated (**B, Fig. 29**), you will need to adjust the primary mirror Phillips-head tilt screws of the primary mirror cell (**3, Fig. 24**).
- To adjust the primary mirror tilt screws (**3, Fig. 24**), first unscrew several turns the three hex-head primary mirror cell locking screws (**2, Fig. 24**), to allow free turning movement of the tilt knobs.
- As you make adjustments to the primary mirror tilt screws (**3, Fig. 24**), you will notice that the out-of-focus star disk image will move across the eyepiece field. Choose one of the three primary mirror tilt screws that will move the star disk image to the center of the eyepiece field.
- Repeat this process as many times as necessary until the out-of-focus star disk appears as in **C, Fig. 29**, when the star disk image is in the center of the eyepiece field.
- With the star testing of the collimation complete, tighten the three hex-head primary mirror locking screws (**2, Fig. 24**).

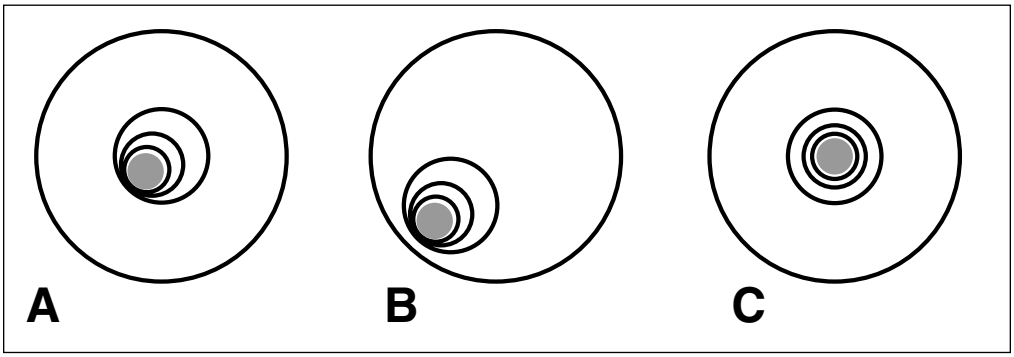

Fig. 29: *Collimation.*

MODEL 4504 TELESCOPE SPECIFICATIONS

Optical design	Newtonian Reflector
Clear aperture	114mm (4.5”)
Focal length	910mm
Focal ratio (photographic speed)	f/8
Resolving power	1.0 arc secs
Multi-coatings on objective lens	Standard
Limiting visual stellar magnitude (approx.)	12.4
Image scale	1.6°/inch
Maximum practical visual power	325X
Optical tube dimensions	
(dia. x length)	14cm x 86.4cm (5.5” x 34”)
Eyepieces	
Modified Achromatic	H 25mm (0.965” O.D.)
Modified Achromatic	H 12.5mm (0.965” O.D.)
Modified Achromatic	SR 4mm (0.965” O.D.)
Barlow	3x magnification
Telescope mounting	German equatorial mount
Setting circle diameters	6.2cm (2.45")
Input voltage	12-volts DC
Motor Drive System	DC servo motors with encoders, both axes
Slow-Motion Controls	Electric, 7 speeds, both axes
Hemispheres of operation	North and South, switchable
Materials	
Tube body	Aluminum
Mounting	Die-cast aluminum
Telescope net weight:	
(telescope only, without batteries, eyepieces)	10.5 kg (23 lbs.)
Telescope shipping weight	
(telescope, accessories, instruction manual, packing)	14 kg (31 lbs.)
Battery Life (approx.)	
with Starfinder	20 hrs.

STARFINDER SPECIFICATIONS

Processor	68HC11, 8MHz
Flash Memory	512KB, reloadable
Keypad	10 key
Display	2 line, 16 character LCD
Backlight	Red LED
Coil Cord	24"

STARFINDER DIMENSIONS

Length	14.2cm (5.60")
Width (LCD end)	78.0cm (3.08")
Width (Connector end)	53.5cm (2.10")
Depth	23.5cm (0.93")

APPENDIX A: Calculating Eyepiece Power

The power, or magnification of the telescope depends on two optical characteristics: the focal length of the main telescope and the focal length of the eyepiece used during a particular observation. The focal length of the 4504 telescope is fixed at 910mm. To calculate the power in use with a particular eyepiece, divide the focal length of the eyepiece into the focal length of the main telescope. *E.g.,* using the H 25mm eyepiece supplied with the telescope, the power is calculated as follows:

$$\text{Power} = \frac{\text{telescope focal length}}{\text{eyepiece focal length}} = \frac{910\text{mm}}{25\text{mm}} = 36\text{x}$$

The maximum practical magnification is determined by the nature of the object being observed and, most importantly, by the prevailing atmospheric conditions. Generally powers of perhaps 35x to 175x will be useful most often, consistent with high image resolution. When unsteady air conditions prevail (as witnessed by rapid "twinkling" of the stars), extreme high-power results in "empty magnification," where the object detail observed is actually diminished by the excessive power.

The 3x Barlow lens included with your telescope triples the eyepiece magnification. To calculate the power of an eyepiece used with a Barlow lens, multiply the eyepiece power by the Barlow value. *E.g.*, using the H 25mm eyepiece, the power or magnification of the 4504 telescope (as calculated in the example above) is 36x and the Barlow value is 3x. The total power using the Barlow lens is:

Total power = eyepiece power x Barlow value = 36 x 3 = 108x

To install the Barlow lens, first place the Barlow lens into the focuser assembly (remove the focuser dustcap, if necessary), followed by the eyepiece (**Fig. 30**). Tighten the Barlow thumbscrews and the focuser thumbscrews to a firm feel only.

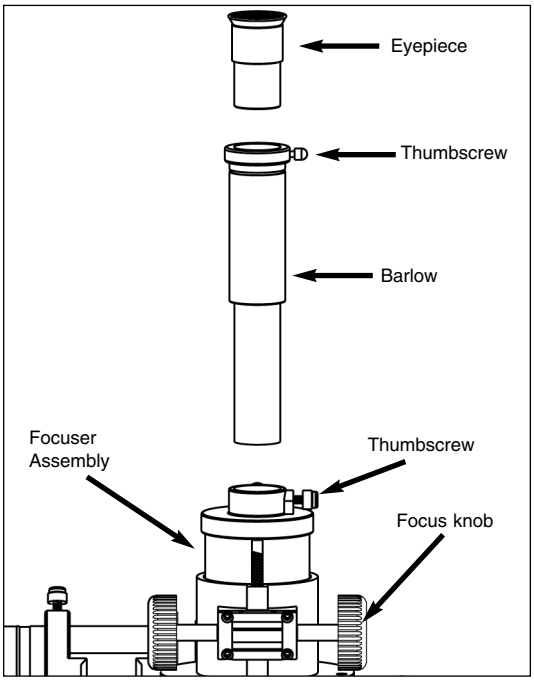

Fig. 30: *Insert Barlow into focuser assembly.*

APPENDIX B: Terrestrial Viewing, Celestial Movement, and Polar Alignment

Terrestrial Viewing

The 4504 is an excellent, high-resolution terrestrial (land) telescope. Viewing terrestrial objects requires looking along the Earth's surface through heat waves. These heat waves often cause degradation of image quality. Low power eyepieces, like the H 25mm 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 low-power, where the heat waves do not have such an effect on image quality. 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, your telescope has many optical and electro-mechanical capabilities. It is in astronomical applications where the high level of optical performance is readily visible. The range of observable astronomical objects is, with minor qualification, limited only by the observer's motivation.

Polar Alignment

Lunar or planetary photography requires that the telescope be Polar aligned. In Polar Alignment, the telescope is oriented so that the horizontal and vertical axes of the telescope are lined up with the celestial coordinate system.

In order to understand Polar Alignment, it is essential to have an understanding of how and where to locate celestial objects as they move across the sky. This section provides a basic introduction to the terminology of Polar-aligned astronomy, and includes instructions for finding the celestial pole and for finding objects in the night sky using Declination and Right Ascension.

Understanding Celestial Movements and Coordinates

Understanding where to locate celestial objects and how those objects move across the sky is fundamental to enjoying the hobby of astronomy. Most amateur astronomers adopt the simple practice of "star-hopping" to locate celestial objects by using star charts or astronomical software which identify bright stars and star patterns (constellations) that serve as "road maps" and "landmarks" in the sky. These visual reference points guide amateur astronomers in their search for astronomical objects.

Understanding How Astronomical Objects Move

Due to the Earth's rotation, celestial bodies appear to move from East to West in a curved path through the sky. The path they follow is known as their line of Right Ascension (R.A.). The angle of the path that they follow is known as their line of Declination (Dec). The system of R.A. and Dec is analogous to the Earth-based coordinate system of latitude and longitude. Like Earth, imaginary lines have been drawn on the celestial sphere to form a coordinate grid. Celestial object positions on the Earth's surface are specified by their latitude and longitude.

Understanding Celestial Coordinates

Celestial objects are mapped according to the R.A. and Dec coordinate system on the "celestial sphere" (**Fig. 31**), the imaginary sphere on which all stars appear to be placed. 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 is that point in the sky where an extension of the Earth's axis through the North Pole intersects the celestial sphere. In fact, this point in the sky is located near the North Star, or Polaris.

On 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 is simply a projection of the Earth's equator onto the celestial sphere. Just as on the surface of the The celestial equivalent to Earth latitude is called “Declination,” or simply “Dec.” It is measured in degrees, minutes or seconds north ("+") or south ("-") of the celestial equator. Thus any point on the celestial equator (which passes, for example, through the constellations Orion, Virgo and Aquarius) is specified as having 0°0'0" Dec. The Dec of the star Polaris, located very near the North Celestial Pole, is +89.2°.

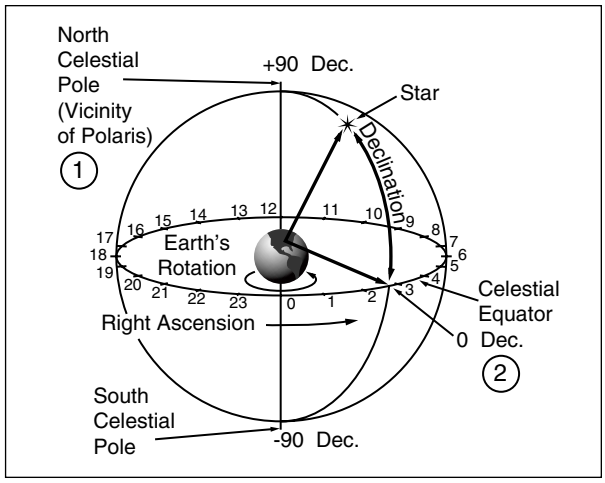

***Fig. 31**: Celestial sphere.*

The celestial equivalent to Earth longitude is called “Right Ascension,” or “R.A.” It is measured in hours, minutes, and seconds from an arbitrarily defined “zero” line of R.A. passing through the constellation Pegasus. R.A. coordinates range from 0hr0min0sec up to (but not including) 24hr0min0sec. 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 (0h0m0s) R. A. grid line carry increasing R.A. coordinates.

With all celestial objects therefore capable of being specified in position by their celestial coordinates of R.A. and Dec, the task of finding objects (in particular, faint objects) in the telescope is vastly simplified. The setting circles, R.A. (**15, Fig. 2a**) and Dec (**9, Fig. 2a**)of the Meade 4504 Telescope may be dialed, in effect, to read the object coordinates, and the object can be found without resorting to visual location techniques. However, these setting circles may be used to advantage only if the telescope is first properly aligned with the Celestial Pole.

Lining Up with the Celestial Pole

Objects in the sky appear to revolve around the Celestial Pole (actually, celestial objects are essentially “fixed,” and their apparent motion is caused by the Earth’s axial rotation). During any 24 hour period, stars make one complete revolution about the pole, making concentric circles with the pole at the center. By lining up the telescope’s polar axis with the North Celestial Pole (or, for observers located in Earth’s Southern Hemisphere, with the South Celestial Pole), astronomical objects may be followed, or tracked, by moving the telescope about one axis, the polar axis.

Virtually all of the required telescope tracking will be in R.A. (if the telescope were perfectly aligned with the pole, no Dec tracking of stellar objects would be required). For the purposes of casual visual telescopic observations, lining up the telescope’s polar axis to within a degree or two of the pole is more than sufficient.

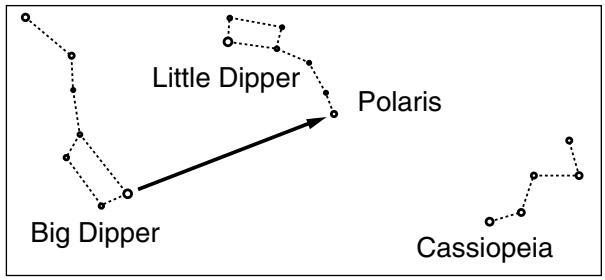

***Fig. 32:** Locating Polaris.*

Using Setting Circles

The setting circles of the Polar aligned equatorial mount can be used to locate faint celestial objects not easily found by direct visual observation. To use the setting circles, follow this procedure:

- Use a star chart or star atlas, and look up the celestial coordinates, Right Ascension and Declination (R.A. and Dec), of an easy-to-find bright star that is within the general vicinity of the faint object you wish to locate.
- Center the determined bright star in the telescope's field of view.
- Manually turn the R.A. setting circle (**15, Fig. 2a**) to read the R.A. of the object now in the telescope's eyepiece.
- The setting circles are now calibrated (the Dec setting circle (**9, Fig. 2a**) is factory calibrated). To locate a nearby faint object using the setting circles, determine the faint object's celestial coordinates from a star chart and move the telescope in R.A. and Dec until the setting circles read the R.A. and Dec of the object you are attempting to locate. If the above procedure has been carefully performed, the faint object will now be in the field of a low power eyepiece.
- The R.A. setting circle must be manually re-calibrated on the current R. A. of a star every time the telescope is set up, and reset to the centered object's R.A. coordinate before moving to a new R.A. coordinate setting. The R.A. setting circle has two sets of numbers. The inner set is for Southern hemisphere use while the outer set (the set closest to the R.A. gear) is for use by observers located North of the Earth's equator (*e.g.,* in North America and Europe).

Two-Star Polar Alignment

Besides One-Star Polar Alignment which was covered earlier in this manual (see "ALIGNING YOUR TELESCOPE USING STARFINDER," page 20), another type of alignment, Two-Star Polar Alignment, is also available.

Two-Star Polar Alignment requires some knowledge of the night sky. Starfinder provides a database of bright stars and two stars from this database are chosen by the observer for alignment. The rest of the alignment procedure is identical to One-Star Polar Alignment.

1. Perform steps 1 through 4 as described in the "ALIGN YOUR TELESCOPE USING STARFINDER," page 20.
2 . Starfinder displays a database of stars for the observer to choose from. Use the Scroll keys to scroll to a star that you wish to align upon. Select a star that you can easily locate in the night sky.
3. Press ENTER. The telescope slews to the star for alignment. Use the Arrow keys to move the telescope until the star is visible and centered in the eyepiece.
4. Press ENTER. Repeat the procedure for the second alignment star. The telescope is aligned and you are now ready to use Starfinder's GO TO capabilities for a night of observing.

APPENDIX C: Using Starfinder to Enter Celestial Coordinates

Although Starfinder's database contains more than 1400 objects (stars, nebulae, planets, *etc.*) that you can observe, you may eventually want to view objects that are not part of the database. Starfinder provides a feature that allows you to enter an object's R.A and Dec coordinates in the "User: Objects" option of Starfinder's Object menu, and then will automatically slew the telescope to the user-entered coordinates.

In order to use this menu option, you first need to look up the R.A and Dec coordinates of the object or objects you wish to observe. Check out your local library, computer store, or bookstore for astronomy books, CD Roms, or magazines (such as *Sky & Telescope* or *Astronomy*), to find coordinates of celestial objects. A list of the coordinates of 14 common stars are printed at the end of this manual; see "STAR LOCATOR," page 46.

The objects/coordinates you enter become part of your own permanent database, called "User Objects." You may use this menu to view these object as often as you like, but the objects' coordinates just need to be entered once.

To enter coordinates of an object into the "User: Objects" option of the Object menu:

1. Make sure Starfinder has been initialized (see "INITIALIZING STARFINDER," page 17) and the telescope has been aligned (see "ALIGN YOUR TELESCOPE USING STARFINDER," page 20).
2. After the telescope is aligned, "Select Item: Object" displays. (If necessary, use the Scroll keys to scroll through the menus, as previously described, to find this option.) Press ENTER.
3. "Object: Solar System" displays. Keep pressing the Scroll Up key until "Object: User Object" displays and press ENTER.
4. "User Object: Select" displays. Press the Scroll Down key once. "User Object: Add" displays. Press ENTER.
5. "Name" displays on the top line and a blinking cursor on the second line. Use the Arrow keys (as previously described) to enter the name of the object you wish to add to the database. When you are finished, press ENTER.
6. "Right Asc.: +00.00.0" displays. Use the Arrow keys to enter the digits for the Right Ascension (R.A.) coordinate of your object. If necessary, use the Scroll Keys to change "+" to "-." When you are finished, press ENTER.
7. "Declination: +00°.00'" displays. Use the Arrow keys to enter the digits for the Declination (Dec) coordinate of your object. If necessary, use the Scroll Keys to change "+" to "-." When you are finished, press ENTER.
8. Starfinder then prompts you to enter the Size of the object. This step is optional. Use the Arrow keys to enter this information, if so desired, and press ENTER to go to the next display. If you do not wish to enter this information, simply press ENTER.
9. Starfinder then prompts you to enter the Magnitude of the object. This step is also optional. Use the Arrow keys to enter this information, if so desired, and press ENTER to go to the next display. "User Object: Add" displays again.

To GO TO a user-entered object:

1. With "User Object: Add" displayed, press the Scroll Up key once. "User Object: Select" displays. Press ENTER.
2. Use the Scroll keys (if necessary) to scroll to the desired object. Press ENTER.
3. The name of the object and the R.A. and Dec coordinates display.
4. Press GO TO and the telescope slews to the object.

APPENDIX D: Helpful Charts

Latitude Chart for Major Cities of the World

To aid in the Polar Alignment procedure (see "TO POLAR ALIGN THE TELESCOPE," page 15), 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

EUROPE (cont'd)

City	Country	Latitude
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	Chile	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° S
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

APPENDIX E: Basic Astronomy

In the early 17th century, an Italian Scientist named Galileo, using a crude telescope considerably smaller than your 4504, turned it to look towards the sky instead of distant trees and mountains. What he saw, and what he realized about what he saw, forever changed the way mankind thought of the universe. Imagine what it must have been like being the first human to see moons revolve around the planet Jupiter or to see the changing phases of Venus! Because of his observations, Galileo correctly realized Earth's movement and position around the Sun, and in doing so, gave birth to modern astronomy. Yet Galileo's telescope was so crude, he could not clearly make out the rings of Saturn.

Galileo's discoveries laid the foundation for understanding the motion and nature of the planets, stars, and galaxies. Building on his foundation, Henrietta Leavitt determined how to measure the distance to stars; Edwin Hubble proposed a glimpse into the origin of the universe; Albert Einstein unraveled the relationship of time and light. Almost daily, using sophisticated successors to Galileo's crude telescope, such as the Hubble Space Telescope, more and more mysteries of the universe are being solved and understood. We are living in a golden age of astronomy.

Unlike other sciences, astronomy welcomes contributions from amateurs. Much of the knowledge we have on subjects such as comets, meteor showers, variable stars, the Moon, and our solar system comes from observations made by amateur astronomers. So as you look through your Meade telescope, keep in mind Galileo. To him, a telescope was not a mere machine of glass and metal, but something far more – a window through which the beating heart of the universe might be glimpsed, a fuse to set fire to mind and imagination.

Starfinder Glossary
Be sure to make use of Starfinder's Glossary feature. The Glossary menu provides an alphabetical listing of definitions and descriptions of common astronomical terms. Access these directly through the Glossary menu or through hypertext words embedded in Starfinder. See "GLOSSARY MENU," page 29, for more information.

***Fig. 33**: The Moon. Note the deep shadows in the craters.*

Objects in Space
Listed below are some of the many astronomical objects that can be seen with the 4504:

The Moon
The Moon is, on average, a distance of 239,000 miles (380,000km) from Earth and is best observed during its crescent or half phase when Sunlight strikes the Moon's surface at an angle. It casts shadows and adds a sense of depth to the view (**Fig. 33**). No shadows are seen during a full Moon, causing the overly bright Moon to appear flat and rather uninteresting through the telescope. Purchase a neutral Moon filter for use when observing the Moon. Not only does it protect your eyes from the bright glare of the Moon, but it also helps enhance contrast, providing a more dramatic image.

Using the 4504, 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) are smooth, dark areas scattered across the lunar surface. These dark areas are large ancient impact basins that were filled with lava from the interior of the Moon by the depth and force of a meteor or comet impact.

Twelve Apollo astronauts left their bootprints on the Moon in the late 1960's and early 1970's. However, no telescope on Earth is able to 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.

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 the 4504.

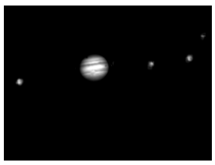

Fig. 34: *Jupiter and its four largest moons. The moons can be observed in a different position every night.*

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, and appears through the telescope as a tiny reddish-orange disk. It may be possible to see a hint of white at one of the planet's Polar ice caps. Approximately every two years, when Mars is closest to Earth in its orbit, additional detail and coloring on the planet's surface may be visible.

Jupiter is the largest planet in our solar system and is 11 times the diameter of Earth. The planet 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 using even the lowest magnification. These moons orbit Jupiter so that the number of moons visible on any given night changes as they circle around the giant planet.

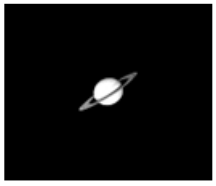

Fig. 35: *Saturn has the most extensive ring structure in our Solar System.*

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 occasionally visible through the 4504. Titan, the largest of Saturn's 18 moons can also be seen as a bright, star-like object near the planet.

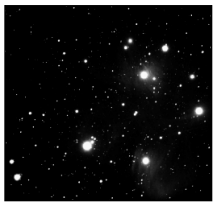

Fig. 36: *The Pleiades is one of the most beautiful open clusters.*

Deep-Sky Objects

Star charts can be used 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 self-illuminated by nuclear fusion in their core. Because of their vast distances from our solar system, all stars appear as pinpoints of light, irrespective 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 is an open cluster 410 light years away. Through the 4504, numerous stars are visible.

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.

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.

A Roadmap to the Stars

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. The Big Dipper is usually easy to locate year round in North America.

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 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 most observed deep-sky objects by amateur astronomers.

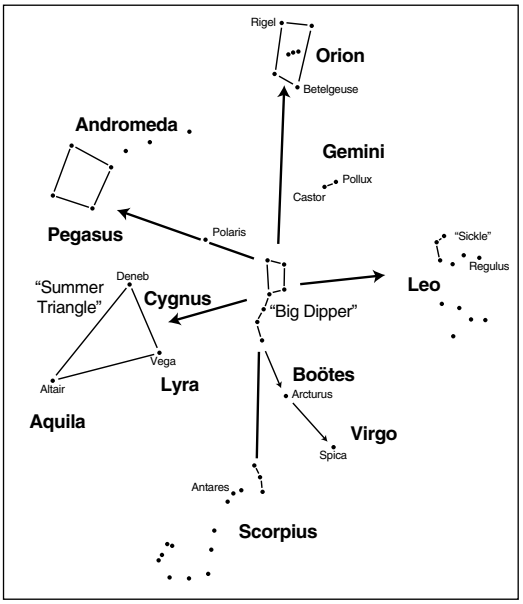

Fig. 37: *Roadmap to the stars.*

Extending from the "pointer stars" of the Big Dipper's cup is Polaris, the North Star. Extending from Polaris is the Great Square shared by the constellations Pegasus and Andromeda.

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.

Star Locator

The chart below lists 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 aids 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	Aquila	19h51m	08° 52"
Summer	Antares	Scorpius	16h30m	-26° 26"
Fall	Markab	Pegasus	23h05m	15° 12"
Fall	Fomalhaut	Pisces Austrinus	s22h58m	-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"

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