Instruction Manual
Model 2080
8" Schmidt-Cassegrain
Model 2120
10" Schmidt-Cassegrain

Meade

PLEASE NOTE......

FOR OWNERS OF THE MODEL 2080/LX3 OR MODEL 2120/LX3 SEE APPENDIX FOLLOWING PAGE 62.

CONTENTS

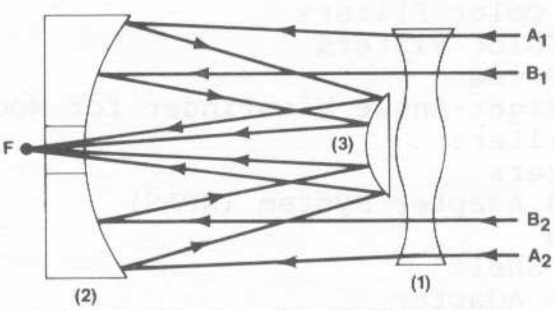
NOTE

Instructions for the use of the following optional accessories and systems are not included in this manual, but are shipped with the respective items:

- Table Tripod for Model 2080
- Model 46 VariGuide Dual-Axis Drive Corrector
- Models 2047, 2048 4" Schmidt-Cassegrain Photo-Guide Telescopes
- Models 2066, 2068 4" f/2.64 Schmidt Cameras
- Models 41 and 43 R.A. Drive Correctors

THE SYSTEM 2000 SCHMIDT-CASSEGRAIN OPTICAL SYSTEM

(Diagram not to scale.)



In the Schmidt-Cassegrain design of the Meade 8-inch Model 2080 shown, light enters from the right, passes through a thin lens with 2-sided aspheric correction (1) ("correcting plate"), proceeds to a spherical primary (2) and then to a convex aspheric secondary mirror (3). The convex secondary mirror multiplies the effective focal length of the primary mirror and results in a focus at F, with light passing through a central perforation in the primary mirror.

The 8-inch Model 2080 telescope includes an oversize 8.25-inch diameter primary mirror, yielding a fully illuminated field-of-view significantly wider than is possible with a standard 8-inch diameter primary. Because the Schmidt correcting plate near its edge acts, in effect, as a negative lens, light impinging near the circumference of the correcting plate is lost unless the primary mirror size compensates for this light diverging from the corrector. (Note in the diagram that light rays A_1 and A_2 would be lost except for the oversize primary mirror.) In fact, the oversize primary of the Model 2080 results in about 6 percent more light reaching the focal surface of the telescope. The optical design of the 4" Model 2040 is almost identical but does not include an oversize primary, since the effect in this case is small.

MEADE MODELS 2080 and 2120

8" and 10" SCHMIDT-CASSEGRAIN TELESCOPES

PRECAUTIONARY WARNING! Be sure to read this manual, or at minimum the introductory assembly and operational procedures contained herein (pages 5 to 15) before attempting to use your Model 2080 or 2120.

INTRODUCTION

The Meade Model 2080 8" Schmidt-Cassegrain Telescope and Model 2120 10" Schmidt-Cassegrain Telescope are instruments of advanced mirror-lens design for astronomical and terrestrial applications. Optically and mechanically, the Models 2080 and 2120 are perhaps the most sophisticated and precisely-manufactured telescopes ever made available to the serious amateur. The Models 2080 and 2120 enable the visual astronomer to reach out for detailed observations of the Solar System (the planets: Jupiter, Saturn, Mars) and beyond to distant nebulae, star clusters, galaxies. The astrophotographer will find a virtually limitless range of possibilities since, with the precision Meade worm-gear motor drive system, long exposure guided photography becomes not a distant goal, but an achievable reality. The capabilities of the instrument are essentially limited not by the telescope, but by the acquired skills of the observer and photographer. Do take the time to read this manual thoroughly, so that you will be fully acquainted with the many important features of the telescope, as well as with the auxiliary equipment and accessories available for advanced applications.

The Models 2080 and 2120 are, with the exceptions of a few assembly operations and features, almost identical operationally. Most standard and optional accessories are interchangeable between the two telescopes. As such, the instructions in this manual generally apply to both telescopes; when exceptions to this rule occur, they are clearly pointed out in the following.

THE BASIC MODEL 2080 TELESCOPE: STANDARD EQUIPMENT

The Meade Model 2080 Telescope is packed in a urethane-foam-lined carrying case. If the telescope was shipped to you, this carrying case was in turn placed in a thick-wall corrugated carton, lined on all 6 sides with styrofoam sheets.

(NOTE: We recommend that you keep all packing materials for either the Model 2080 or Model 2120; if it is ever necessary for you to return your telescope to the Meade factory for servicing, these materials will help to assure that no shipping damage will occur.)

Packed in the carrying case are the complete basic Model 2080, consisting of the 8" Schmidt-Cassegrain optical tube assembly and fork mount. Accessories included as standard equipment are normally also packed within the carrying case.

The Model 2080 (or foreign Model 2080F) includes the following standard equipment:

8" Schmidt-Cassegrain optical tube and Fork Mount with Motor Drive
2 Eyepieces (1¼" O.D.): MA 9mm (222X)
MA 25mm (80X)
Eyepiece-Holder (1¼")
Diagonal Prism (1¼")
6 x 30mm Viewfinder with bracket
Dust Covers: One for rear-cell opening
One for correcting plate
3-Knob screws for attaching Model 2080 Telescope to Equatorial Wedge
Hex wrench set (3 pcs.)
Carrying Case
Power Cord

THE BASIC MODEL 2120 TELESCOPE: STANDARD EQUIPMENT

The Model 2120 is packed for shipment in 2 cartons: Carton No. 1 includes the complete 10" Optical Tube Assembly with fork arms attached; Carton No. 2 includes the Motor Drive base (and 4 bolts for attachment of the Motor Drive base to the fork arms), viewfinder, viewfinder bracket, accessories, power cord, and hardware package, all packed within the carrying case.

The Model 2120 (or foreign Model 2120F) includes the following standard equipment:

10" Schmidt-Cassegrain optical tube and Fork Mount with Motor Drive
2 Eyepieces (1¼" O.D.): MA 9mm (278X)
MA 25mm (100X)
Eyepiece-Holder (1¼")
Diagonal Prism (1¼")
8 x 50mm Viewfinder with bracket
Dust Covers: One for rear-cell opening
One for correcting plate
3-Socket capscrews for attaching Model 2120 Telescope to the Equatorial Wedge

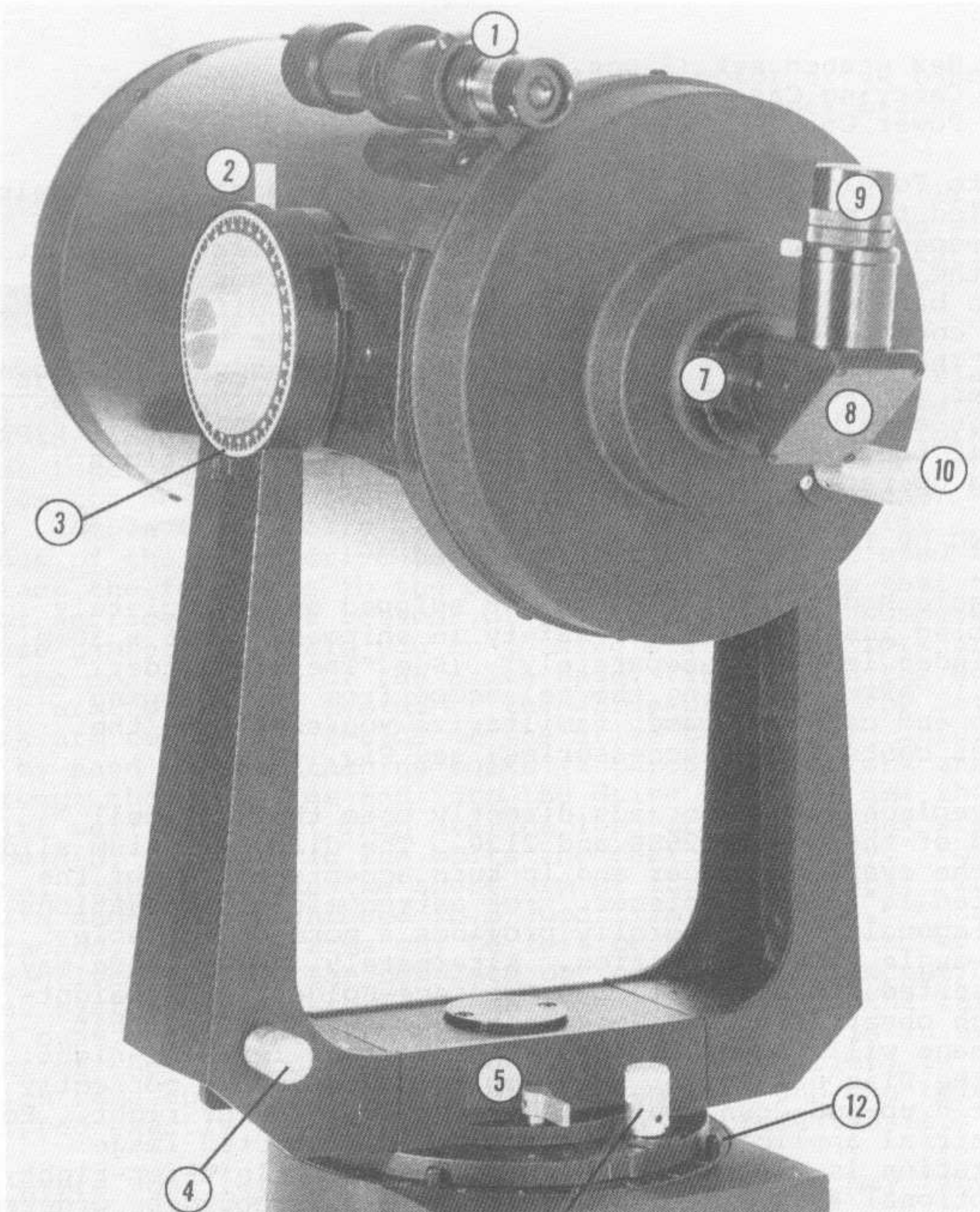


Fig. 1: Meade Models 2080 and 2120. (1) Viewfinder; (2) Declination Lock; (3) Declination Setting Circle; (4) Declination Slow-Motion Control; (5) R.A. Lock; (6) R.A. Slow-Motion Control; (7) Eyepiece-Holder; (8) Diagonal Prism; (9) Eyepiece; (10) Focus Knob; (11) Drive Base; (12) R.A. Setting Circle.

Hex wrench set (5 pcs.)
Carrying Case
Power Cord

Note to Foreign Users: 8" and 10" Schmidt-Cassegrain models supplied to countries outside the U.S.A. are identical in all respects to the telescopes offered domestically, except that the power cord and the electrical connector (located in the base of the telescope fork mount) are different. The power cord plugs directly into the base of the telescope (see "The Motor Drive"), but you may have to supply your own adapter in order to plug into your local electrical outlet. In this case be sure that the adapter is of a "3-prong" type so that the telescope is properly grounded at all times during operation.

SETTING UP THE MODEL 2080

The basic Model 2080 telescope is shipped as a completely assembled instrument. For safety in shipment the 6 x 30mm Viewfinder is packed separately. (See "The Viewfinder," below.) After removing the telescope from its shipping carton and carrying case, familiarize yourself with the various controls and accessories; see Fig. 1.

The eyepiece-holder threads directly onto the rear-cell thread of the Models 2080 and 2120. The diagonal prism slides into the eyepiece-holder and in turn accepts either of the supplied 1¼" O.D. eyepieces. For astronomical observations the diagonal prism generally provides a more comfortable right-angle viewing position. Alternately, an eyepiece may be inserted directly into the Eyepiece-Holder for straight-through observations. Note in this case, however, that the image will appear inverted and reversed left-for-right. With the Diagonal Prism, telescopic images appear correctly oriented up-and-down, but still reversed left-for-right. For terrestrial applications, where a fully corrected image orientation is desired, both up-and-down and left-for-right, the optional #924 Erecting Prism (1¼" O.D.) should be ordered separately. (See the Meade General Catalog for details.) Eyepieces and the Diagonal Prism are held in their respective places on the telescope by a moderate tightening of the thumb-screws on the Diagonal Prism and Eyepiece-Holder.

ASSEMBLY AND SET-UP OF THE MODEL 2120

The basic Model 2120 telescope is shipped with the optical tube assembly (with fork arms attached) in one carton, and with the motor drive base in a separate carton. The only assembly operations required are the following:

1. Attaching the fork arms to the motor drive base.
2. Attaching the viewfinder and viewfinder bracket to the optical tube.

To remove the optical tube from the shipping carton, (1) lift off the lid of the carton; (2) place the carton on end with the eyepiece-end at the bottom; (3) remove packing material from the top of the carton; (4) pull the tube assembly toward you and out of the carton.

To attach the fork arms to the motor drive base: (1) Place the optical tube flat on a carpeted floor. (2) Remove the threaded metal rod that has been used to tie the fork arms together for safety in shipment (this rod may be set aside for re-use in case of future commercial shipment). (3) Remove the 4 bolts (2 on each side) from the flat sides of the motor drive base (these bolts will be used to attach the fork arms to the drive base). (4) Note that the flat surfaces at the bottoms of the fork arms are numbered; these numbers will aid you in joining the correct fork arm to the correct side of the drive base. Thus, join the No. 1 fork arm to the No. 1-side of the drive base, and the No. 2 fork arm to the No. 2-side of the drive base. (5) Thread in by hand the 4 attaching bolts (2 through each fork arm) through the fork arms and into the drive base, to get the bolts well started. Then use the long-arm of the hex wrench provided, to screw in the bolts the rest of the way. For final tightening use the short arm of the hex wrench. These bolts should be tightened to a good firm tightness. Once attached, the fork arms may be left permanently attached to the drive base and the complete optical tube/fork mount/drive base system may be stored as an assembled unit in the carrying case. (The only exception to this statement is in shipment of the telescope by commercial freight carrier, in which case the drive base should be removed, and the telescope shipped exactly in the manner in which you received it.)

To store your telescope in its carrying case you may find the following procedure most convenient:

1. Stand the case on end with the lid open.
2. Place the telescope inside the case with the flat side of the drive base at bottom.
3. If the 8 x 50 viewfinder (see "The Viewfinder: Model 2120", below.) is mounted on the telescope you will note that it will prohibit your closing the lid of the case. Therefore,
4. Push the fork arm on the side of the viewfinder towards the back (or bottom) of the case. You will note that the viewfinder is now far enough back so that the lid, when closed, will not touch the viewfinder.

5. Tuck in the 2 pieces of blue foam (provided with shipment) along the base of each fork arm so that the instrument will not move inside the case. You can now store the instrument or place it in your car for transport to an observing site.

CAUTION

DO NOT ATTEMPT TO TURN THE FOCUSER KNOB OF THE OPTICAL TUBE UNTIL YOU HAVE READ THIS NOTICE!

Next to the base of the focuser knob you will see a red-colored slotted bolt head. This bolt is used only for safety in shipment. Remove this bolt before attempting to turn the focuser knob. In its place insert the rubber plug provided as a dust protector (this rubber plug is included with your hardware package).

Your focuser is now operational.

WARNING! The Model 2120 should never be commercially shipped without this red-colored-head bolt secured in place. This is essential during commercial transport where rough handling may occur. For your personal transport and storage you will never need to use this bolt again.

TO COMMERCIALLY RE-SHIP THE MODEL 2120 BE SURE TO FOLLOW THIS PROCEDURE:

1. Turn the focuser knob clockwise continuously until it stops. This will bring the primary mirror all the way back in the tube.
2. Remove the rubber plug and insert the red-headed bolt. Thread it in to a firm snug feel. Do not over-tighten. (If you have misplaced the red-head bolt you may use any other bolt that is ¼-20x1" long).

Please note that commercial shipment of the Model 2120 telescope without this safety bolt in place is done at owner's risk and your freight insurance may be voided if shipping damage results.

TELESCOPE OPERATION: YOUR FIRST OBSERVATIONS THROUGH THE MODEL 2080 OR 2120

With the telescope standing upright on its motor drive base, as shown in Fig. 1, and with the Diagonal Prism and MA 25mm eyepiece in place, you are ready to make observations through the telescope. (Because the viewfinder has not yet been attached to the telescope, be sure to use the MA 25mm eyepiece, which yields 80 power on the Model 2080 (100X on the Model 2120), and not the higher power MA 9mm eyepiece.

Even without the viewfinder, terrestrial objects will be fairly easy to locate and center in the telescope's field of view with the lower-power eyepiece, simply by "gun-sighting" along the side of the main telescope tube.)

IMPORTANT NOTE: NEVER POINT THE TELESCOPE DIRECTLY AT THE SUN, OR ATTEMPT TO OBSERVE THE SUN, EITHER THROUGH THE MAIN TELESCOPE OR THE VIEWFINDER, WITHOUT PROPER PROFESSIONAL EQUIPMENT. INSTANT AND IRREVERSIBLE DAMAGE TO YOUR EYE MAY OTHERWISE RESULT! (SEE "SOLAR FILTERS" IN THIS MANUAL.)

By unlocking the R.A. lock (5), Fig. 1, the telescope may be turned rapidly through wide angles in Right Ascension (R.A.). (The reason for the terminology "Right Ascension" and its complementary term "Declination" will be made clear further on in this manual. For now, "Right Ascension" simply means "horizontal" and "Declination" means "vertical.") Fine adjustments in R.A. are made by turning the R.A. control knob (6), Fig. 1, while the R.A. lock is in the "unlocked" position.

DO NOT ATTEMPT TO MOVE THE TELESCOPE MANUALLY IN A HORIZONTAL DIRECTION WHEN THE R.A. LOCK IS IN THE "LOCKED" POSITION.

The R.A. control knob may be turned, if desired, with the R.A. lock in a "partially locked" position. In this way a comfortable "drag" in R.A. is created. But do <u>not</u> attempt to operate the R.A. control knob with the telescope fully locked in R.A., as such operation may result in damage to the internal gear system.

Releasing the Declination lock (2), Fig. 1, permits sweeping the telescope rapidly through wide angles in Declination.

DO NOT ATTEMPT TO MOVE THE TELESCOPE MANUALLY IN A VERTICAL DIRECTION WHEN THE DECLINATION LOCK IS IN THE "LOCKED" POSITION.

To use the Declination fine-adjust, or slow-motion, control, lock the telescope in Declination using the Declination lock (2), Fig. 1, and turn the Declination slow-motion knob (4).

NOTE THAT THIS DECLINATION SLOW-MOTION CONTROL HAS A FIXED TRAVEL LENGTH, LIMITED BY THE MOTION OF A TANGENT ARM (LOCATED INSIDE THE FORK TINE). DO NOT FORCE THE DECLINATION SLOW-MOTION KNOB WHEN THE TANGENT ARM HAS REACHED THE END OF ITS TRAVEL. IN THIS CASE TURN THE DEC. KNOB TO RETURN THE TANGENT ARM TO THE MID-POINT IN ITS TRAVEL RANGE, UNLOCK THE DECLINATION LOCK, AND RE-CENTER THE TELESCOPE TUBE MANUALLY.

With above mechanical operations in mind, select an easy-to-find terrestrial object as your first telescope subject--for example, a house or building perhaps one-half mile distant.

Unlock the Dec. lock (2), Fig. 1, and R.A. lock (5), center the object in the telescopic field of view, and then re-lock the Dec. and R.A. locks. Precise image centering is accomplished by using the Dec. and R.A. slow motion controls, (4) and (6).

FOCUSING

The focusing knob (10), Fig. 1, is located at the "4 o'clock" position as you face the rear cell of the telescope. Focusing is accomplished internally by a precise motion of the telescope primary mirror, so that, as you turn the focus knob there are no externally moving parts.

Focusing the telescope from its nearest possible focus point (on an object about 25 ft. away with the Model 2080, or about 50 ft. with the Model 2120) to an object at infinity requires a fairly large number of rotations of the focus knob. The focuser is designed to provide an extremely sensitive means of bringing an object into precise, sharp focus. After a specific object has been brought into focus, closer objects require turning the focus knob clockwise; more distant objects require turning the focus knob counterclockwise.

It is possible that you may notice a slight shifting of the image as you focus, particularly at high powers. This image shift is caused by very small lateral motions of the primary mirror as it moves toward or away from the secondary mirror during the focusing procedure.

MAGNIFICATIONS

The magnification, or power, 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 main Model 2080 telescope is fixed at 2000mm; the focal length of the main Model 2120 telescope is fixed at 2500mm. 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. For example, using the MA 25mm eyepiece supplied with the Model 2080, the power is calculated as follows:

$$\text{Power} = \frac{2000\text{mm}}{25\text{mm}} = 80\text{X}$$

Similarly, with the MA 9mm eyepiece, a magnifying power of 2000mm/9mm, or 222X, results. The <u>type</u> of eyepiece (whether "MA" Modified Achromatic, "OR" Orthoscopic, "ER" Erfle, etc.) has no bearing on magnifying power, but does affect such optical characteristics as field of view, flatness of field, and color correction.

The table below lists the operating powers of the Models 2080 and 2120 telescopes, when the instrument is used with eyepieces of varying focal lengths.

Eyepiece Focal Length	Magnifying Power When Used with Model 2080	Magnifying Power When Used with Model 2120
40mm	50X	63X
32mm	63X	78X
28mm	71X	89X
25mm	80X	100X
20mm	100X	125X
18mm	111X	139X
16.8mm	119X	149X
15.5mm	129X	161X
12.4mm	161X	202X
10.5mm	190X	238X
9mm	222X	278X
7mm	286X	357X
6mm	333X	417X
4mm	500X	625X

The maximum practical magnification is determined by the nature of the object being observed and, most importantly, by the prevailing atmospheric conditions. Under very steady atmospheric "seeing," the Model 2080 may be used at powers up to about 500X on astronomical objects, the Model 2120 up to about 600X. Generally, however, lower powers of perhaps 250X to 350X will be the maximum permissible, consistent with high image resolution. When unsteady air conditions prevail (as witnessed by rapid "twinkling" of the stars), extremely high-power eyepieces result in "empty magnification," where the object detail observed is actually diminished by the excessive power.

When beginning observations on a particular object, start with a low power eyepiece; get the object well-centered in the field of view and sharply focused. Then try the next step up in magnification. If the image starts to become fuzzy as you work into higher magnifications, then back down to a lower power: the atmospheric steadiness is not sufficient to support high powers at the time you are observing. Keep in mind that a bright, clearly resolved, but smaller, image will show far more detail than a dimmer, poorly resolved, larger image.

Because of certain characteristics of the human eye (in particular, eye pupil diameter) and because of optical considerations inherent in the design of a telescope, there exist minimum practical power levels also. Generally

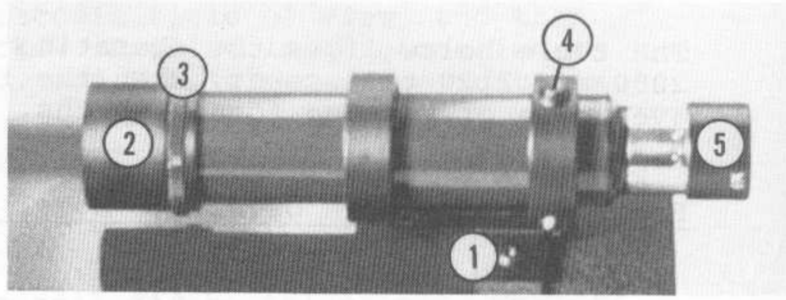


Fig. 2A: 6 x 30mm Viewfinder for Model 2080. (1) Mounting Screw; (2) Objective Lens Cell; (3) Knurled Collar; (4) Collimation Screw; (5) Eyepiece.

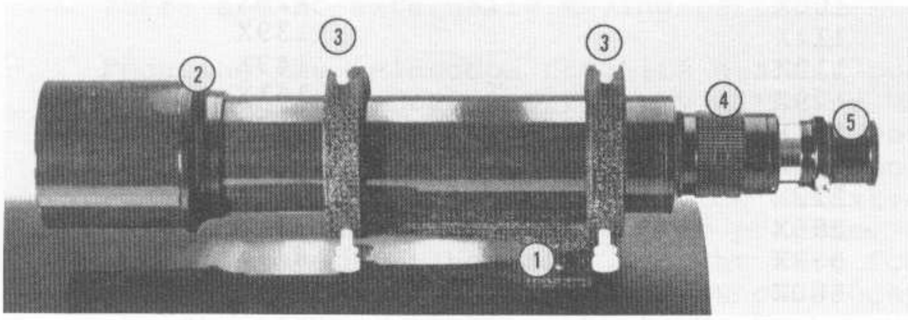


Fig. 2B: 8 x 50mm Viewfinder for Model 2120. (1) Mounting Screw; (2) Objective Lens Cell; (3) Collimation Screws; (4) Focuser; (5) Eyepiece.

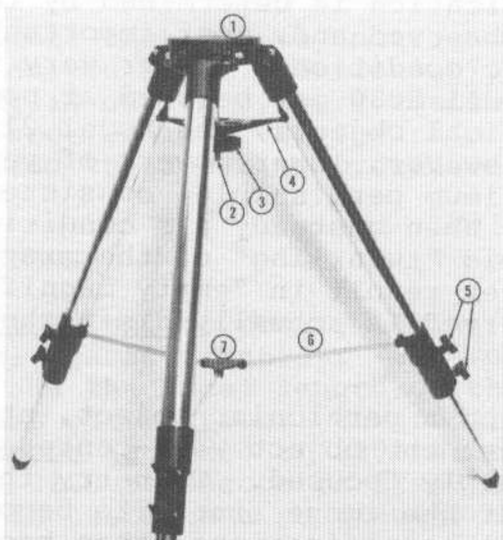


Fig. 3: Field Tripod. (1) Head; (2) Threaded Rod; (3) Tension Knob; (4) Spreader Bar; (5) Lock Knobs; (6) Extension Strut; (7) Hub.

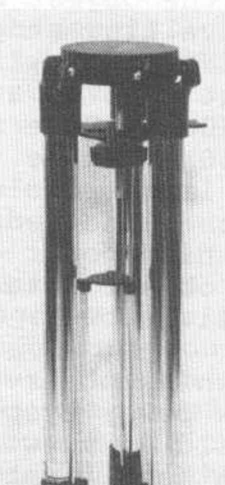


Fig. 4: Field Tripod (collapsed)

speaking, the lowest usable power is approximately 4X per inch of telescope aperture, or about 32X in the case of the 8" aperture Model 2080, about 40X in the case of the 10" Model 2120. During the daytime, when human eye pupil diameter is reduced, the minimum practical power with the Model 2080 is increased to about 60X, or to about 75X with the Model 2120; powers lower than this level should be avoided during daytime observations. A reasonable magnification range for daytime terrestrial observations through the Model 2080 is from about 80X to 190X; through the Model 2120, from about 100X to 200X.

Accessories are available both to increase and decrease the operating eyepiece power of the telescope. See the sections of this manual on "The Barlow Lens" and "Wide Field Adapter System."

THE VIEWFINDER: MODEL 2080

The standard 6 x 30mm Viewfinder is shipped in its mounting bracket with each Model 2080 telescope. Mounting screws for the viewfinder bracket have been threaded into the top of the main telescope's rear cell, at the hole-positions where the viewfinder bracket will be seated. See Fig. 2A.

To attach the viewfinder, remove the 2 viewfinder mounting screws from the rear-cell, using one of the hex wrenches provided with the telescope; place the viewfinder-with-bracket over these mounting holes, and then replace the 2 mounting screws to securely attach the viewfinder bracket to the rear-cell. Tightening these mounting screws to a "firm feel" is sufficient; avoid over-tightening, which might cause the rear-cell threads to strip.

WARNING: Never use set screws on any part of the optical tube assembly, except those factory-supplied set screws included with the basic telescope or with optional accessories. Longer, non-standard set screws may protrude too far into the optical tube and cause serious damage to the primary mirror.

The 6 x 30mm Viewfinder has been factory pre-focused at infinity. Should this focusing need adjustment for your eyes, loosen the knurled collar at the objective lens-end of the viewfinder (see (3), Fig. 2A), enabling rotation of the objective lens cell, forward or backward, for precise focusing. Then tighten down the knurled collar against the objective lens cell, to lock the focus in place. Note that no focusing is possible, or necessary, at the eyepiece-end of the viewfinder.

The optional 6 x 30mm Right-Angle Viewfinder fits into the same mounting bracket as the standard 6 x 30mm Viewfinder. To insert the 6 x 30mm Right-Angle finder into the bracket, first unthread the objective lens cell and knurled ring from the finder, insert the finder tube into the bracket, and re-attach the knurled ring and objective lens cell. Focusing may be fixed following the same procedure outlined in the preceding paragraph.

The viewfinder will require alignment, or collimation, to the main telescope. Using the 25mm eyepiece, point the main telescope at some easy-to-find land object (e.g., the top of a telephone pole or corner of a building) at least 200 yards distant. Center a well-defined object in the main telescope. Then, using one of the hex wrenches provided, tighten or loosen, as appropriate, the viewfinder's 3 collimation screws (see (4), Fig. 2A) until the crosshairs of the viewfinder are precisely centered on the object already centered in the main telescope. With this collimation accomplished, objects located first in the wide-field viewfinder will then be centered in the main telescope's field of view.

Once attached, the viewfinder may be left permanently mounted onto the telescope's rear-cell. The viewfinder need not be removed when storing the telescope in its carrying case.

THE VIEWFINDER: MODEL 2120

Each Model 2120 is supplied as standard equipment with an 8 x 50mm straight-through viewfinder. The bracket for this viewfinder is packed separately from the finder itself, and 6 nylon thumbscrews for collimation are pre-threaded into the viewfinder bracket. Mounting screws for attachment of the finder bracket to the main telescope have been threaded into the top of the main telescope's rear cell, at the hole positions where the viewfinder bracket will be seated. See Fig. 2B.

To attach the viewfinder, remove the 2 viewfinder mounting screws from the rear-cell, using one of the hex wrenches provided with the telescope; place the viewfinder-with-bracket over these mounting holes, and then replace the 2 mounting screws to securely attach the viewfinder bracket to the rear-cell. Tightening these mounting screws to a "firm feel" is sufficient; avoid over-tightening, which might cause the rear-cell threads to strip.

WARNING: Never use set screws on any part of the optical tube assembly, except those factory-supplied set screws included with the basic telescope or with optional accessories. Longer, non-standard set screws may protrude too far into the optical tube and cause serious damage to the primary mirror.

Focusing the finder is accomplished with the helicoid mechanism located near the finder's eyepiece. Note: if the eyepiece is ever removed from the finder, be careful not to touch in any way the crosshairs of the eyepiece, which are exposed at the barrel-end of the eyepiece!

Collimation, or alignment, of the Model 2120's viewfinder is accomplished in the same way as described above for the Model 2080, except that no hex wrench is required: simply turn the 6 nylon thumbscrews to achieve correct alignment.

Once attached, the viewfinder may be left permanently mounted onto the telescope's rear-cell; the viewfinder need not be removed when storing the telescope in its carrying case, if the procedure described above (see "Assembly and Set-up of the Model 2120") is employed.

THE FIELD TRIPOD

The Field Tripods for the Meade Models 2080 and 2120 telescopes are supplied as completely assembled units, except for 6 lock-knobs (2 knobs for each of the 3 tripod legs) used to adjust the height of the tripod. These knobs are packed separately for safety in shipment.

Note that, except for 6 additional threaded holes located on the top surface of the Model 2120's Field Tripod, the Field Tripods for Models 2080 and 2120 are identical. These threaded holes serve as additional mounting points when the Equatorial Wedge of the Model 2120 is attached to the Field Tripod. This function will be made clear below.

For terrestrial observations the base of the Model 2080's fork mount may be attached to the Field Tripod, using the optional Altazimuth Adapter. (Because of the additional weight of the Model 2120, we do not normally recommend use of the Model 2120 with the Altazimuth Adapter.) The Model 2080 telescope in this way is mounted in an "altazimuth" ("altitude-azimuth," or "vertical-horizontal") format, ideal for non-astronomical applications. The telescope in this set-up moves along vertical and horizontal axes, corresponding respectively to the Declination and Right Ascension axes in an astronomical observing mode. The telescope may of course be used for astronomical observations when set-up in the altazimuth mode, but the electric motor drive will in this case be non-functional from a practical point of view.

Alternately, the Field Tripod of the Model 2080 or 2120 is normally used in conjunction with the appropriate Equatorial Wedge (see next section) for serious astronomical applications. The Equatorial Wedge permits alignment of the telescope's Polar Axis with the Celestial Pole, so that the electric motor drive becomes operational.

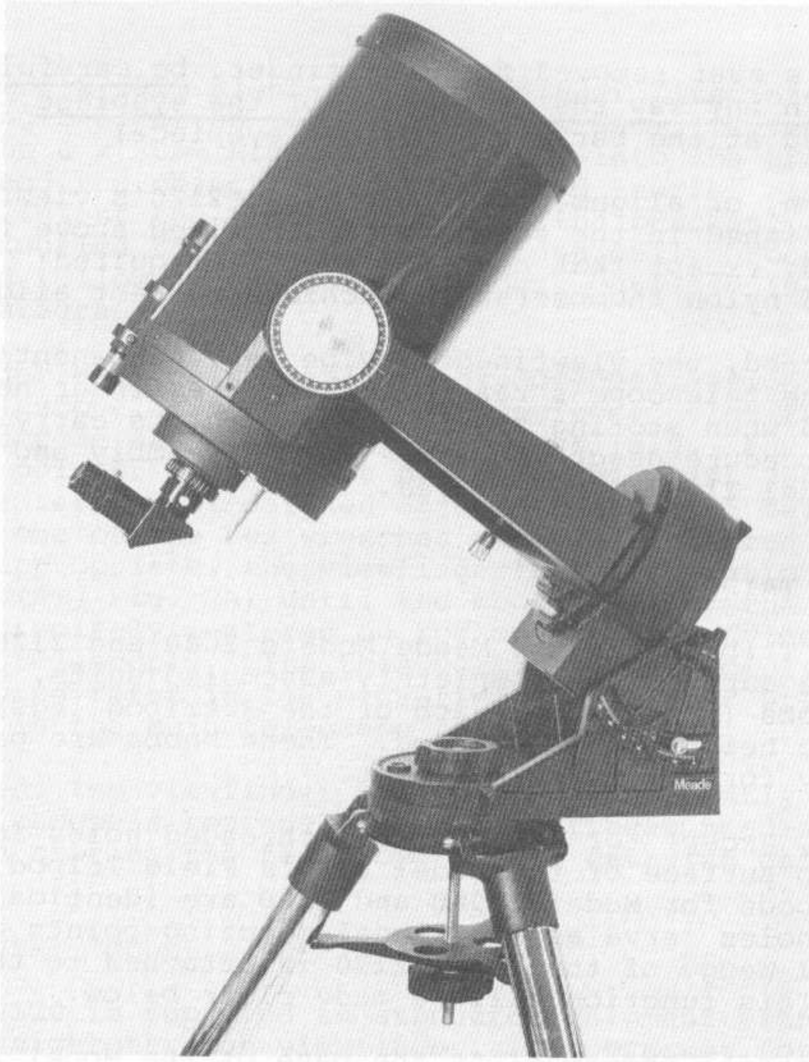


Fig. 5: The Model 2080 Mounted on Equatorial Wedge and Field Tripod.

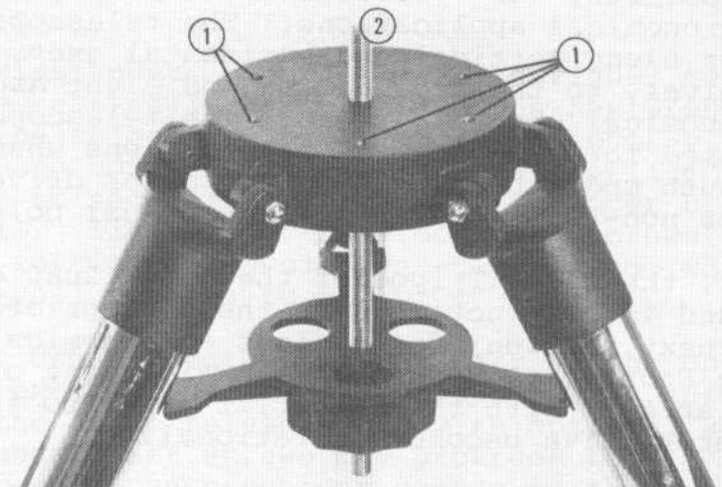


Fig. 6: Field Tripod Head. (1) Threaded Holes (Model 2120 Tripods only); (2) Threaded Rod.

After removing the Field Tripod from its shipping carton, stand the tripod vertically, with the tripod feet down, and with the tripod still fully collapsed. Grasp two of the tripod legs and, with the full weight of the tripod on the third leg, gently pull the legs apart to a fully open position.

Thread in the 6 lock-knobs (2 on each tripod leg) near the foot of each tripod leg. Refer to Fig. 3. These lock-knobs are used to fix the height of the inner, extendable tripod leg sections. Note: "Firm feel" tightening is sufficient; over-tightening may result in stripping of the knob threads.

Unthread the Tension Knob (see (3), Fig. 3) sufficiently to allow the Spreader Bar (4) to rotate. The Spreader Bar should be rotated about 60^{o} from its shipping position until the 3 arms of the Spreader Bar are lined up with the 3 tripod legs. Then, turn the Threaded Rod (2) so that about 1½" of its length protrudes up through the Head (1) of the Field Tripod.

Underneath the Head (1) of the Field Tripod is a hex lock-nut, which should be tightened to fix the position of the Threaded Rod.

Re-tighten the Tension Knob (3). Firm tightening of the Tension Knob is sufficient to result in rigid positioning of the tripod legs. It is not necessary to use extreme force in tightening this knob.

The Field Tripod is now ready to accept the Equatorial Wedge.

To vary the tripod height, loosen the 6 lock-knobs and slide the 3 inner tripod leg sections out to the desired height.

To collapse the tripod for storage, follow these steps:

(1) Loosen the Tension Knob (see (3), Fig. 3) sufficiently to allow the Spreader Bar (4) to rotate 60^{o} from its assembled position, so that one Spreader Bar arm is located between each adjacent pair of tripod legs.

(2) Leave the Tension Knob near the bottom end of the Threaded Rod (2), with the Spreader Bar resting on the Tension Knob.

(3) At the base of the tripod is a 3-vane extension strut system, with a circular hub at its center. To collapse the tripod, grasp the tripod head (1) with one hand, and, with the other hand,

pull directly "up" on the central hub of the extension strut system. This operation will cause the tripod legs to move inward to a collapsed position.

PRECAUTIONARY NOTES

(1) If the tripod does not seem to extend or collapse easily, do not force the tripod legs in or out. By following the instructions above the tripod will function properly, but if you are unclear on the proper procedure, forcing the tripod into an incorrect position may damage the extension strut system.

(2) Do not overtighten the 6 lock-knobs used to fix the inner tripod leg sections at various heights. "Firm feel" tightening is sufficient.

THE EQUATORIAL WEDGE

The Equatorial Wedge permits use of the Model 2080 or 2120 telescope in an astronomical or "equatorial" mode. The wedge fits onto the Field Tripod, described above, and accepts the base of the Model 2080 or 2120 fork mount. See Fig. 5.

NOTE: The Meade Equatorial Wedge is designed solely for use in conjunction with the Meade Field Tripod. The wedge should never be used without the Field Tripod, e.g. by placing the wedge alone on a table top, and then mounting the telescope on the wedge. The Model 2080 or 2120 telescope, placed onto the Equatorial Wedge alone, without the Field Tripod attached to the wedge, may become seriously imbalanced, to the point where the telescope may actually tip over.

Except for the tilt plate (Fig. 8) appropriate to each model, the Equatorial Wedges for the Models 2080 and 2120 are otherwise identical.

The Equatorial Wedges appropriate to either the Model 2080 or 2120 are of modern design, with several important features incorporated to simplify and facilitate telescope operation. After using the wedge for your telescope, you will find that the functional design features included are of very significant value in routine telescope operations. Some of these features include:

1. Attachment of the wedge to the field tripod by means of only one manual knob. (For photographic applications with the Model 2120 where extreme steadiness is required, 3 additional hex-head screws are provided.)

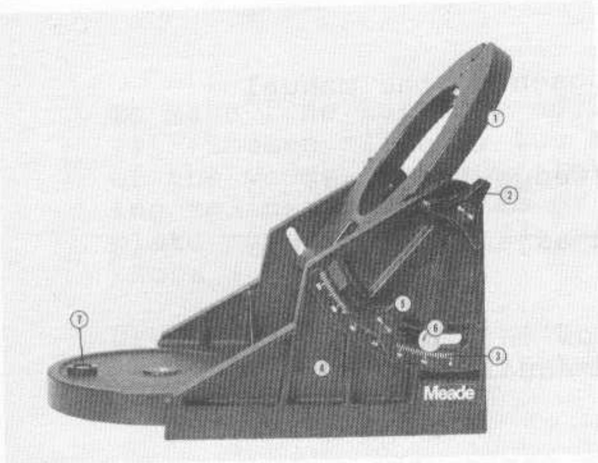


Fig. 7A: Equatorial Wedge for 2080. (1) Tilt-Plate; (2) Attachment Knob; (3) Latitude Scale; (4) Wedge Body; (5) Tilt Angle Adjustment Knob; (6) Fine Latitude Adjustment Mechanism; (7) Bubble Level.

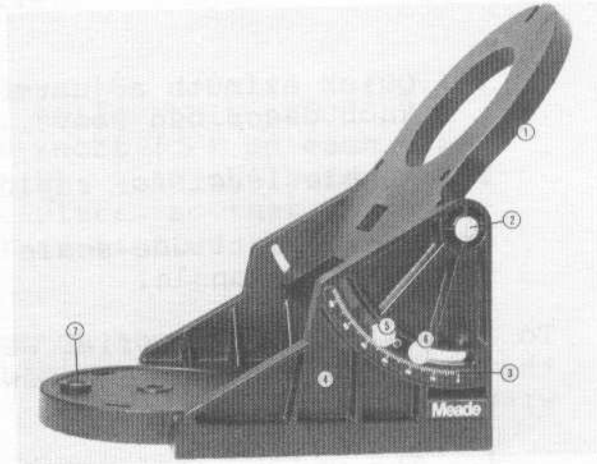


Fig. 7B: Equatorial Wedge for 2120. (1) Tilt-Plate; (2) Attachment Screw; (3) Latitude Scale; (4) Wedge Body; (5) Tilt Angle Adjustment Screw; (6) Fine Latitude Adjustment Mechanism; (7) Bubble Level.

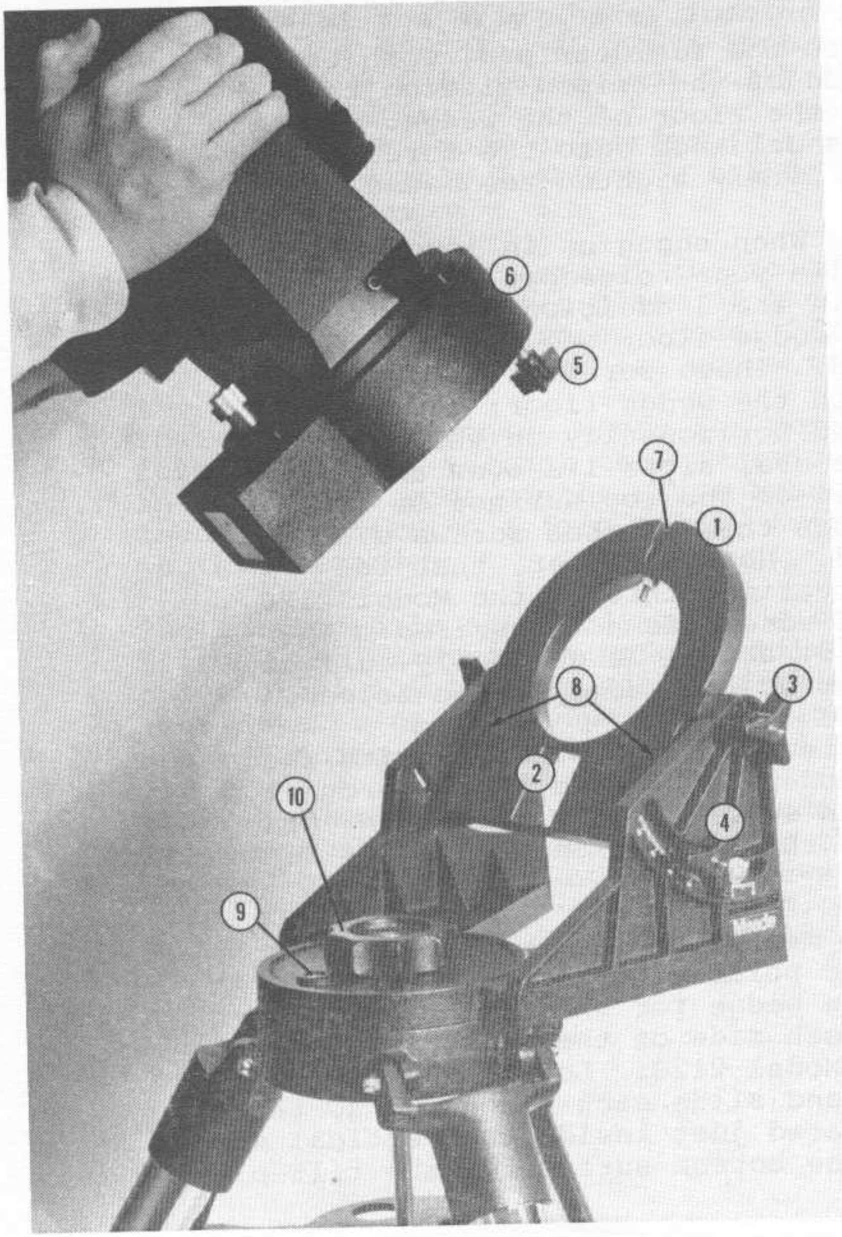


Fig. 8: Placing the Telescope on the Wedge.
(1) Tilt-Plate.
(2) Aperture for Power Cord.
(3) Wedge Body-to-Tilt Plate Attachment Knob.
(4) Tilt Angle Adjustment Knob.
(5) Knob for attaching Telescope to Tilt-Plate.
(6) Drive Base.
(7) Slot for Knob (5).
(8) Holes for additional attachment knobs.
(9) Bubble Level.
(10) Manual Knob for attaching Wedge to Field Tripod.

2. Quick azimuth adjustment by loosening the manual knob described above.

3. Bubble level for rapid tripod/wedge leveling.

4. Etched latitude scale for fast adjustment of the latitude angle.

To assemble the Equatorial Wedge follow this procedure (note that all required wedge hardware and manual knob are shipped within the wedge carton):

1. The wedge consists of two basic parts, the wedge body and the tilt-plate, as shown in Figs. 7A and 7B. Attach the tilt-plate to the wedge body by means of the hex-screws (Model 2120) or knobs (Model 2080) provided. Two screws (or knobs), with washers, should be used on each side of the wedge body, so that a total of 4 screws (or knobs) attach the tilt plate to the wedge body.

2. Place the wedge onto the field tripod, with the central threaded rod of the tripod fitting through the center hole in the floor of the wedge. Thread the 2½"-diameter manual knob onto the threaded rod of the tripod, and firmly tighten the manual knob.

3. Model 2120 owners: When engaging in long-exposure astrophotography with your telescope, it is advisable to thread-in the 3 additional socket screws through the wedge floor and into the top of the field tripod. These screws fit through the oval-shaped slots in the wedge floor; the wedge must first be turned horizontally on the field tripod, so that the oval slots lie over any 3 of the 6 threaded holes on the top surface of the tripod head. Tighten the 3 socket screws with the hex wrench provided. Note, however, that for normal visual observations through the Model 2120, use of these socket screws is not required: the manual knob (Step (2) above) is generally sufficient for rigid attachment of the wedge to the tripod.

The 3 additional socket screws are not provided with the Model 2080, nor does the Model 2080's wedge have provision for the attachment of these screws, since firm tightening of the manual knob is more than sufficient, even in the most demanding applications.

A fine latitude adjustment mechanism (necessary only for precision astrophotographic polar alignment) is included in one slot on the side of the wedge for the Model 2080; two of these mechanisms (one at each side of the wedge) are provided with the wedge for the Model 2120. Loosen the hex-screw at the side of the wedge, and slide each mechanism so that the 1-inch long screw (located just inside the vertical wedge wall) presses up against the bottom surface of the tilt-plate.

To make fine latitude adjustments, follow this procedure: (1) Loosen slightly the screws or knobs (5) on each side of the wedge, as shown in Fig. 7; (2) turn the screw pressing against the bottom of the tilt-plate, so that the tilt-plate moves in latitude angle; (3) re-tighten the screws or knobs (5).

Use of the fine latitude mechanisms on the wedge for the Model 2120 requires that both mechanisms be adjusted as just described.

MOUNTING THE TELESCOPE ONTO THE WEDGE

With the Model 2080 three knobs are supplied with the telescope for mounting the telescope's drive base to the tilt-plate of the wedge. (With the Model 2120 three socket screws are provided for this purpose.) Thread one of these knobs (or screws, as appropriate) partially into the hole on the underside of the drive base, located at the curved-end of the drive base. See Fig. 8. This knob or screw should be threaded in about 3 full turns, not fully threaded into the hole.

Check that the knobs or screws (5) at the side of the wedge, Fig. 7, are firmly tightened, before placing the telescope onto the wedge.

Grasping the 2 fork arms of the telescope firmly, place the telescope onto the tilt-plate of the wedge by sliding the knob (Model 2080) or screw (Model 2120) into the slot at the top of the curved-end of the wedge tilt-plate.

Insert the 2 remaining knobs for Model 2080, or socket screws for Model 2120, through the underside of the tilt plate and into the underside of the drive base. Tighten down all 3 knobs or screws to a firm feel. Extreme force is <u>not</u> necessary in this regard.

The telescope is now fully mounted onto the wedge and field tripod. Adjustments in wedge latitude angle and/or azimuth orientation may be made with the telescope in place. Further details on telescope polar alignment are given below, under "Lining Up with the Celestial Pole."

CAUTION: When changing the latitude angle of the wedge/ telescope system, be sure to grasp the telescope firmly <u>before</u> loosening the knobs or screws (5), Fig. 7. When these knobs or screws are loosened, the telescope and fork mount will fall rapidly if not held by hand.

CELESTIAL COORDINATES: DECLINATION AND RIGHT ASCENSION

Analogous to the Earth-based coordinate system of latitude and longitude, celestial objects are mapped according to a coordinate system on the "celestial sphere," the imaginary sphere on which all stars appear to be placed. The Poles of the celestial coordinate system are defined as those 2 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 Earth, imaginary lines have been drawn on the celestial sphere to form a coordinate grid. Celestial object positions are mapped on this grid, in the same manner as positions on the Earth's surface are specified by their latitude and longitude.

The celestial equivalent to Earthly latitude is called "Declination," or simply "Dec," and is measured in degrees, minutes, and 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 $0^o0'0"$ Declination. The Declination of the star Polaris, located very near the North Celestial Pole, is $+89.2^o$.

The celestial equivalent to Earthly longitude is called "Right Ascension," or "R.A." and is measured in hours, minutes, and seconds from an arbitrarily defined "zero" line of R.A. passing through the constellation Pegasus. Right Ascension coordinates range from $0^{hr}0^{min}0^{sec}$ up to (but not including) $24^{hr}0^{min}0^{sec}$. Thus there are 24 primary lines of R.A., located at 15^o intervals along the celestial equator. Objects located further and further east of the prime ($0^h0^m0^s$) Right Ascension grid line carry increasing R.A. coordinates.

With all celestial objects therefore capable of being specified in position by their celestial coordinates of Right Ascension and Declination, the task of finding objects (in particular, faint objects) in the telescope is vastly simplified. The setting circles of the Models 2080 and 2120 may be dialed, in effect, to read the object-coordinates, and the object 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 North 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, describing 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, simply by moving the telescope about one axis, the polar axis. In the case of the Meade Models 2080 and 2120, this tracking may be accomplished automatically with the electric motor drive.

If the telescope is reasonably well aligned with the pole, therefore, very little use of the telescope's Declination slow motion control is necessary: virtually all of the required telescope tracking will be in Right Ascension. (If the telescope were <u>perfectly</u> aligned with the pole, <u>no</u> Declination 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: with this level of pointing accuracy, the telescope's motor drive will track accurately and keep objects in the telescopic field of view for perhaps 20 to 30 minutes.

To line up the Model 2080 or 2120 with the Pole, follow this procedure:

<u>Model 2080</u>:

(1) Using the bubble level located on the floor of the wedge, adjust the tripod legs so that the telescope/wedge/tripod system reads "level."

(2) After grasping the telescope firmly, loosen the tilt plate knobs (5), Fig. 7A, so that the telescope may be moved in latitude angle. Set the tilt-plate angle so that the latitude scale (3), correctly reads your latitude. Firmly re-tighten the knobs (5). (The fine latitude adjustment (6) may be moved along the wedge slot and out of the way for now.)

Fig. 9: Lining Up With the Celestial Pole.

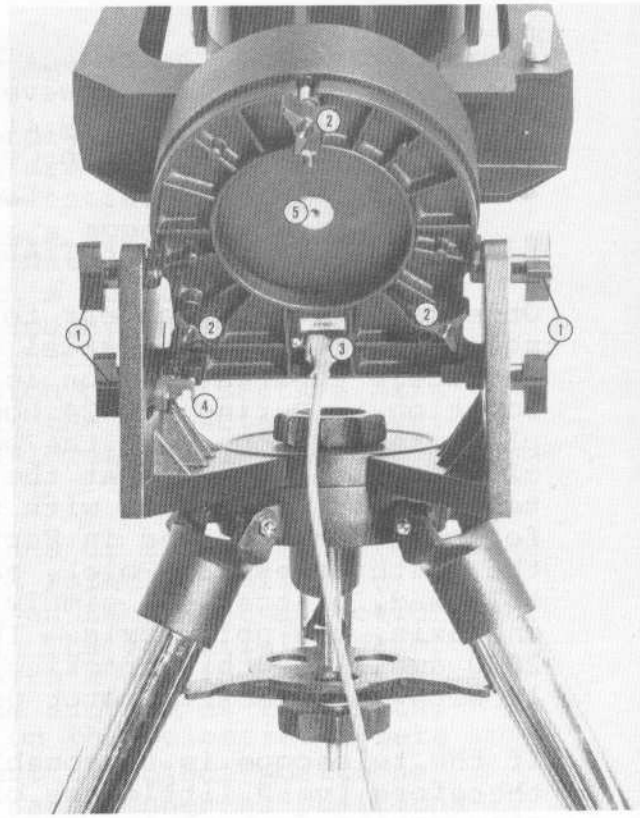


Fig. 10: Rear View of the Complete Telescope/Wedge/Field Tripod. (1) Tilt-Plate Attachment Knobs; (2) Telescope-to-Tilt Plate Attachment Knobs; (3) Power Cord Connector Plug; (4) Latitude Fine-Adjustment Mechanism; (5) ¼-20 Photo-Tripod Attachment Hole.

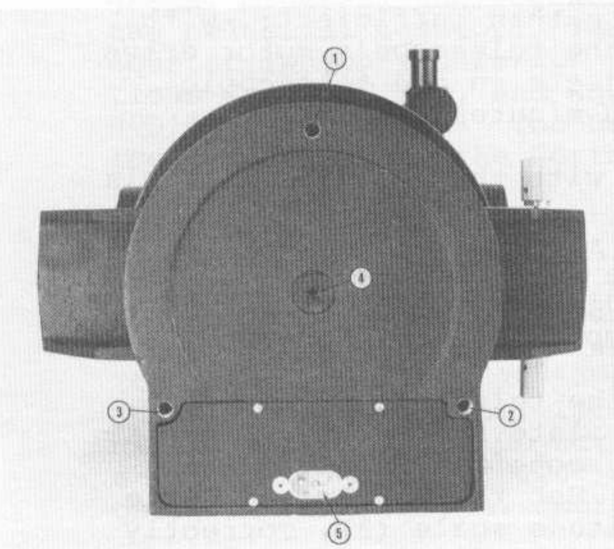


Fig. 11: Underside of the Drive Base. (1), (2), and (3) Wedge Attachment Holes; (4) ¼-20 Photo-Tripod Attachment Hole; (5) Power Cord Socket.

(3) Loosen the Dec. lock (2), Fig. 1, and rotate the telescope tube in Declination so that the telescope's optical axis is lined up with its polar axis; i.e. parallel to the fork arms. See Fig. 9. Careful eye-alignment of these 2 axes is sufficient. Tighten the Dec. lock.

(4) Loosen the manual knob(10), Fig. 8 half-a-turn, and rotate the telescope/wedge combination horizontally until the telescope itself, oriented as in Step (3), is pointing due North. Gun-sighting along the telescope tube on Polaris, the North Star, will be helpful in this regard. Then re-tighten the manual knob (10). The telescope is now approximately aligned with the Pole, and for casual observations this alignment procedure is adequate.

(5) For more precise polar alignment during extended use of the telescope at one observing session, now insert the 25mm eyepiece into the telescope, and keep the optical tube oriented as shown in Fig. 9. By a combination of the 2 wedge motions described above (Step (2), latitude angle and Step (4) azimuth, or horizontal, motion), center Polaris in the field of the telescope. Use of the latitude fine adjustment (see "The Equatorial Wedge," above) may be helpful in this operation. Be sure to re-tighten the knobs (5), Fig. 7A, and the manual knob (10), Fig. 8, upon conclusion of the alignment.

Model 2120: The polar alignment procedure for the Model 2120 is identical to that of the Model 2080. If the 3 socket screws are used to provide extra rigidity in attaching the wedge to the tripod (see "The Equatorial Wedge"), it will be necessary to loosen these screws, as well as the manual knob (10), Fig. 8, to rotate the telescope/wedge combination horizontally, i.e. in azimuth. With these socket screws and the manual knob slightly loosened, azimuth adjustment plus-or-minus about 5^{o} is possible. Therefore, the North-pointing procedure (Step (4) above) must first be roughly accomplished by turning the entire telescope/wedge/tripod combination. The final North-pointing operation may then be performed by rotating the telescope/wedge combination, only, on the tripod.

As an aside procedure, during your first use of the telescope, you should check the calibration of the Declination setting circles (See (3), Fig. 1), located at the top of each fork arm. After performing the polar alignment procedure, center the star Polaris in the telescope field. Loosen slightly the knurled central hub of each Declination setting circle. Now turn each circle until it reads 89.2°, the Declination of Polaris, and then tighten down the knurled knobs, avoiding any motion of the circles.

Once the latitude angle of the wedge has been fixed and locked-in, according to the above procedure, it is not necessary to repeat this operation each time the telescope is used, unless you move a considerable distance North or South from your original observing position. (Approximately 70 miles movement in North-South observing position is equivalent to 1° in latitude change.) The wedge may be detached from the field tripod and, so long as the latitude angle setting is not altered, it will retain the correct latitude setting when replaced on the tripod.

It should be emphasized that precise alignment of the telescope's polar axis to the celestial pole for casual visual observations is not necessary. Don't allow a time-consuming effort at lining up with the pole to interfere with your basic enjoyment of the telescope. For long-exposure photography, however, the ground rules are quite different, and precise polar alignment is not only advisable, but almost essential.

PRECISE POLAR ALIGNMENT

Unless you intend to engage in long-exposure astrophotography, it is not necessary to follow the precise polar alignment procedure described in this section.

Notwithstanding the precision and sophistication of the drive system supplied with the Meade Models 2080 and 2120, the fewer tracking corrections required during the course of a long-exposure photograph, the better. (For our purposes, "long-exposure" means any photograph of about 10 minutes' duration or longer.) In particular, the number of Declination corrections required is a direct function of the precision of polar alignment.

The procedure described here should be implemented only after the alignment procedures of the preceding section have first been carried out.

Precise polar alignment requires the use of a crosshair eyepiece. The Meade MA 12mm Illuminated Reticle Eyepiece is well-suited in this application, but you will want to increase the effective magnification through the use of a 2X or 3X Barlow lens. Then follow this procedure:

1. Place the Illuminated Reticle Eyepiece (or Eyepiece/Barlow combination) into the eyepiece-holder of the telescope.

2. Point the telescope with the motor drive running, at a moderately bright star near where the meridian (the North-South line passing through your local zenith) and the celestial equator intersect. For best results the star should be located within ± 30 minutes in R.A. of the meridian and within ± 5° of the celestial equator.

3. Note the extent of the star's drift in Declination (disregard drift in Right Ascension):

   a) If the star drifts <u>South</u>, the telescope's polar axis is pointing too far <u>East</u>.

   b) If the star drifts <u>North</u>, the telescope's polar axis is pointing too far <u>West</u>.

4. Move the wedge in azimuth (horizontal) to effect the appropriate change in polar alignment. Reposition the telescope's East-West polar axis orientation until there is no further North-South drift by the star. Track the star for a period of time to be certain that its Declination drift has ceased.

5. Next, point the telescope at another moderately bright star near the Eastern horizon, but still near the celestial equator. For best results the star should be about 20° to 30° above the Eastern horizon and within ± 5° of the celestial equator.

6. Again note the extent of the star's drift in Declination:

   a) If the star drifts <u>South</u>, the telescope's polar axis is pointing too <u>low</u>.

   b) If the star drifts <u>North</u>, the telescope's polar axis is pointing too <u>high</u>.

7. Use the latitude angle fine-adjust control on the wedge to effect the appropriate change in latitude angle, based on your observations above. Again track the star for a period of time to be certain that Declination drift has ceased.

The above procedure results in very accurate polar alignment, and minimizes the need for tracking corrections during astrophotography.

POLAR ALIGNMENT AT LOW LATITUDES

The Meade equatorial wedge permits polar alignment in a latitude range of 11° to 64°. However, the wedge and field tripod may still be employed at latitudes within $\pm 10^{\circ}$ of the Earth's equator. In this latitude range the latitude fine-adjust mechanism(s) of the wedge should be removed. By so doing, latitude angle settings to 0° may be achieved.

ELECTRIC MOTOR DRIVE

Supplied as standard equipment with the Models 2080 and 2120 is an extremely accurate worm gear drive system, operating from a 115 volt/60Hz synchronous electric motor. (Foreign models may include a 220v-240v/50Hz motor; drives for Southern Hemisphere operation are reversed in direction from their Northern Hemisphere counterparts.) The power cord for the Models 2080 and 2120 plugs into the bottom of the telescope's drive base, through apertures in the wedge mounting plate (or the table tripod for the Model 2080). See Figs. 10 and 11.

CAUTION: If an extension cord is required for your operation of the telescope, be sure that it is of the 3-prong type. Do not defeat the safety purpose of the supplied 3-prong cord by using a 2-prong extension cord or 2-prong adapter plug.

With the telescope set up in the equatorial mode (accomplished with the wedge/field tripod combination), plug the power cord into a power outlet. Immediately, if you put your ear to the drive base of the telescope, you will be able to hear the low-level noise created by the running motor. The drive system turns the fork mount of the telescope through one complete revolution every 24 hours, and results in the stars "standing still" as you view them through the telescope eyepiece. The motor drive also drives the R.A. setting circle, as described in the next section.

The motion of the telescope caused by the drive system is not obvious if you look <u>at</u> the telescope (in fact, it is not even perceptible), but while observing <u>through</u> the telescope, it is a very significant motion indeed. To check this point, with a star centered in the telescope field and the electric motor drive running, unplug the power cord: the star will immediately begin to drift out of the field of view; at higher powers the effect is even more pronounced.

To actuate operation of the electric motor drive, the R.A. lock (see (5), Fig. 1)must be in the "locked" position. As you move from object to object, unlocking and re-locking the R.A. lock each time, the motor drive automatically re-actuates each time the R.A. lock is locked.

NOTE: DO NOT ATTEMPT TO TURN THE R.A. SLOW-MOTION CONTROL KNOB WHEN THE R.A. LOCK IS IN THE "LOCKED" POSITION. SUCH AN OPERATION WILL CAUSE INTERNAL DAMAGE TO THE GEARS OF THE R.A. SLOW-MOTION CONTROL. IN ADDITION, DO NOT ATTEMPT TO TURN THE TELESCOPE MANUALLY ON ITS FORK MOUNT IN R.A. WHEN THE R.A. LOCK IS "LOCKED," AS SUCH OPERATION WILL CAUSE RAPID WEAR OF THE INTERNAL CLUTCH SYSTEM.

SETTING CIRCLES

Setting circles included with the Models 2080 and 2120 permit the location of faint celestial objects not easily found by direct visual observation. Located on the top surface of the telescope's drive base, the R.A. circle (12), Fig. 1, is 8" in diameter. Identical Declination circles (3), Fig. 1, are located at the top of each fork tine. With the telescope pointed at the North Celestial Pole, the Dec. circle should read 90^{o} (understood to mean $+90^{o}$). Objects located below the 0-0 line of the Dec. circle carry minus Declination coordinates. Each division of the Dec. represents a 1^{o} increment. The R.A. circle runs from 0^{hr} to (but not including) 24^{hr}, and reads in increments of 5^{min}.

Note that the R.A. circle is double-indexed; i.e. there are 2 series of numbers running in opposite directions around the circumference of the R.A. circle. The <u>outer</u> series of numbers (increasing counterclockwise) applies to observers located in the Earth's <u>Northern</u> Hemisphere; the inner series of numbers (increasing clockwise) applies to observers located in the Earth's <u>Southern</u> Hemisphere.

With the telescope aligned to the pole, center an object of known R.A. in the telescopic field. Then turn the R.A. circle, which can be rotated manually, until the R.A. coordinate of the object is correctly indicated by the R.A. pointer. As long as the telescope's motor drive remains "ON," the R.A. pointer will then correctly indicate the R.A. of any object at which the telescope is pointed throughout the duration of the observing session.

To use the circles to locate a particular object first look up the celestial coordinates (R.A. and Dec.) of the object in a star atlas. Then loosen the R.A. lock and turn the telescope to read the correct R.A. of the desired object; lock the R.A. lock onto the object. Next, turn the telescope in Declination to read the correct Declination of the object. If the procedure has been followed carefully, and if the telescope was well-aligned with the pole, the desired object should now be in the telescopic field of a low-power eyepiece.

If you do not immediately see the object you are seeking, try searching the adjacent sky area, using the R.A. and Dec. slow-motion controls to scan the surrounding region. Keep in mind that, with the 25mm eyepiece, the field of view of the Model 2080 is about $\frac{1}{2}^{o}$ and the field of the Model 2120 about 0.4^{o}. Because of its much wider field, the viewfinder may be of significant assistance in locating and centering objects, after the setting circles have been used to locate the approximate position of the object.

Pinpoint application of the setting circles requires that the telescope be precisely aligned with the pole. Refer to the preceding section on "Precise Polar Alignment" for further details.

The setting circles may also be utilized in the absence of a power source for the motor drive. In this case, however, it is necessary to manually reset to the R.A. of the object you are observing just before going to to the next object.

OBSERVING WITH THE TELESCOPE

The Meade Models 2080 and 2120 Schmidt-Cassegrain Telescopes permit an extremely wide array of serious observational opportunities. Even in normal city conditions, with all of the related air and light pollution, there are a good many interesting celestial objects to observe. But to be sure there is no substitute for the clear, steady, dark skies generally found only away from urban environments, or on mountaintops: objects previously viewed only in the city take on added detail or are seen in wider extension, or even become visible at all for the first time.

The amateur astronomer is faced typically with two broadly defined problems when viewing astronomical objects through the Earth's atmosphere: first is the clarity, or <u>transparency</u>, of the air, and secondly the <u>steadiness</u> of the air. This latter characteristic is often referred to as the quality of "seeing." Amateur astronomers talk almost constantly about the "seeing conditions," since, perhaps ironically, even the clearest, darkest skies may be almost worthless for serious observations if the air is not steady. This steadiness of the atmosphere is most readily gauged by observing the "twinkling" of the stars: rapid twinkling implies air motion in the Earth's atmosphere, and under these conditions resolution of fine detail (on the surface of Jupiter, for instance) will generally be limited. When the air is steady, stars appear to the naked eye as un-twinkling points of unchanging brightness, and it is in such a situation that the full potential of the telescope may be realized: higher powers may be used to advantage, closer double stars resolved as distinct points, and fine detail observed on the Moon and planets.

Several basic guidelines should be followed for best results in using your telescope:

1. Try not to touch the eyepiece while observing. Any vibrations resulting from such contact will immediately cause the image to move.

2. Allow your eyes to become "dark-adapted" prior to making serious observations. Night adaptation generally requires about 10 to 15 minutes for most people.

3. Let the telescope "cool down" to the outside environmental temperature before making observations. Temperature differentials between a warm house and cold outside air require about 30 minutes for the telescope's optics to regain their true and correct figures. During this period the telescope will not perform well. A good idea is to take the telescope outside 30 minutes before you want to start observing.

4. If you wear glasses and do not suffer from astigmatism, take your glasses off when observing through the telescope. You can re-focus the image to suit your own eyes. Observers with astigmatism, however, should keep their glasses on, since the telescope cannot correct for this eye defect.

5. Avoid setting up the telescope inside a room and observing through an open window (or, worse yet, through a closed window!). The air currents caused by inside/outside temperature differences will make quality optical performance impossible.

6. Perhaps most importantly of all, avoid "overpowering" your telescope. The maximum usable magnification at any given time is governed by the seeing conditions. If the telescopic image starts to become fuzzy as you increase in power, drop down to a reduced magnification. A smaller, but brighter and sharper, image is far preferable to a larger, but fuzzy and indistinct, one.

7. As you use your telescope more and more, you will find that you are seeing finer detail: observing through a large-aperture telescope is an acquired skill. Celestial observing will become increasingly rewarding as your eye becomes better trained to the detection of subtle nuances of resolution.

OPTIONAL ACCESSORIES AND SYSTEMS

The Meade Models 2080 and 2120, as parts of a wide-ranging telescope system, permit the addition of more than two dozen auxiliary accessories, for use of the basic telescopes in many varying observational and photographic situations.

EYEPIECES (1¼" O.D.)

The standard Models 2080 and 2120 include two multi-coated eyepieces of Modified Achromatic, 3-element, design: 25mm (80X on the 2080; 100X on the 2120) and 9mm (222X on the 2080; 278X on the 2120). Higher power (shorter focal length) and lower power (longer focal length) eyepieces are available to suit individual requirements. For example the MA 40mm eyepiece yields a low (50X on the 2080; 63X on the 2120) power and wide field of view, ideal for the observation of faint extended objects such as diffuse nebulae and spiral galaxies. The Meade Research Grade Erfle 20mm is also excellent in this latter application and provides an extremely wide-angle field at 100X on the 2080, 125X on the 2120. Advanced observers will quickly become "spoiled" with the use of the Research Grade Erfles, since their wide-angle fields permit comfortable "eye-relief," even at higher powers, during long observing sessions. Under favorable atmospheric conditions, higher eyepiece powers allow the observation of finer lunar and planetary detail; in these cases Orthoscopic eyepieces in the 4mm to 7mm focal length range are probably the most advantageous.

EYEPIECES (2" O.D.)

Used in conjunction with the 2" Diagonal Mirror (see below) eyepieces of the oversize 2" O.D. barrel provide breathtaking wide-field views of deep space objects such as nebulae, galaxies, and star clusters. The Meade Research Grade Erfle 32mm (2" O.D.) eyepiece yields a magnification of 63X on the Model 2080 (78X on the Model 2120) with an actual field of about 1^{o}, or about 2 Moon-diameters.

BARLOW LENSES

The widely-used Meade Telenegative Amplifiers are customdesigned lenses of the Barlow type that increase effective eyepiece power. The Model 122 2X Telenegative Amplifier (1¼" O.D.) slides directly into the telescope eyepiece holder, followed by the diagonal prism and eyepiece. A particular advantage of Barlow lenses is that the eye relief of longer focal length eyepieces is maintained while, in conjunction with the Barlow, higher powers are utilized. Meade Telenegative Amplifiers are also available in 3X and in variable 2X-3X formats.

2" DIAGONAL MIRROR

The 2" Diagonal threads directly onto the rear-cell thread of the Model 2080 or 2120. With this accessory, eyepieces of the oversize 2" O.D. barrel may be employed for spectacular wide-field views of the heavens. Included with the 2" Diagonal is an adapter bushing for 1¼" O.D. eyepieces so that the 2" Diagonal need not be removed each time 1¼" O.D. eyepieces are employed.

Note: The 2" Diagonal includes a front-surface-aluminized precision flat mirror, not a prism. Avoid rubbing or wiping this mirror, or scratches will almost certainly result. If a light layer of dust collects on the mirror surface, use an ear syringe (available at local pharmacies) to blow off the dust.

THREAD-IN COLOR FILTERS

During observations of the Moon and planets Meade photo-visual thread-in color filters enhance the level of visible detail, increase image contrast, and reduce irradiation in the observer's eye. The 1¼" filters thread into the barrels of all Meade 1¼" O.D. eyepieces, and into most other eyepiece brands as well. The filters may be piggybacked to yield many subtle color differences useful in planetary observations.

NOTE: THESE THREAD-IN COLOR FILTERS SHOULD NOT BE USED IN OBSERVING THE SUN! INSTANT AND IRREVERSIBLE EYE DAMAGE MAY OTHERWISE RESULT. FOR SOLAR OBSERVATIONS USE ONLY THE SPECIAL SUN FILTERS DESCRIBED ELSEWHERE IN THIS MANUAL. (SEE "SOLAR FILTERS.")

Hints for visual filter observations on the planets and Moon:

The Moon: Use a polarizer filter to reduce undesirable glare; when the Moon is full or near-full, 2 polarizers piggybacked provide a variable-density polarizing system:

rotate one filter relative to the other to obtain a comfortable level of image brightness. The following filters may also be employed, either singly or in combination with a polarizer, to increase the image contrast of lunar features: #8 Light Yellow, #11 Yellow-Green, #21 Orange, #23A Light Red.

Venus: The #47 Violet filter is useful for the low-contrast shadings of Venus, because of the yellowness of these markings. Dark surface shadings may occasionally be glimpsed with the aid of the #25A Red, #47 Violet, or #58 Green filters.

Mars: Most of the scattered blue light in Mars' atmosphere may be filtered out with a #12 Yellow or #21 Orange filter; these filters also reduce the light from the blue and green areas, darkening the maria, oases, and canal markings while lightening the orange-hued desert regions of the planet. A #8 Light Yellow filter will also stop the scattered blue light, but will allow transmission of more green light from the maria. A #25A Red filter transmits red and some yellow light, but blocks out all blue and green, giving maximum contrast. To restrict observations to the top of the Martian atmosphere, the #47 Violet filter is useful to sharpen the boundaries of high-lying clouds. The #58 Green filter may be employed for further cloud comparisons directly above the planet's surface. The #11 Yellow-Green filter will sharpen the boundary of a Martian polar cap by darkening the ochre desert, while allowing adequate penetration of Mars' atmosphere.

Jupiter: The #8 Light Yellow and #21 Orange filters are useful in judging the colors of the low-hue cloud belts and zones. To bring out a white area on a reddish background, the #58 Green is helpful. The #58 Green is also very effective for observing the low contrast hues of blue and red that exist in Jupiter's atmosphere. The green filter blocks out both red and blue colors, enhancing the contrast of red and blue detail. The #80A Blue filter is useful in the observation of faint cloud formations, and for enhancement of the Great Red Spot.

Saturn: Because the surface characteristics and atmospheric structure of Saturn are generally similar to those of Jupiter, the filter recommendations are similar in both cases. Use the #8 Light Yellow, #21 Orange, or #80A Blue for the observation of Saturn's rather faint cloud belts. The #58 may help to increase contrast between white surface areas and dusky belt markings.

The thread-in color filters may also be used for photographic studies of the Moon and planets, in conjunction with the

Tele-Extender. (See "The Tele-Extender" below.) Exposure time should be increased to account for the reduced transmission of the filtered light; some experimentation is required to achieve the proper exposure time under varying conditions.

SERIES 6 COLOR FILTERS

The rear-cell thread of the Models 2080 and 2120 includes a special recessed cell to permit the addition of Series 6 drop-in filters. See Fig. 12. Used in conjunction with the T-Adapter during terrestrial telephotography or astrophotography, a flange on the inside of the T-Adapter holds the filter firmly in place. Particularly in terrestrial daylight conditions the Series 6 filters may render a higher contrast level between the object being photographed and background phenomena. The Series 6 filter set consists of the following colors: Pink (#1A); Light Yellow (#8); Yellow-Green (#11); Red (#25); Blue (#80A); Neutral Density (0.6). Typical applications of the filters are as follows:

Pink (#1A): A "skylight" filter, usually employed in color photography. Reduces ultraviolet and some blue rays during telephotography of objects with a sky background. Good for sunny scenes. No exposure-time compensation is necessary.

Light Yellow (#8): Provides good gray-shading balance and contrast in black-and-white photography of clouds and terrestrial subjects, including trees, flowers and other greenery. Exposure compensation factor: 1.5X.

Yellow-Green (#11): Also used in black-and-white photography. Heightens image contrast of flowers and greenery, and darkens blue sky backgrounds. Recommended for outdoor shots with panchromatic black-and-white films. Exposure compensation factor: 2.5X.

Red (#25A): Dramatically reduces atmospheric haze and produces excellent image contrast of background cloud formations. Enhances the textural rendition of materials such as ceramic, wood, stone, trees, etc. Use for black-and-white photography. Exposure compensation factor: 8X.

Blue (#80A): Used in conjunction with color films, the #80A filter compensates daylight-type films for photography under 3200°K. flood and spot lights or ordinary household lights. Without the filter, the photo may be too reddish. Exposure compensation factor: 3.2X.

Neutral Density (0.6): Useful for black-and-white or color work in extreme lighting conditions. The ND (0.6) filter transmits only 25% of the incident light at all wavelengths. Possible applications include brightly lit seascapes or snowscapes, particularly with high-speed films. Exposure compensation factor: 2X.

Fig. 12: Series 6 Color Filters

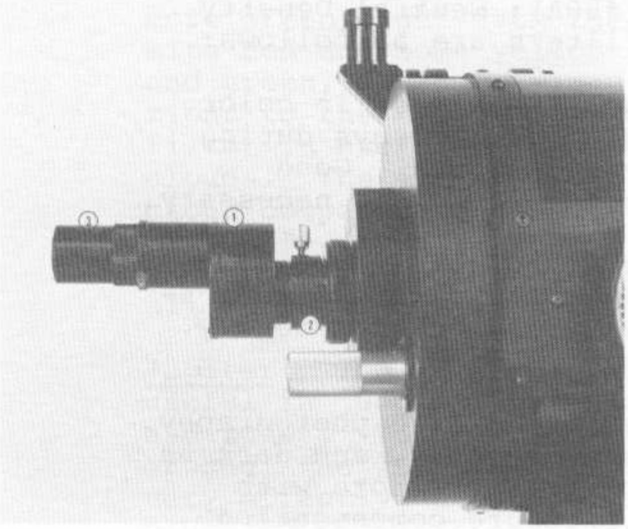


Fig. 13: Using the Erecting Prism. (1) Erecting Prism; (2) Eyepiece-Holder; (3) Eyepiece

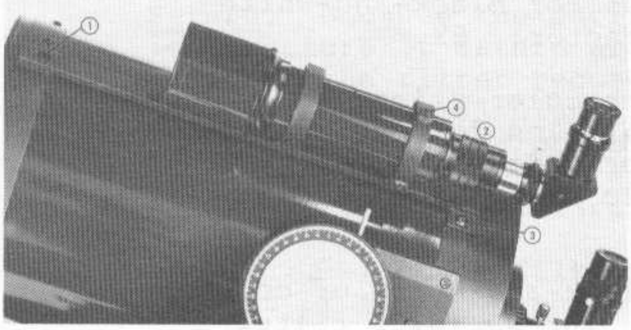


Fig. 14: 8 x 50mm Right-Angle Viewfinder for Model 2080. (1) and (3) Attachment Screws; (2) Focuser; (4) Collimation Screws.

Fig. 15: Full-Aperture Solar Filter for Model 2080.

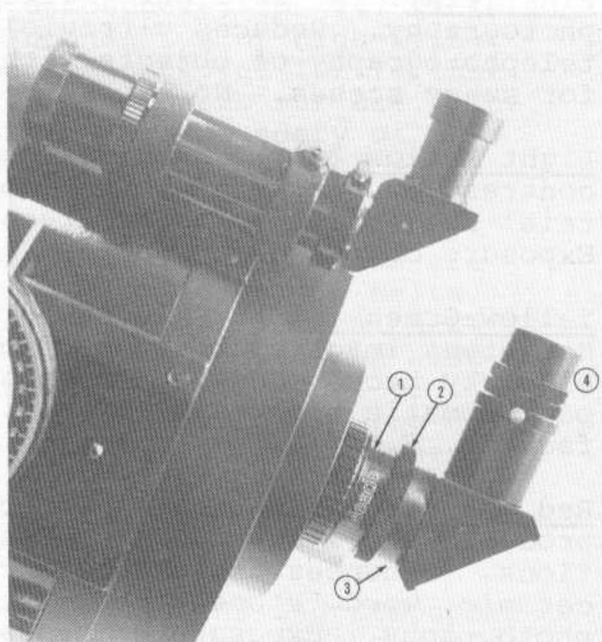


Fig. 16: The #671 Wide-Field Adapter System (WFAS). (1) Special WFAS T-Adapter; (2) Telecompressor Lens; (3) #919 Diagonal Prism; (4) Eyepiece

ERECTING PRISM

The 1¼" O.D. Erecting Prism, Model 924, fits into the standard eyepiece-holder of the Models 2080 and 2120 and accepts any 1¼" O.D. eyepiece. The erecting prism inverts the image presented by the telescope's optical system so that the image is correctly oriented up-and-down and left-for-right for terrestrial observations. See Fig. 13.

8 x 50mm RIGHT-ANGLE VIEWFINDER (MODEL 527, for MODEL 2080)

This large aperture viewfinder replaces the standard 6 x 30mm viewfinder on the Model 2080 and provides bright wide-field capability, facilitating the visual location of faint nebulous objects. Remove the standard 6 x 30mm finder, using one of the Allen (hex) wrenches shipped with the telescope. The bracket of the Model 527 attaches, at the eyepiece-end of the telescope, into the same threaded holes used by the standard viewfinder, and uses the same attachment screws as the standard viewfinder. At the upper (correcting lens) end of the main tube, the bracket attaches into the single, left-most threaded hole. See Fig. 14

The 8 x 50mm Right-Angle Viewfinder should be collimated, or aligned, with the main telescope, following a similar procedure to that previously described for the standard 6 x 30mm viewfinder. (See "The Viewfinder.") Focusing of the Model 527 is accomplished by a precise helical mechanism at the eyepiece-end of the finder.

Note: If you remove the eyepiece of the Model 527 viewfinder, <u>do not touch</u> the exposed crosshairs of the eyepiece, which are located near the end of the chrome-plated eyepiece barrel.

With the Model 527 Viewfinder attached to the main telescope, the telescope may still be placed in its foam-lined storage case. We do <u>not</u> recommend that the telescope be shipped by commercial carrier with the Model 527 attached, however, since the large viewfinder is more vulnerable to shipping damage.

NEBULAR FILTERS

Two nebular filters are available for use with the Meade Models 2080 and 2120: the #908 nebular filter threads into the barrels of all Meade 1¼" O.D. eyepieces for visual enhancement of nebular objects viewed with 1¼" eyepieces through the telescope; the larger #911 filter threads directly onto the rear-cell thread and converts the telescope into a basic "nebular mode." The standard eyepiece-holder, 2" diagonal, off-axis guider, T-Adapter, or other accessories may then be attached to the telescope as desired, while light reaching these systems is pre-filtered.

Nebular filters are of very significant value, both visually and photographically, to the city-dwelling astronomer. On deep-space emission nebulae, these filters transmit most of the nebular light, while effectively blocking the urban light pollution of sodium and mercury vapor lights, as well as natural air glow. Note, however, that nebular filters are not generally effective for the observation of non-nebular objects such as galaxies or stellar objects.

SOLAR FILTERS

Meade solar filters, Models 955 and 956 (for Model 2080 telescope) and Model 958 (for Model 2120 telescope), attach directly over the front of the respective telescope's main correcting lens(see Fig. 15). Each filter press-fits onto the outside diameter of the corrector lens cell. Tighten down the safety thumbscrews located around the circumference of each filter, and make certain that these thumbscrews fit into the recessed ridge machined into the circumference of the corrector lens cell.

IMPORTANT NOTE: Meade solar filters are manufactured of optical glass and coated with Inconel, to transmit only an extremely small, completely safe amount of solar radiation. Even so, however, care should always be exercised when viewing the Sun: make sure that the filter is snugly press-fit over the outside of the corrector cell and that the safety thumbscrews are fitted into the cell's recessed ridge. Never use any solar filter which is not specifically designed for use with the Model 2080 or 2120. In particular, do not use small "sun filters" which thread into the eyepiece, so-called "Herschel wedges," sun diagonals, or sun projection screen devices. Instant and irreversible eye damage, as well as physical damage to the telescope itself, can result from the use of improper or inadequate sun filters not designed for the large apertures of the Models 2080 and 2120.

When observing the Sun, always place the dust cap of the viewfinder in position over the front (objective) lens of the finder. Otherwise, heat will quickly build up inside the viewfinder and destroy the cemented lenses and cross-hairs of the finder.

After using one of the solar filters during an observing session, always re-point the telescope away from the Sun, before removing the solar filter.

WIDE-FIELD ADAPTER SYSTEM (WFAS)

The #671 Wide-Field Adapter System (1¼" O.D.) is a visual focal-reducing system for use with eyepieces of 1¼" O.D. barrel. The WFAS reduces the effective focal ratio of the Model 2080 or 2120 from f/10 to f/5, yielding twice the visual field of view, 4 times the image brightness, and one-half the magnification normally obtained with a given eyepiece. The following parts are included with the #671 WFAS:

Special WFAS T-Adapter
Telecompressor Lens
#919 Diagonal Prism

To use the WFAS, attach the Special WFAS T-Adapter to the rear-cell thread of the telescope; the Telecompressor Lens threads into the T-Adapter, followed by the #919 Diagonal Prism. See Fig. 16. (The #919 Diagonal Prism is similar to the #918A Diagonal Prism supplied with the telescope, but has a threaded fitting for attaching to the Telecompressor thread, in place of the standard 1¼" O.D. chromed sleeve.)

Any standard 1¼" O.D. eyepiece may be used with the WFAS, but eyepieces in the focal length range of 18mm to 25mm generally perform best, since they result in beautiful wide-field panoramas of the sky, without approaching the lower magnification limit of the telescope. An Erfle eyepiece of about 20mm focal length is perhaps the single most suitable ocular for use with the WFAS: the resultant field in the Model 2080 is about 1.3° in diameter, or about 1° in the Model 2120.

DEW SHIELD

In moist climates the Dew Shield (#712 for Model 2080, #710 for Model 2120) inhibits water condensation on the front surface of the correcting plate. The Dew Shield press-fits over the outside diameter of the telescope's corrector cell. Tighten down to a "firm feel" (do not overtighten) the thumbscrews located around the circumference of the Dew Shield, so that these screws fit into the recessed machined ring which runs around the outside diameter of the corrector cell.

During daytime terrestrial photography the Dew Shield may also be used as a Sun Shield (not to be confused with a Sun <u>filter</u>!), and helps to prevent stray, off-axis light rays or glare from entering the telescope.

ACCESSORY SHELF

This shelf attaches to the central hub of the 3-vane support system on the Field Tripod. Simply place the supplied screw through the central hole of the shelf, with the shelf sitting on the hub of the 3-vane system. The supplied wing nut attaches from the underside of the shelf; tighten the wing nut to a firm feel. The accessory shelf can accept a total weight up to about 4 lbs.

ALTAZIMUTH ADAPTER (MODEL 2080 ONLY)

For terrestrial observations on the field tripod with the Model 2080, the Altazimuth Adapter attaches the telescope's drive base directly to the head of the field tripod. See Fig. 17. The equatorial wedge is not used in this application, and the telescope is oriented in the altitude-azimuth ("altazimuth"), or vertical-horizontal, mode most advantageous for terrestrial viewing.

NOTE: Because of the Model 2120's additional weight and leverage when sitting atop the Field Tripod in the altazimuth mode, we do not normally recommend use of the Altazimuth Adapter with the Model 2120.

To attach the Altazimuth Adapter, follow this procedure:

1. With the field tripod fully set-up, unthread the tension knob (see (3), Fig. 3) completely, so that it falls off the threaded rod (2), Fig. 3. Also remove the spreader bar (4), Fig. 3, sliding it down the threaded rod.

2. The threaded rod, supplied as part of the field tripod, screws into the underside of the field tripod head. Remove the threaded rod by turning it counterclockwise, but save the hex lock-nut for use in Step (4) below.

3. The Altazimuth Adapter is supplied with a threaded rod almost identical to the one removed in Step (2) above, but hollowed out throughout its entire length. Thread this new rod into the same hole, in the underside of the tripod head, from which the previous rod was removed. The rod should be threaded in so that it comes out the top of the tripod head, <u>just flush (flat) with the top surface of the tripod head</u>.

4. The newly-attached threaded rod should be firmly locked in place using the hex lock-nut supplied on the original threaded rod of the field tripod. This new rod may now remain a permanent part of your field tripod, even when the Altazimuth Adapter is not in use.

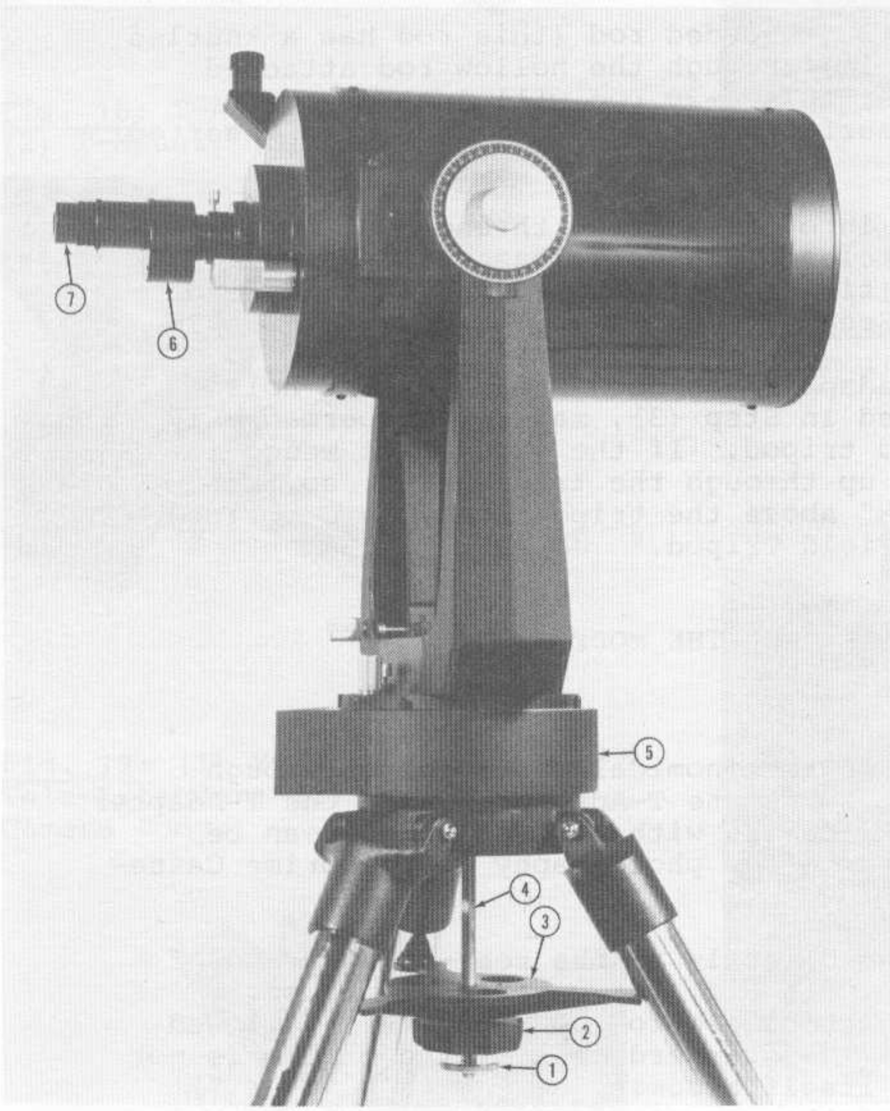


Fig. 17: The Model 2080 Telescope Attached to the Field Tripod with the Altazimuth Adapter.
(1) Knurled Knob.
(2) Tension Knob of Field Tripod.
(3) Spreader Bar of Field Tripod.
(4) Threaded Rod Supplied with Altazimuth Adapter.
(5) Drive Base.
(6) Erecting Prism.
(7) Eyepiece.

5. Now replace the spreader bar (4), Fig. 3, and thread on the tension knob (3), Fig. 3, so that the field tripod is once again fully assembled and ready for use.

6. Place the Model 2080 telescope on the field tripod, with the telescope's drive base centered on the tripod head.

7. Slide the long ¼-20 threaded rod (this rod has a knurled knob attached to it) through the hollow rod attached in Step (3) above; this ¼-20 rod will just protrude through the top surface of the tripod head when inserted all the way.

8. Fit the ¼-20 rod into the central threaded hole (4), Fig. 11, of the telescope's drive base. Turn the knurled knob and tighten down the rod into the base of the telescope. See Fig. 17.

Once the altazimuth adapter has been attached, the hollow threaded rod, attached in Step (3), may remain permanently attached to the field tripod. If the equatorial wedge is used, thread the rod up through the tripod head, so that it protrudes about 1½" above the tripod head, as described in the section "The Field Tripod."

PHOTOGRAPHIC ACCESSORIES FOR THE MODEL 2080

T-ADAPTER

Basic to terrestrial or astronomical photography through the Models 2080 and 2120 is the T-Adapter. With the T-Adapter almost any 35mm S.L.R. camera with removable lens can be attached to the telescope for photography at the prime Cassegrain focus.

The T-Adapter attaches directly to the rear-cell thread of the telescope, as shown in Fig. 18. A standard T-Mount for your camera brand threads onto the T-Adapter, followed by the camera body. (The standard lens of the camera is not used: the telescope itself becomes the camera's "lens.") Correct orientation of the camera body relative to the telescope is achieved by loosening the T-Adapter's knurled ring, rotating the camera, and re-tightening the ring.

<u>Terrestrial Photography</u>: Compared to the magnification of standard 50mm camera lenses, the Model 2080-with-T-Adapter results in magnification of 40X; in the case of the Model 2120, this magnification is 50X. Rarely will magnifications greater than these levels be required for terrestrial photography. Keep in mind that the Models 2080 and 2120

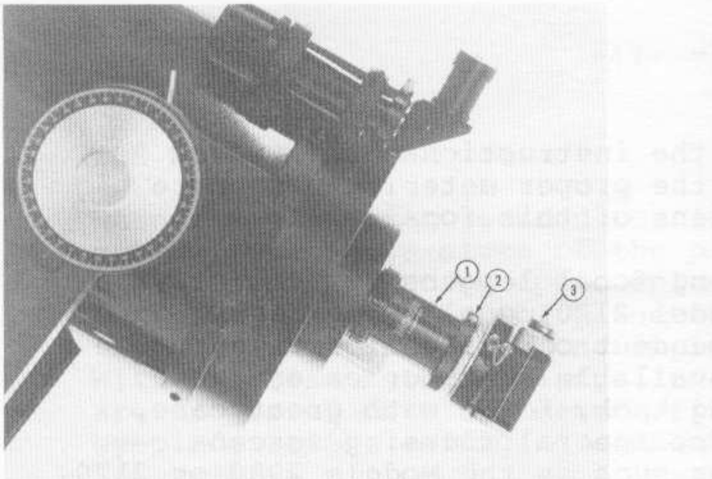


Fig. 18: T-Adapter. (1) T-Adapter; (2) T-Mount; (3) Camera body.

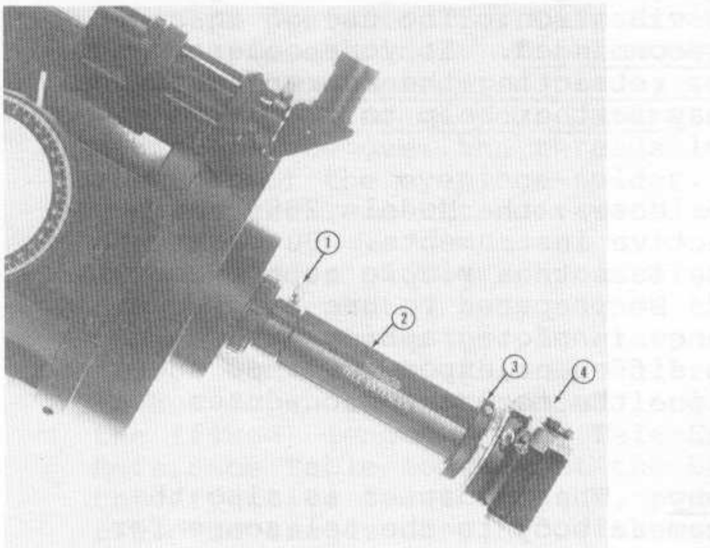


Fig. 19: (1) Eyepiece-Holder; (2) Tele-Extender; (3) T-Mount; (4) Camera body.

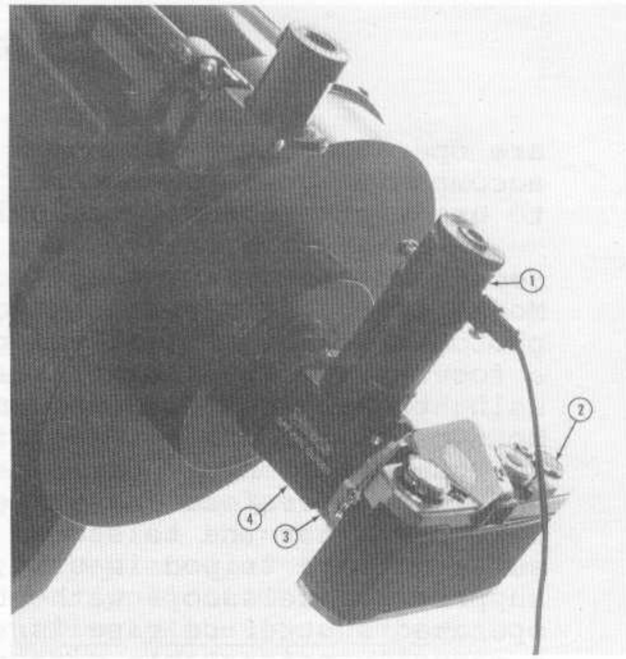


Fig. 21: Using the Off-Axis Guider. (1) Illuminated Reticle Eyepiece; (2) Camera body; (3) T-Mount; (4) Off-Axis Guider Body.

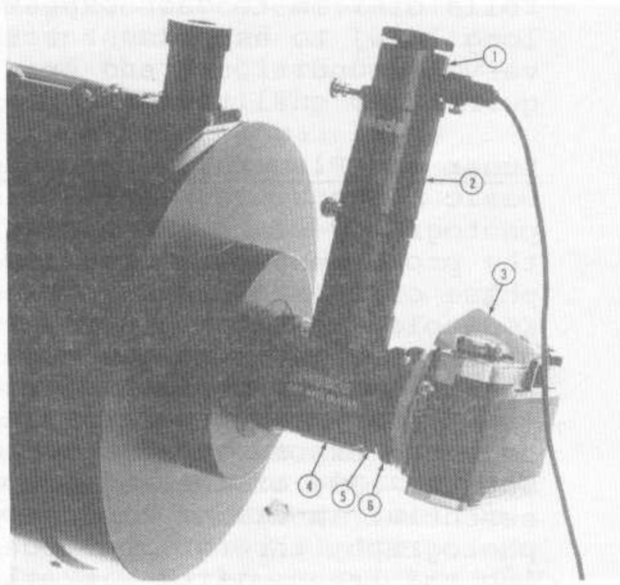
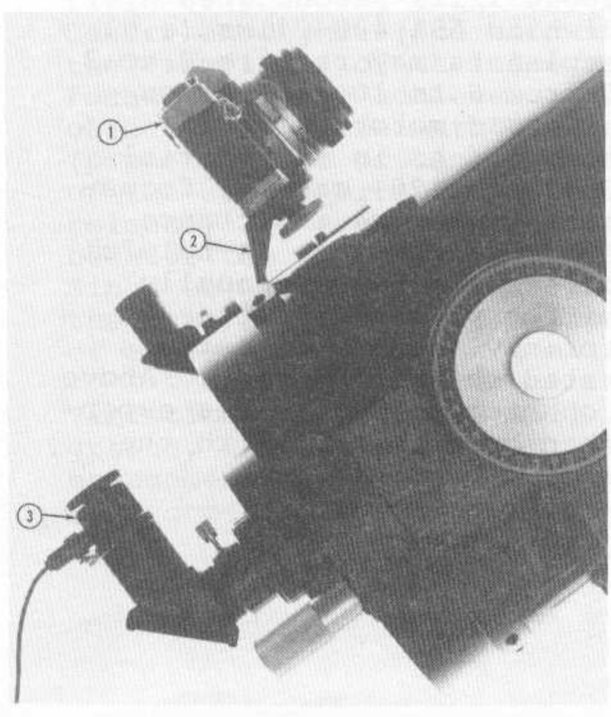


Fig. 22: Using the Telecompressor with the Off-Axis Guider. (1) Illuminated Reticle Eyepiece; (2) Extender Tube; (3) Camera body; (4) Off-Axis Guider Body; (5) Telecompressor; (6) T-Mount.



← Fig. 20: (1) 35mm Camera-with-Lens; (2) Piggyback Bracket; (3) Illuminated Reticle Eyepiece.

are operating at f/10; check the instruction manual which accompanied your camera, for the proper metering procedure to use with a non-automatic lens of this focal ratio.

Because of the telescopes' long focal lengths (2000mm for the Model 2080, 2500mm for the Model 2120) quality terrestrial photographs are crucially dependent on careful focusing. Use a focus magnifier if one is available for your camera, and, using the telescope's focusing knob, focus with great care. Most camera manufacturers offer special focusing screens for use with long focus lenses such as the Models 2080 or 2120, and the proper focusing screen can be a significant aid. Take care that the telescope is mounted on a vibration-free surface; if a tripod is used, it should be stable enough to support the telescope without vibration. The use of an air-operated shutter release is recommended. If your camera has a manually retractable mirror, retracting the mirror just prior to shutter engagement may further help to reduce vibration problems.

Used as terrestrial telephoto lenses, the Models 2080 and 2120 are extraordinarily effective instruments. But using the telescope for this purpose is not as simple as photography through standard 50mm lenses. Be prepared to use a few rolls of film to gain experience in photographing with a long lens, to experiment with different exposure times under varying conditions, and practice the focusing procedures required for quality work.

Lunar and Planetary Photography: The T-Adapter is also the basic means of coupling the camera body to the telescope for photography of the Moon and planets. For lunar photography, the proper exposure time depends on the film used and on the phase of the Moon. With a color film speed of ASA 64 (e.g. Kodacolor-X), exposure time will range from about 1/8-second at the Moon's crescent phase to about 1/125-second when the Moon is near-full. Black-and-white ASA 400 films (e.g. Tri-X), used in photographing the planets may require 2 to 3 seconds' exposure on Jupiter, and from 6 to 10 seconds on Saturn. Use of the telescope's electric motor drive is essential in all of these applications. As in terrestrial photography through the Models 2080 and 2120, careful focusing and freedom from vibrations are of extreme importance for quality astrophotography. A focus magnifier is helpful for achieving sharp focus. If your camera has a manually retractable mirror, retract the mirror prior to shutter engagement (allow a few seconds for any induced vibrations to damp out), and use an air-operated shutter release. Above all, have patience: quality astrophotography requires experience, but the rewards are more than commensurate with the effort required.

THE TELE-EXTENDER

When the T-Adapter is used for lunar and planetary photography, the image sizes of the planets, in particular, are small, and photographic enlargement will generally be desired. A method of planetary photography not requiring such enlargement is one employing the Tele-Extender. With the Tele-Extender large lunar and planetary images are projected onto the camera film plane, using a standard eyepiece as the enlarging element.

To use the Tele-Extender (see Fig. 19), first attach the eyepiece-holder to the rear-cell thread of the telescope. Then place an eyepiece (generally, eyepieces of 12mm to 40mm are preferred for Tele-Extender applications) into the eyepiece-holder. Tighten down firmly the thumbscrew holding the eyepiece in place, so that the eyepiece cannot fall out and damage your camera! Then thread the Tele-Extender tube over the threads located on the outside diameter of the eyepiece-holder. Attach your 35mm camera body to the Tele-Extender with a standard T-Mount.

Tele-Extender photography is also known as "eyepiece-projection" photography, since the eyepiece literally projects the lunar or planetary image onto the camera film. The extent of image enlargement obtained by this method depends on the focal length of the eyepiece and on the (fixed) length of the Tele-Extender tube. The Optical Reference Table located at the back of this manual lists the effective focal lengths, powers, focal ratios, and field coverages obtained with various eyepieces used in the Tele-Extender mode.

To photograph through the Tele-Extender, the telescope must be set up in the equatorial mode, using the wedge/field tripod, and with the electric motor drive operating. Center an object (the Moon is easiest to begin with) in the viewfinder of the camera and rotate the telescope focuser knob to achieve a critically sharp focus on the object. The same methods used in T-Adapter astrophotography (proper choice of camera focusing screen; manual retraction of the camera mirror, if possible; air-operated shutter release) are even more important in Tele-Extender photography, because the effective magnification is so much greater. Since objects in the Tele-Extender format, as seen through the camera viewfinder, will appear much fainter, the use of a clear focusing screen is advisable.

Vibrations of any type will ruin lunar and planetary photographs, whether these vibrations emanate from the shutter engagement of the camera, from people walking near the telescope during the time of the exposure, or from other sources. The atmospheric "seeing" conditions (i.e. the steadiness of the air) are similarly of vital importance in high-power photography of the Moon and planets, and Tele-Extender photography should be attempted only when the air is relatively steady.

A certain amount of trial-and-error will be required to become familiar with the proper exposure times for various objects under differing conditions. Such factors as the film speed, effective telescope focal length (a function of the projection eyepiece focal length) and object brightness are all important considerations. Generally, for example, Tele-Extender photographs of Jupiter with the 25mm eyepiece, and using Tri-X film (ASA 400), will require an exposure time of from 1/2 second to 2 seconds. The half-phase Moon under the same conditions requires about the same exposure time. Mars requires an exposure time of from about 1/2 second to 4 seconds, depending on its distance from the Earth. For Saturn, exposure times from about 3 seconds to 10 seconds are in order. Higher power (shorter focal length) eyepieces increase the necessary exposure time; lower power (longer focal length) eyepieces decrease the exposure time requirement.

GUIDED ASTROPHOTOGRAPHY

All astronomical telescopes used for serious long-exposure photography include an electric drive system for automatic tracking of astronomical objects. In the cases of the Models 2080 and 2120 telescopes, the electric drive system includes a precision 5.75-inch diameter worm gear and synchronous motor. This drive system is perhaps the most advanced yet offered as standard equipment on Schmidt-Cassegrain telescopes in the aperture ranges of the Models 2080 and 2120. For visual observations through the telescope, and for T-Adapter or Tele-Extender photographs of the Moon and planets, no other driving mechanism or electronic corrector is required. However, for long exposure astrophotography the story is quite different: during the period of a long exposure (from 2 minutes to 45 minutes, or more) photograph, small tracking errors evidence themselves and must be corrected for.

These tracking errors arise from a variety of sources, including differential refraction of objects by the Earth's atmosphere (starlight is bent by the atmosphere through a steeper angle when the object is near the horizon); variations in the local frequency of alternating current; mechanical tolerances in the manufacture of the drive system; improper balancing of the telescope; and inaccurate alignment of the telescope with the celestial pole.

During the entire time of a long-exposure photograph, the telescope must be pointed precisely at the object being photographed. This requirement implies that the astrophotographer must make small manual and/or electronic corrections in the telescope position during the exposure. For this purpose a drive corrector is employed. The drive corrector is an electronic device which varies the frequency of the electric current input to the telescope, so that it becomes possible to speed up or slow down the telescope's tracking rate in R.A. Small tracking corrections in Declination may be effected by manually turning the Declination slow-motion knob. (Note that such manual corrections must be made with care so as not to induce vibrations.) Alternately, the Meade Dual-Axis Drive Corrector (Model 46) includes an electric declination motor, permitting 2-axis electronic corrections. The technique of guiding consists of monitoring a time exposure photograph while it is being taken and of making small corrections in R.A. and Declination to keep the telescope accurately pointed during the exposure.

PIGGYBACK CAMERA BRACKET

Perhaps the simplest form of deep-space astrophotography is to mount a 35mm camera atop the Model 2080 or 2120 telescope in "piggyback" fashion. Using a standard 50mm lens in the camera, wide-angle photographs of remarkable detail are possible by this method.

The piggyback bracket may be attached to the telescope's rear cell casting, either on the upper or lower surface, using the standard tapped holes provided with all Model 2080's and 2120's. Your camera attaches to the piggyback bracket by means of the camera tripod socket located on the camera body. See Fig. 20.

To guide the piggyback-mounted camera, the Meade Illuminated Reticle Eyepiece should be inserted into the diagonal prism of the main telescope. Using the double-line pattern of this eyepiece, keep a starpoint precisely centered in the telescopic field, during the period of the piggyback exposure. If the starpoint begins to drift off-center, use the remote controller of the R.A. drive corrector and the manual declination knob (or, better, the dual-axis drive corrector) to bring it back to the center of the reticle pattern. Because of the small image scale involved, a considerable error-margin will exist in such a guided piggyback photograph. Once you have become proficient in this type of astrophotography, and can guide successfully a piggyback photo for perhaps up to 30 minutes, then you will be ready to attempt long-exposure photography through the main telescope, using either the off-axis guider or the photo-guide telescope.

THE OFF-AXIS GUIDER

Long-exposure photography through the main 2000mm focal length (Model 2080) or 2500mm focal length (Model 2120) telescope requires a means of accurately monitoring the position of the subject in the photographic field during the exposure. Because of the large image scale at the focal planes of the main instruments, there is only a small margin for guiding error, if the photograph is to be of high quality. In fact, even with careful guiding, you will doubtless need to take a good many photographs in order to obtain one really good one, since there are so many variables in this type of photography. Do not be discouraged if your first efforts are not spectacular: with experience your guiding technique will improve and the results can be very rewarding.

The off-axis guider attaches directly to the rear-cell thread of the main telescope. (See Fig. 21.) Using a standard T-Mount, attach your camera body to the off-axis guider body. The off-axis guider thus functions in a similar way to the T-Adapter, discussed previously, but with an important difference: a small portion of the light incoming to the camera film plane is diverted at a right-angle, where it may be observed with an eyepiece.

The Meade MA 12mm illuminated reticle eyepiece should be inserted into the eyepiece sleeve of the off-axis guider, since the crossline reticle pattern of this eyepiece is designed for guiding purposes. (Other eyepieces may not reach proper focus in the off-axis guider.) Note that focusing of the illuminated reticle eyepiece, while it is inserted into the off-axis guider, is accomplished by push-pull in the eyepiece sleeve of the off-axis guider; use the thumbscrew located on the eyepiece sleeve to hold the eyepiece at proper focus.

The procedure for using the off-axis guider in long-exposure deep-space photography is as follows:

1. With the off-axis guider, camera body, and illuminated reticle eyepiece attached as described above, center the object you wish to photograph in the telescopic field.

2. Focus the object in the camera by turning the main focus knob of the telescope. Also focus the illuminated reticle eyepiece.

3. Loosen slightly the knurled attachment ring of the guider body, so that the off-axis guider will rotate about the telescope's optical axis. While rotating

in this manner, observe through the illuminated reticle eyepiece until a suitable guide star is located. Center the crossline pattern of the eyepiece on the guide star and tighten down the knurled attachment ring.

4. During the period of the time exposure, the astrophotographer must observe the position of the guide star at all times. If the guide star begins to move off-center, use the R.A. drive corrector and manual declination knob, or the dual-axis drive corrector, to adjust the telescope's position.

Many beautiful and dramatic astrophotographs have been taken using the above equipment and technique. The method is limited, however, by the fact that a suitable guide star is not always conveniently located; in these cases the off-axis guider should not be used. But for most deep-space objects the off-axis guider provides a relatively inexpensive means of precisely guiding during long exposure photographs, and it reduces virtually to zero any errors induced by differential flexture between the guiding device and the main telescope.

TELECOMPRESSOR

The Meade Telecompressor is a positive, focal-reducing lens, threaded for use with either the T-Adapter or the off-axis guider. (See Fig. 22.)

With the T-Adapter, attach the telecompressor as follows:

Telescope + T-Adapter + Telecompressor +
T-Mount + Camera Body

For use with the off-axis guider, attach as follows:

Telescope + Off-Axis Guider Body + Telecompressor +
T-Mount + Camera Body

With the telecompressor used in conjunction with the T-Adapter or off-axis guider, the effective telescopic focal ratio is reduced from f/10 to f/5. This focal reduction results in a fourfold reduction of exposure time: a 5-minute exposure taken at f/5 yields the same level of image detail as a 20-minute exposure at f/10, assuming that the same film is used in each case. With the telecompressor the actual field at the camera film plane is reduced in size to about a 1-inch diameter circle.

When using the telecompressor with the off-axis guider, an extender tube is required for proper focusing of the illuminated reticle eyepiece. This extender tube slides into the eyepiece sleeve of the off-axis guider and accepts the illuminated reticle eyepiece.

TUBE BALANCE SYSTEM

Tube Balance Weight Systems(#1401 for Model 2080, #1402 for Model 2120) are available for attachment to the Meade Models 2080 and 2120 telescopes. With a balance weight system, heavier accessories attached to the main telescope, whether at the eyepiece end or piggybacked, may be balanced for proper tracking. See Fig. 23.

To install the balance weight system, first remove the center screws located on the bottom surfaces of the corrector cell and rear cell of the telescope. Remove the 3 weights from the bar assembly of the balance weight system, by unthreading the thumbscrews at each end of the bar assembly and sliding off the weights. Then attach the bar to the underside of the telescope using the socket screws provided.

The 3 weights supplied with each tube balance weight system are of different sizes, permitting a considerable variation in the total weight available for balancing. Only the minimum weight(s) required for balancing of the accessory in question should be used. Slide the weights onto the bar assembly and tighten down each weight firmly with the thumbscrews provided.

When all of the weights required for a particular application are on the bar assembly, be sure to replace the 2 safety thumbscrews at each end of the bar assembly.

For storage, simply remove the balance weights from the bar assembly; the bar assembly itself may remain permanently attached to the telescope, whether or not the weights are in use.

CLEANING THE OPTICS

Perhaps the most common telescope maintenance error is cleaning the optics too often. A little dust on the surface of the correcting plate causes negligible degradation of optical performance: don't clean the outside surface of this lens unless really necessary. To remove small particles on the corrector lens surface, use a camel's hair brush (gently!) or blow off with an ear syringe (available from a local pharmacy). If further cleaning is required, a photographic lens cleaner may be used. In any case DO NOT clean the correcting plate by taking strong

Fig. 23: The #1401/#1402 Tube Balance Weight System.
(1) Attachment screws.
(2) Safety Thumbscrew.
(3) Bar Assembly.
(4) Weight-Lock Thumbscrew
(5) Weight

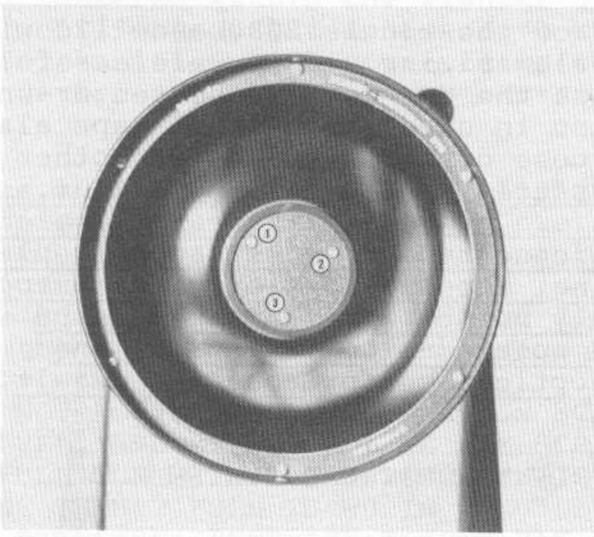


Fig. 24: Collimation of the Optical System.
(1), (2), (3) Set screws for adjusting collimation.

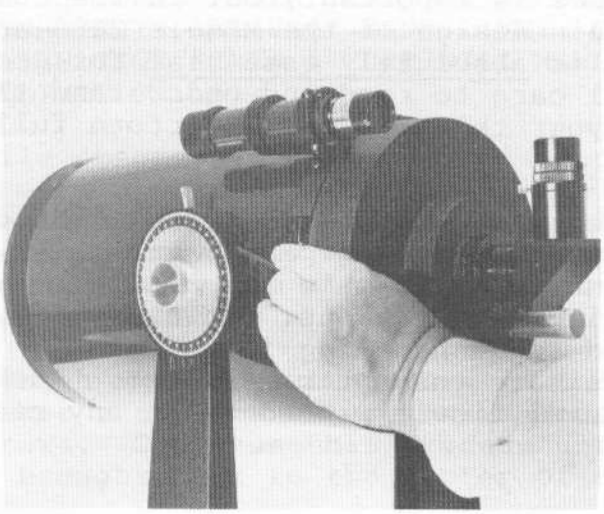


Fig. 25: Adjusting the Declination Lock.

circular wipes with a piece of cloth or other material: use a <u>white</u> "Kleenex"-type tissue and make short, gentle, radial wipes (from the center outward). Change tissues several times when cleaning the entire plate.

If grease or other organic materials (e.g. fingerprints) are in evidence on the outer surface of the corrector lens, the following homemade cleansing solution works well: 2 parts distilled water, 1 part isopropyl alcohol, and 1 drop of biodegradable liquid dishwashing detergent per pint of solution. Use only a small amount of solution, and take gentle, radial wipes, changing tissues several times, to clean the corrector lens.

The above solution may also be used to clean correctors with the special High Transmission Coating (Magnesium Fluoride). <u>If your optics are so coated, take special care in cleaning to avoid scratches</u>.

The aluminized surfaces of the Models 2080 and 2120 will probably never need re-aluminizing, if you are careful to replace the dust caps at the eye-end and corrector-end, when the telescope is not in use. These dust caps also serve the important purpose of keeping dust and other contaminants off the surfaces of the corrector lens.

WARNING: <u>Do not in any case remove the correcting plate from its machined housing, for cleaning or other purposes. You will almost certainly not be able to replace the corrector in its proper rotational orientation, and serious degradation of optical performance may result</u>.

ALIGNMENT (COLLIMATION) OF THE OPTICAL SYSTEM

The optical collimation of any astronomical telescope used for serious purposes is important, but in the cases of the Schmidt-Cassegrain design of the Models 2080 and 2120, such collimation is <u>absolutely essential</u> for good performance. Take special care to read and understand this section well, so that your telescope will perform fully to its capabilities.

All Meade Schmidt-Cassegrains are precisely collimated at the factory before packing and shipment, and it is probable that you will not need to make any optical adjustments before making observations. However, if the telescope sustained rough handling in shipment, you may need to re-collimate the optical system. Such re-collimation is not a difficult procedure in any case.

To check the collimation of your telescope, locate in the telescope a moderately bright (first or second magnitude) star near the zenith; alternately, a terrestrial "hot spot," such as reflected sunlight from a distant car bumper or telephone pole insulator, will suffice. This test is simplified if the telescope is in thermal equilibrium. If the telescope has been moved through temperature extremes (e.g. taken from a warm house into cold outside air), allow 30 to 45 minutes for the telescope to "cool down."

To perform the test, center the point source (e.g. star image) in the telescopic field with a low power eyepiece, such as the 25mm eyepiece normally supplied as standard equipment. Defocus the image to fill about 1/4 of the field of view. You will see in the out-of-focus image a circle of light, with the darker circular shadow of the secondary mirror somewhere within. If the darker shadow is well-centered within the lighter circle, your telescope is well collimated, but continue to read this section for the more sensitive high-power tests to be described below. If the darker shadow is <u>not</u> so centered, follow this procedure:

1. <u>Note that the only optical alignment adjustment of the Models 2080 and 2120 that is ever necessary, or possible, is the tilt-angle adjustment of the secondary mirror</u>. Adjustment of this tilt-angle is achieved by turning the 3 set screws shown in Fig. 24, located at the edge of the outer surface of the secondary mirror housing.

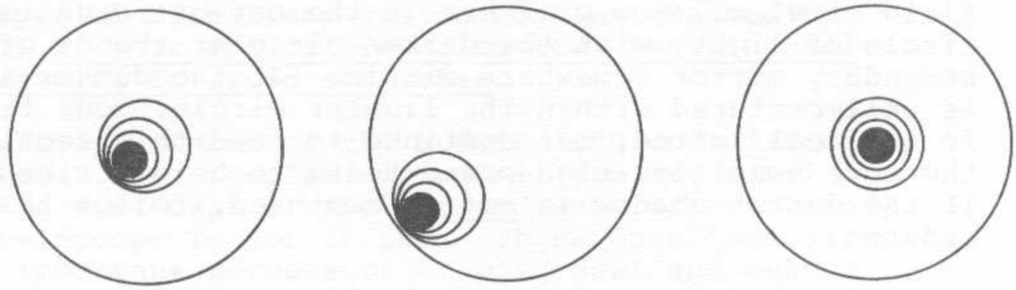
   DO NOT FORCE THE 3 COLLIMATION SCREWS PAST THEIR NORMAL TRAVEL, AND DO NOT ROTATE ANY SCREW OR SCREWS MORE THAN 2 FULL TURNS IN A COUNTERCLOCKWISE DIRECTION (i.e. NO MORE THAN 2 FULL TURNS IN THE "LOOSENING" DIRECTION), OR ELSE THE SECONDARY MIRROR MAY BECOME LOOSENED FROM ITS SUPPORT. NOTE THAT THE SECONDARY MIRROR COLLIMATION ADJUSTMENTS ARE VERY SENSITIVE: GENERALLY, TURNING A COLLIMATION SCREW ½-TURN WILL HAVE DRAMATIC EFFECTS ON COLLIMATION.

2. While observing the defocused star image, note the <u>direction</u> in which the darker shadow is offset within the lighter circle. Using the telescope's slow-motion controls, move the defocused image to the edge of the field of view, in the same direction as the darker shadow is offset.

3. Tighten the screw or screws in the same direction as the darker shadow is off-center, loosen the other screw or screws. Continue this process until the defocused image is brought back to the center of the telescopic field.

4. Now proceed to a higher power (e.g. 9mm) eyepiece and repeat the above test. Any lack of concentricity at this point will require only extremely slight adjustments of the 3 set screws.

5. As a final check on collimation, examine the star image <u>in-focus</u> with a fairly high-power (9mm or shorter focal length) eyepiece, under good seeing conditions. The star point should appear as a small central dot (the so-called "Airy disc")with one diffraction ring surrounding it. Make very small adjustments of the 3 set screws, if necessary, to center the Airy disc in the diffraction ring. With this final adjustment performed, your telescope is collimated.



(a) (b) (c)

<u>Summary of the Collimation Procedure</u>: (a) Note if the darker shadow is de-centered, as shown, inside the lighter circles; (b) use the telescope's controls to move the image to the edge of the field, in the same direction as the darker shadow is off-center; (c) tighten and/or loosen, as appropriate, the secondary housing's 3 collimation set screws to bring the image back to the center of the field; repeat (a) and (b), if necessary.

DEWING OF THE CORRECTING PLATE

Because of the correcting plate's proximity to the open air, it is possible in moist climates that dew may form on the outer surface of the glass during observations. One simple remedy for this dewing is to use a portable hair blow-drier; just a few "light" swipes of the warm air will clear the dew for a period of time.

If the above approach is not satisfactory the correcting plate's outer surface may be hand cleaned. BUT BE CAREFUL! The correcting plate should be completely free of dirt and abrasive particles before wiping the glass.

Use only a clean, white Kleenex tissue, and wipe radially outward from the center of the lens to the edge. Change Kleenexes often. Avoid using circular motions when wiping, and apply only the minimum pressure required to do the job. Hard wiping of the correcting plate will introduce fine scratches into the glass.

If dewing is a continual problem, a Dew Shield (see previous description in this manual) may be required. The Dew Shield effectively recesses the correcting plate from night air, and significantly inhibits dew formation.

If you find that dew has formed on the correcting plate after bringing telescope indoors from an observing session, allow the warm indoor air to dissipate the dew, before placing the telescope back in its carrying case. Do not wipe off the dew in this instance, as it will evaporate naturally.

ADJUSTING THE RIGHT-ASCENSION LOCK

After a period of time it is possible that the R.A. lock (see (5), Fig. 1) of the telescope will not tighten sufficiently, due to internal wear of the clutch mechanism. In such an event, remove the R.A. lock lever, using one of the Allen hex wrenches supplied with the telescope. Then, with a pair of pliers, tighten the shaft protruding outward from the motor drive base, until you cannot easily rotate the fork mount in R.A. (Take care in this operation not to damge the cosmetic finish of your telescope.) Replace the R.A. lock lever, so that its handle points straight out from the cross-bar connecting the fork arms.

ADJUSTING THE DECLINATION LOCK

Continual use of the Declination lock (see (2), Fig. 1) may cause this lock to loosen. To re-tighten the lock, first turn the manual Declination slow motion knob (4), Fig. 1, so that the Declination tangent arm (located inside the left-hand fork arm) is about in the middle of its travel. Put the Declination lock lever in the "unlocked" position, and insert the appropriate Allen hex wrench into the notched-out section of the left-hand fork arm. Tighten the hex-head nut located just inside the notch. See Fig. 25. <u>Caution</u>: a little tightening of this nut goes a long way; generally only one turn of the nut is required to fully re-tighten the Declination lock.

A NOTE ON THE "FLASHLIGHT" TEST

Approximately 94% of the light impinging on the primary mirror of the Model 2080 or 2120 is reflected by the mirror; about 6% of the light is scattered. Similarly, the correcting plate of either model transmits about 95% of the light impinging at each surface; about 5% of the light impinging each surface is scattered.

If a flashlight or other high-intensity light source is pointed down the main telescope tube under dark conditions, the total amount of scattered light will be very considerable. As a result the optics of the telescope will appear to be of very poor surface quality. This same statement may be made of any high-quality optical surfaces, when given this grossly misleading "test."

FACTORY SERVICING AND REPAIRS

Meade Models 2080 and 2120 have been designed and manufactured for years of trouble-free operation, and repairs should rarely be necessary. If a problem does occur, first write or call our Service Department. Do not return the telescope for servicing until you have communicated with us in this way, since the great majority of problems can be handled without return of the telescope to us. When telephoning or writing, please explain in detail the exact nature of the problem, so that we may offer a prompt remedial procedure. Be sure to include your full name, address and phone number.

BASIC SPECIFICATIONS:
MODEL 2080 8" SCHMIDT-CASSEGRAIN TELESCOPE

Optical Design	Schmidt-Cassegrain Catadioptric
Clear Aperture	203mm (8")
Primary Mirror Diameter	210mm (8.25")
Focal Length	2000mm (80")
Focal Ratio (photographic speed)	f/10
Near Focus (approx.)	25 ft.
Resolution	0.56 arc secs. 210 lines per mm
Limiting Visual Magnitude (approx.)	14
Limiting Photographic Magnitude (approx.)	16.5
Image Scale	0.72^{o}/in.
Maximum Practical Visual Power	500x

35mm Film Coverage at Distances of:	
50 ft.	6.2" x 8.7"
500 ft.	6.0' x 8.5'
3000 ft.	36.0' x 51.0'
35mm Angular Film Coverage	0.69° x 0.98°
Telescope Mounting	Fork-Type, Double-Tine
Electric Motor Drive (Note 1)	115v./60Hz; 4 watts
Setting Circle Diameters	Dec.: 4"; R.A.: 8"
Motor Drive Gear Diameter	5-3/4" Worm Gear
Bearings	Dec.: 1-nylon bearing on each fork R.A.: 2-ball bearings
Manual Slow-Motion Controls	Dec. and R.A.
Standard Accessories	
Viewfinder	6 x 30mm
Eyepieces (multi-coated)	1¼" Barrel Dia.: 9mm (222X) 25mm (80X)
Eyepiece-Holder	1¼"
Diagonal Prism	1¼", Model 918A
Powers Obtained with Optional Eyepieces (Note 2)	4mm--500x (1000x) 6mm--333x (667x) 10.5mm--190x (380x) 15.5mm--129x (258x) 20mm--100x (200x) 32mm--62x (124x) 40mm--50x (100x)
Optical Tube Size	9.1" Dia. x 16" Long
Secondary Mirror Obstruction	2.985" Dia.: 14%
Materials & Construction	
Tube Body	All Aluminum
Mirrors	Pyrex Glass
Telescope Size, Swung Down	9¼" x 14" x 24½"
Carrying Case Dimensions	30" x 16" x 12"
Net Telescope Weight (approx.)	25 lbs.
Shipping Weight (approx.)	48 lbs.
Table Tripod (optional) Latitude Range	15° to 90°
Equatorial Wedge (optional) Latitude Range	11° to 64°
Field Tripod (optional) Height	30" min.; 44" max.

NOTES:

(1) Available also for other voltage/frequency requirements, as noted elsewhere in this manual.

(2) Numbers in parenthesis indicate Magnifying Powers when the specified eyepiece is used in conjunction with a 2X Barlow Lens. Note that, in any case, powers in excess of about 500x on the Model 2080 may be used to advantage only under the very best observing conditions.

BASIC SPECIFICATIONS: MODEL 2120 10" SCHMIDT-CASSEGRAIN TELESCOPE

Optical Design	Schmidt-Cassegrain Catadioptric
Clear Aperture	254mm (10"
Primary Mirror Diameter	263.5mm (10.375")
Focal Length	2500mm (100")
Focal Ratio (photographic speed)	f/10
Near focus (approx.)	50 ft. (15m.)
Resolution	0.45 arc secs.
Limiting Visual Magnitude (approx.)	14.5
Limiting Photographic Magnitude (approx.)	17.0
Image Scale	0.57°/in.
Maximum Practical Visual Power	625X
35mm Film Coverage at Distances of:	
50 ft.	5.0" x 7.0"
500 ft.	4.8' x 6.8'
3000 ft.	28.8' x 40.8'
35mm Angular Film Coverage	0.55° x 0.78°
Telescope Mounting	Fork-Type, Double-Tine
Electric Motor Drive (Note 1)	115v./60Hz; 4 watts
Setting Circle Diameters	Dec.: 4" R.A.: 8"
Motor Drive Gear Diameter	5-3/4" Worm Gear
Bearings	Dec.: 1-nylon bearing on each fork tine. R.A.: 2-ball bearings
Manual Slow-Motion Controls	Dec. and R.A.
Standard Accessories	
Viewfinder	8 x 50mm Straight-through
Eyepieces (multi-coated)	1¼" Barrel Dia.: 9mm (278x) 25mm (100x)
Eyepiece-Holder	1¼"
Diagonal Prism	1¼", Model 918A

Powers Obtained with Optional Eyepieces (Note 2)	4mm--625x (1250x) 6mm--417x (834x) 10.5mm--238x (476x) 15.5mm--161x (322x) 20mm--125x (250x) 32mm--78x (156x) 40mm--63x (126x)
Optical Tube Size	11-3/4" x 22"
Secondary Mirror Obstruction	3.70" Dia.; 13.7%
Materials & Construction	
Tube Body	All Aluminum
Mirrors	Pyrex Glass
Telescope Size, Swung Down	12" x 16" x 28"
Carrying Case Dimensions (approx.)	35" x 20" x 16"
Net Telescope Weight (approx.)	46 lbs. (21 kg.)
Shipping Weight (approx.)	77 lbs. (35 kg.)
Equatorial Wedge (optional) Latitude Range	11^{o} to 64^{o}
Field Tripod (optional) Height	30" min; 44" max.

NOTES:

(1) Available also for other voltage/frequency requirements, as noted elsewhere in this manual.
(2) Numbers in parenthesis indicate Magnifying Powers when the specified eyepiece is used in conjunction with a 2X Barlow Lens. Note that, in any case, powers in excess of about 600x on the Model 2120 may be used to advantage only under the very best observing conditions.

OPTICAL REFERENCE INFORMATION: MODEL 2080 8" SCHMIDT-CASSEGRAIN TELESCOPE

NOTE: For the Model 2120, angular and linear coverages are reduced by 20% from the values stated for the Model 2080, while magnifications and effective focal lengths are increased by 25% from the values stated.

FILM COVERAGE WITH T-ADAPTER (40X)

Angular Coverage (35mm film format): 0.69^{o} x 0.98^{o}

Linear Coverage for Selected Distances:

Distance	Coverage
50 ft.	6.2" x 8.7"
500 ft.	6.0' x 8.5'
3000 ft.	36.0' x 51.0'

TELE-EXTENDER f/RATIOS AND ANGULAR COVERAGE

Eyepiece	Projected Power	Focal Length	f/Ratio	Angular Coverage
MA 40mm	115X	5,750mm	28	.23° x .34°
MA 25mm	206X	10,300mm	51	.13° x .19°
OR 18mm	284X	14,200mm	70	.095° x .14°
OR 12.5mm	430X	21,500mm	106	.063° x .092°
MA 9mm	618X	30,900mm	152	.044° x .064°
OR 6mm	956X	47,800mm	235	.028° x .041°
OR 4mm	1454X	72,700mm	358	.019° x .027°

TELE-EXTENDER LINEAR FILM COVERAGE AT SELECTED DISTANCES

Eyepiece	50'	500'	3000'
MA 40mm	2.2" x 3.2"	25" x 36"	12' x 18'
MA 25mm	1.2" x 1.8"	14" x 20"	7' x 10'
OR 18mm	0.9" x 1.3"	10" x 15"	5' x 7'
OR 12.5mm	0.6" x 0.9"	7" x 10"	3' x 5'
MA 9mm	0.4" x 0.6"	5" x 7"	2' x 3'
OR 6mm	0.3" x 0.4"	3" x 4"	1.5' x 2.2'
OR 4mm	0.2" x 0.3"	2" x 3"	1.0' x 1.4'

TELE-EXTENDER USED WITHOUT EYEPIECE

Linear Film Coverage for Selected Distances

Distance	Coverage
50'	5.8" x 8.5"
500'	4.9' x 7.2'
3000'	31' x 45'

VISUAL POWERS AND FIELDS OF VIEW

Eyepiece	Power	Angular Field
MA 40mm	50X	0.71°
MA 25mm	80X	0.49°
OR 18mm	111X	0.40°
OR 12.5mm	160X	0.28°
MA 9mm	222X	0.18°
OR 6mm	333X	0.13°
OR 4mm	500X	0.09°

A P P E N D I X

SUPPLEMENTAL INSTUCTIONS FOR THE OPERATION
OF MODEL 2080/LX3 AND MODEL 2120/LX3
TELESCOPES

TABLE OF CONTENTS

A. INTRODUCTION

Congratulations! You now own the most advanced Schmidt-Cassegrain telescope ever produced for the amateur astronomer. Your new LX3 blends state-of-the-art micro electronics with proven optical precision and superb mechanical accuracy to create a telescope of unequalled practicality and performance. This supplementary manual explains in detail the operation and application of those features unique to the LX3. Refer to the standard Model 2080/2120 Instruction Manual or the special LX3 audio tape for complete detailed information regarding set-up, operation, and specifications of your telescope.

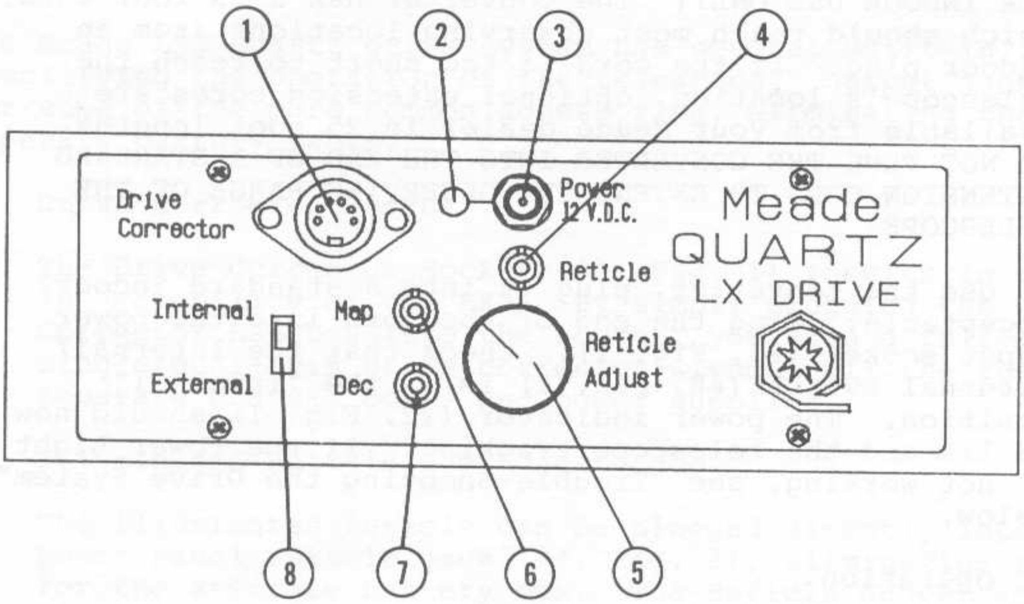


Fig. 1 LX3 Power Panel

(1) Drive Corrector Socket
(2) Power Indicator
(3) Power Input Socket
(4) Illuminated Reticle Adjust Knob
(5) Illuminated Reticle Adjust Knob
(6) Map Light Output
(7) Dec Motor Output
(8) Internal/External Switch

B. LX3 QUARTZ ELECTRONIC DRIVE

The 8" and 10" LX3 Schmidt-Cassegrain telescopes incorporate the superb Meade LX Drive System and the latest in state-of-the-art electronics to achieve a first in commercially produced telescopes: Quartz accuracy coupled with true sidereal rate tracking. The quartz crystal used in the Meade LX3 Quartz Drive provides accurate tracking to within ±.005% of the sidereal frequency, independent of temperature changes or local power line variations. This, coupled with the 10 arcsec or less precision in the mechanical gear train of the LX Drive, results in performance rivaling professional observatories.

1. AC Operation

The 8" and 10" LX3 telescopes are supplied with a 12 V.D.C. converter for AC operation. THIS CONVERTER IS FOR INDOOR USE ONLY! The converter has a 25 foot cord, which should reach most observing locations from an indoor plug. If the cord is too short to reach the telescope's location, optional extension cords are available from your Meade dealer in 25 foot lengths. DO NOT PLUG THE CONVERTER INTO THE END OF A STANDARD EXTENSION CORD TO EXTEND THE OBSERVING RANGE OF THE TELESCOPE.

To use the converter, plug it into a standard indoor receptacle. Plug the end of the cord into the power input socket (#3, Fig. 1). Check that the Internal/External switch (#8, Fig. 1) is on the "internal" position. The power indicator (#2, Fig. 1) should now be lit and the telescope tracking. If the Power Light is not working, see "Trouble-Shooting the Drive System" below.

2. DC Operation

The 8" and 10" LX3 telescopes operate on DC current and may be powered directly from a 12 volt battery or power cell. The LX3 drive system normally draws about .4 amp in standard operation. Maximum current usage is .6 amp when all optional accessories are being used. The Meade Power Cell is a 5 amp/hour power cell, and will operate from 8 to 12 hours depending on usage. If the telescope is being powered from a car battery, the current drain is negligible. The telescope may be used all night without fear of a "dead battery".

The LX3 Schmidt-Cassegrains are supplied with a DC power cable. Connect the cigarette plug to your cigarette lighter, and the other end of the cable into the power socket (#3, Fig. 1) on the power panel of the LX3. If the power indicator is not lit, see "Trouble-Shooting the Drive System" below.

3. Internal/External Switch

The internal/external switch (#8, Fig. 1) is used to move from the standard drive mode to the remote drive corrector mode.

When the telescope is on internal, all frequency control is done internally by the quartz crystal. The drive corrector handbox will not function even if plugged in.

To use the Drive Corrector Handbox, move the slide switch to the "external" position. Now, the frequency control is transferred to the drive corrector. Note: If the slide switch is on "external" and no Drive Corrector Handbox is connected, the drive unit receives no power, and will not work. For detailed drive corrector instructions, see "Single/Dual-Axis Drive Corrector" below.

C. OUTPUT JACKS

The Meade LX3 Quartz drive system has several built-in features for simplifying the operation of the telescope. Output jacks are provided for some of the more common accessories, eliminating the need for separate battery packs.

1. Drive Corrector Socket

The Drive Corrector Socket (#1, Fig. 1) results in the "plug-in" capability of the LX3. By simply plugging the Drive Corrector Handbox into the socket, you have a full-fledged single/dual-axis drive corrector without all the fuss of separate chassis boxes and power supplies.

2. Illuminated Reticle and Adjust Knob

The Illuminated Reticle can be plugged directly into the LX3 power panel reticle jack (#4, Fig. 1), eliminating the need for the separate battery box. The Reticle Adjust Knob (#5, Fig. 1) controls the brightness of the reticle.

3. Map Light

The Meade Map Light plugs into this socket (#6, Fig. 1). It provides a constant brightness red light on a 6 foot cord for reading a star atlas or taking observing notes.

4. Model #38 Declination Motor

The Declination Motor Jack (#7, Fig 1) is used in the dual-axis drive corrector mode. The Drive Corrector Handbox is required for use of the declination motor. The declination motor does not function if the Drive Corrector Handbox is not connected and the Internal/External Switch (#8, Fig. 1) is not set to "External".

D. 8 X 50 POLAR VIEWFINDER

In addition to being an excellent 8 x 50 viewfinder, the Meade Illuminated Reticle Polar Viewfinder is designed to be used as an optical guide for finding the celestial pole.

1. The Illuminated Reticle

To assure safe arrival, the Polar Viewfinder is shipped with the bulb/battery holder not mounted on the viewfinder. To attach, loosen the thumbscrew on the mounting flange located under the viewfinder, and insert the bulb/battery holder. Tighten the thumbscrew to lock into position.

To turn on the reticle, rotate the knurled switch on the bulb/battery to the "on" position. The brightness is adjustable by turning the nylon slotted screw located in the middle of the knurled switch. To prolong battery life, remember to turn off the reticle when not in use.

To replace the battery in the Polar Viewfinder, turn the knurled switch in the "off" direction until the switch comes off. After replacing the battery, thread the knurled switch back on.

2. Focusing the Viewfinder

The Meade Polar Viewfinder has been pre-focused at the factory. However, not everybody has perfect vision and slight adjustment is sometimes necessary to obtain maximum performance.

a. Rotate the eyepiece until the reticle is in sharp focus. Move the rubber eyecup to a comfortable position.

b. Loosen the black knurled locking ring (just behind the dew shield).

c. While looking at a star, rotate the dew shield until the star is in focus. (This refocuses the objective lens.) CAUTION! Take care when rotating counterclockwise. You are unthreading the dew shield and it may fall off if rotated too far! Refocusing the objective lens will only require a few turns of the dew shield at most.

d. When the dew shield is rotated to the sharpest focus for your eye, tighten the locking ring against the dew shield to fix the position.

3. Finding the Celestial Pole

To accurately position the telescope on the celestial pole, follow this procedure:

a. Align the Polar Viewfinder with the main optical tube (as described in the Model 2080/2120 Instruction Manual) by adjusting the black thumbscrews on the bracket until the object in the main optical tube is centered on the cross hairs of the Polar Viewfinder.

b. Rotate the optical tube in declination until the declination circle reads 90 degrees. (In this position, the optical tube will be pointing toward Polaris.)

c. Rotate the telescope in R.A. until one of the cross hairs is vertical to the horizon (this is not necessarily vertical to your eye). You can use either cross hair; select the one that provides the easiest viewing position.

d. Hold the Polaris Reference Circle next to the telescope with the arrow pointing up.

e. Rotate the inner (local time) circle until your current local time corresponds to the current date on the outer (date) circle.

f. The position of Polaris will be indicated by the slant of the inner (local time) circle that extends out to the outer (date) circle.

g. The date circle represents the reticle in the Polar Viewfinder. Move the telescope in azimuth (rotate the wedge) and latitude (move the tilt plate of the wedge) until Polaris is in the same position on the reticle as shown on the Polaris Reference Circle.

You now have an accurate polar alignment which will permit precise use of setting circles, clock drive, and piggyback/eyepiece projection photography.

E. MAGNETIC COMPASS

The magnetic compass helps the observer to set-up the telescope without actually seeing the pole star Polaris. This allows setting up before dark or in locations where the view of Polaris is obstructed. The magnetic compass has an adjustment to compensate for the local angle of Magnetic Declination. Note: Magnetic Declination is the difference between Magnetic North (which the compass shows) and true north (where the telescope should be pointed). Magnetic Declination should not be confused with the astronomical term "Declination", which when used with "Right Ascension" describes the celestial coordinate system.

In order to obtain an accurate reading using the compass, you must first adjust for the Magnetic Declination for your location.

1. First, determine the Magnetic Declination your area using the Isogonic Chart (Fig. 2).

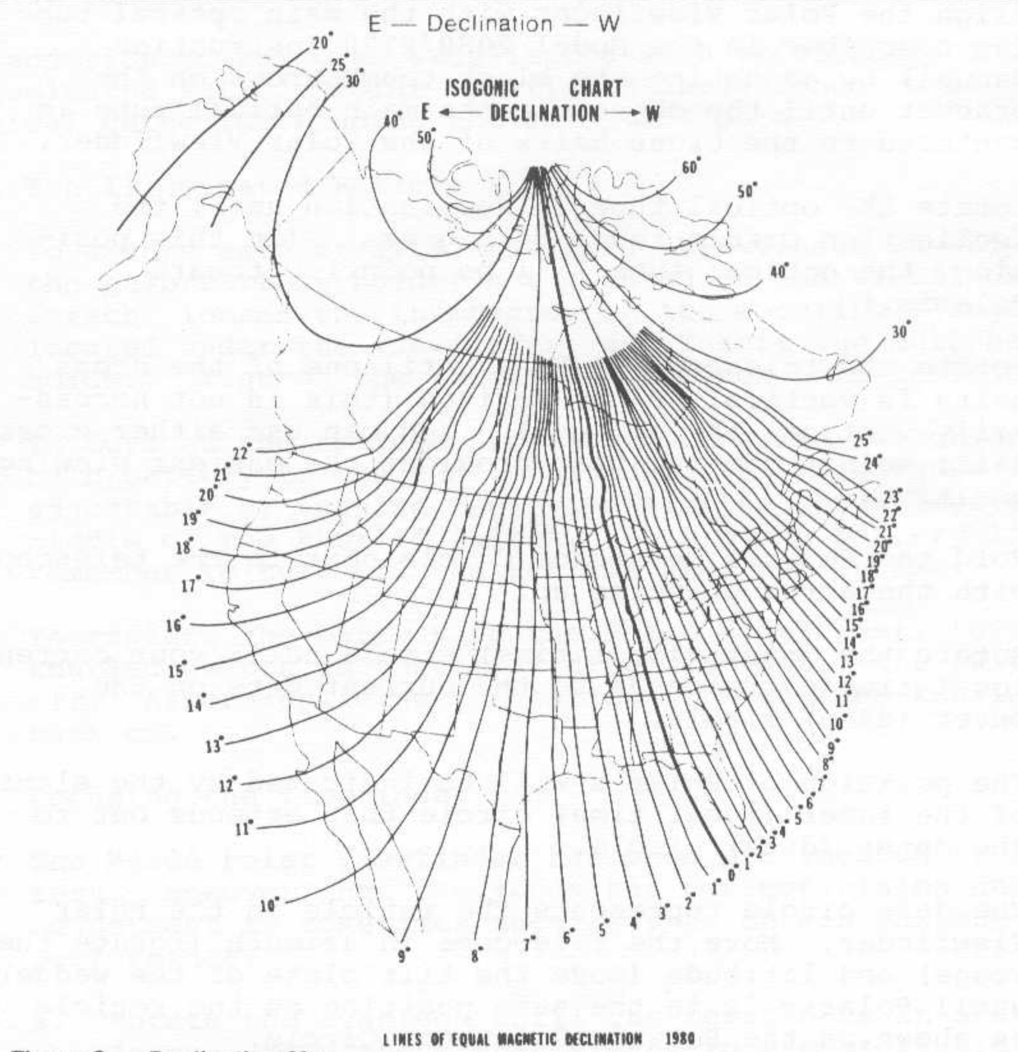


Figure 2 — Declination Map

2. Squeeze the clear central vial with thumb and index finder of the left hand.

3. With the right hand, rotate the outer dial until the orienting arrow (the black arrow painted on inside clear surface) is lined up with the desired Magnetic Declination angle on the declination scale. Notice that East Magnetic Declination is to the right of the "North" position and West Magnetic Declination is left of the "North" position. As an example, Fig. 3 shows the correct setting for 10 degrees west declination, which covers Buffalo, NY, or Philadelphia, PA.

The Magnetic Compass is now set for the correct declination angle. To attach to the Equatorial Wedge, follow these steps:

1. Replace the 10" long threaded rod attached to the center of the field tripod with the new rod supplied. This new rod is made of non-ferrous steel and will not affect the compass readings. (See the Model 2080/2120 Instruction Manual, Altazimuth Adapter, for detailed instructions on replacing

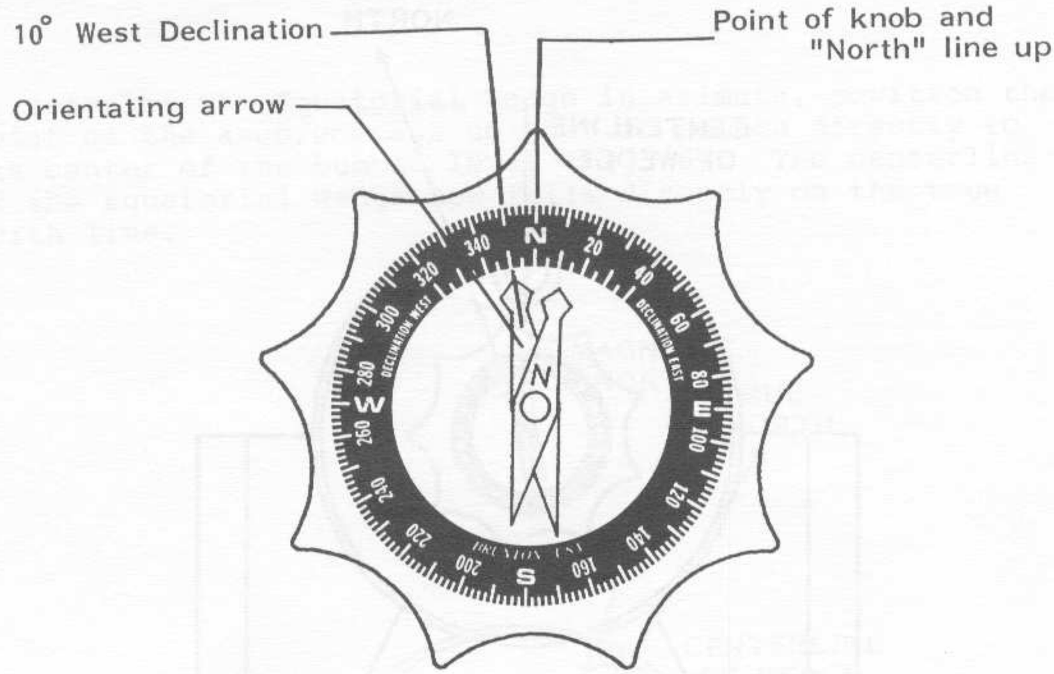


Fig. 3

this rod.) Thread the new rod so that no more than 1-3/8" of its length extends above the center base of the field tripod, and lock into position with the hex nut on the underside of the center base as described in the Instruction Manual.

2. Snap the Magnetic Compass into the 3" diameter wedge attachment knob (after setting the Magnetic Declination as described above). Position the compass into the knob so that the 360 degree location on the direction scale (the "North" position) lines up with one of the nine points of the knob. (See Fig. 3.) Press the compass firmly into the knob.

3. Assemble the Equatorial Wedge onto the Field Tripod as described in the Instruction Manual using the knob/compass combination to attach the wedge to the tripod.

The Magnetic Compass is now ready to use. Just follow these simple steps for a quick and easy azimuth alignment:

1. Loosen the knob/compass slightly. This allows for rotation of the Equatorial Wedge under the knob/compass (Fig. 4). The magnetic pointing arrow will point to magnetic north.

2. Rotate the knob/compass so that the magnetic pointing arrow lies directly over the painted black alignment arrow (Fig. 5). The "North" position on the direction scale (and the point on the knob/compass) now point directly north.

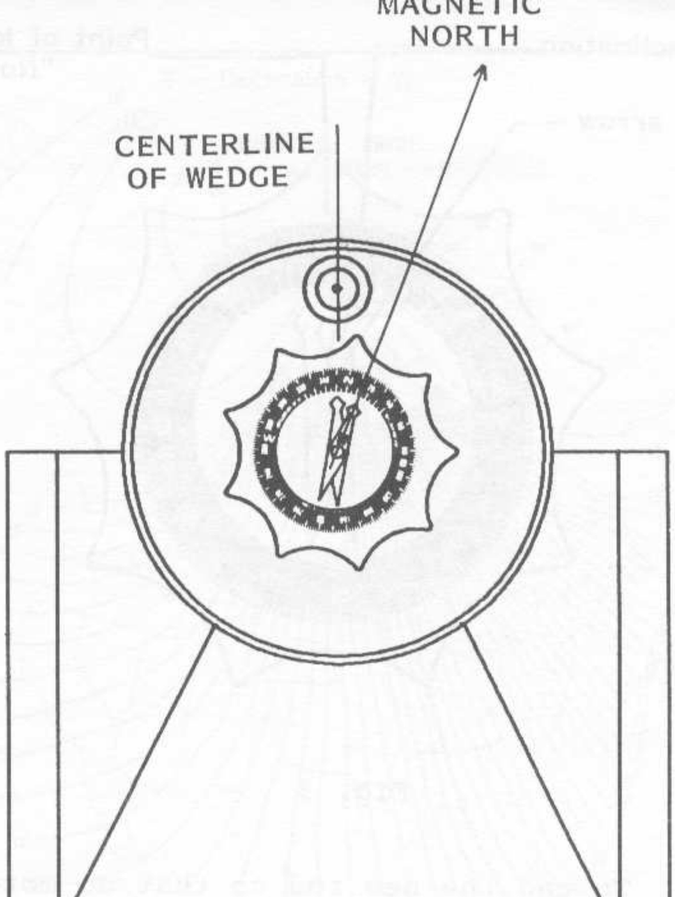

MAGNETIC
NORTH
CENTERLINE
OF WEDGE

Fig. 4

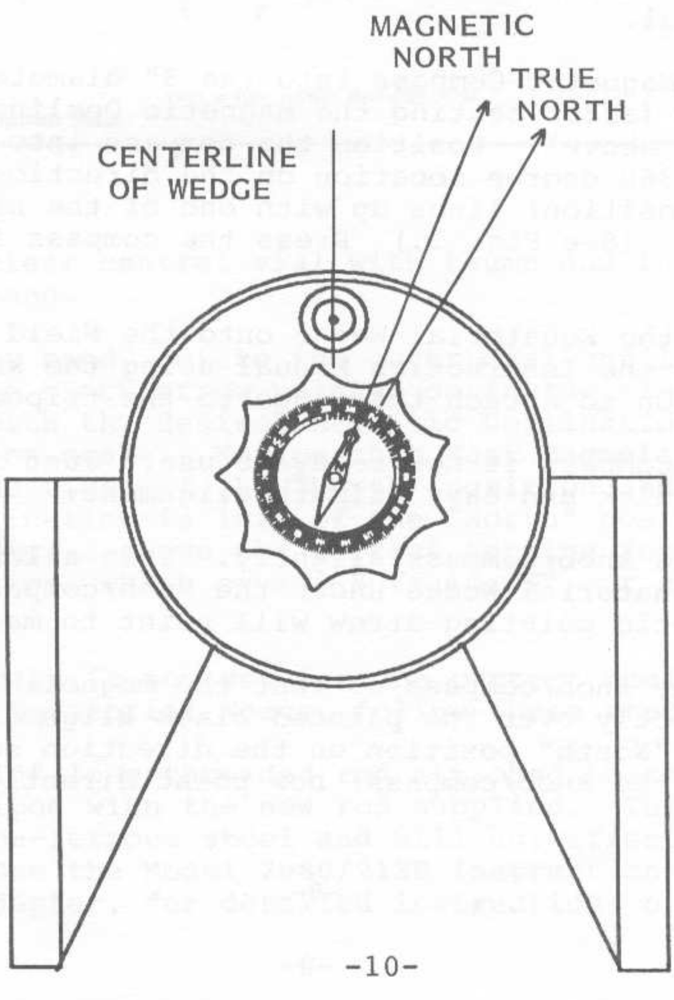

MAGNETIC
NORTH
TRUE
NORTH
CENTERLINE
OF WEDGE

Fig. 5

3. By rotating the Equatorial Wedge in azimuth, position the point of the knob/compass so that it points directly to the center of the bubble level (Fig. 6). The centerline of the Equatorial Wedge now falls directly on the true north line.

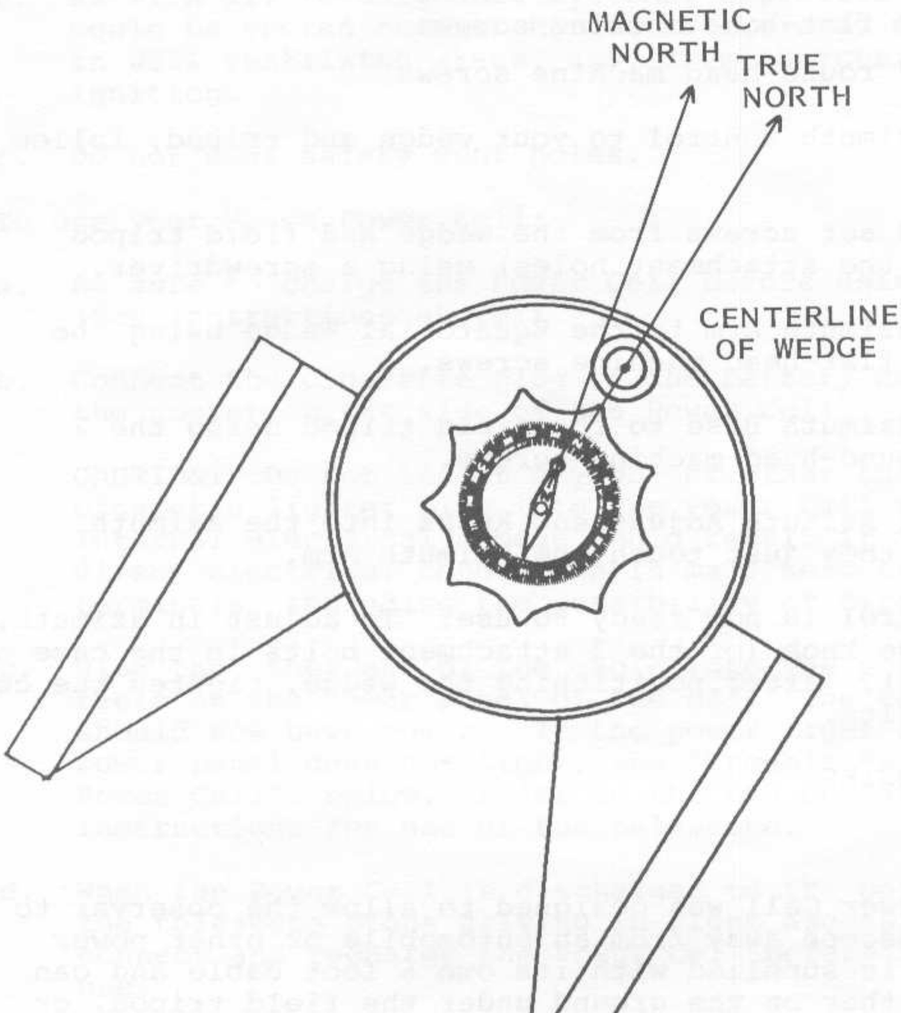


Fig. 6

4. Tighten the knob/compass, locking the Equatorial Wedge into place.

The Field Tripod and Equatorial Wedge are now pointed directly toward Celestial North, without ever having seen the North Star!

F. AZIMUTH CONTROL

The Azimuth Control for the Meade Equatorial Wedge and Field Tripod is shipped in a plastic bag and includes the following parts:

- ° Azimuth Base (large U-shaped piece of aluminum)
- ° Azimuth Arm (small T-shaped piece of aluminum)
- ° 2 Azimuth Knobs
- ° 2 - 8-32 x ½" flat-head machine screws
- ° 2 - 8-32 x 1" round-head machine screws

To attach the Azimuth Control to your wedge and tripod, follow these simple steps:

1. Remove the 4 set screws from the wedge and field tripod (which plug the attachment holes) using a screwdriver.
2. Attach the Azimuth Arm to the Equatorial Wedge using the 2 8-32 x ½" flat-head machine screws.
3. Attach the Azimuth Base to the field tripod using the 2 8-32 x 1" round-head machine screws.
4. Thread the 2 Azimuth Adjustment Knobs into the Azimuth Base, until they just touch the Azimuth Arm.

The Azimuth Control is now ready to use. To adjust in azimuth, loosen the central wedge knob (or the 3 attachment bolts in the case of the Meade Model 2120). After positioning the wedge, tighten the central wedge knob or bolts.

G. OPTIONAL ACCESSORIES

1. Power Cell

The Meade Power Cell was designed to allow the observer to use the telescope away from an automobile or other power source. It is supplied with its own 6 foot cable and can be placed either on the ground under the field tripod, or on the field tripod accessory shelf.

To charge the Meade Power Cell, a constant voltage float charger is provided. This type of charger will not overcharge the battery and may be left plugged in continuously. This will insure a "fully charged" power cell and will also extend the life of the power cell.

To charge the Meade Power Cell:

a. Disconnect the cable from the Power Cell.

b. Insert the charger cigarette plug into the receptacle on the side of the carrying case.

c. Plug the charger AC power cord into the appropriate 120v AC, 60-cycle outlet, or 240v AC, 50-cycle outlet.

d. Charge the Power Cell for approximately 24-36 hours after each complete discharge, to fully recharge the Power Cell. The charger may be left on indefinitely.

e. As with all rechargeable systems, explosive gasses could be vented on overcharge. Therefore, use only in well ventilated areas, away from sources of ignition.

f. Do not seal safety vent holes.

To use your Meade Power Cell:

a. Be sure to charge the Power Cell before using. (See instructions above.)

b. Connect the cigarette plug of the battery cable into the socket on the side of the Power Cell.

   CAUTION: Do not insert any object other than a cigarette lighter plug into the Power Cell socket. Internal electrical damage could result if a direct electrical connection is made between the terminals, including the possibility of fire.

c. Plug the other end of the cable into the power receptacle on the power panel of the LX3. The telescope should now have power. If the power light on the LX3 power panel does not light, see "Trouble Shooting the Power Cell", below. Refer to the LX3 operating instructions for use of the telescope.

d. When the Power Cell is discharged to the point where the telescope stops driving in right ascension, disconnect and recharge the Power Cell before further use.

e. Recharge the Power Cell after each use, as per charging instructions, for maximum life.

f. Like all batteries, these units contain corrosive and toxic materials. Do not puncture, disassemble, mutilate, or incinerate.

Trouble Shooting the Power Cell.

If, after following the above steps, the telescope power light does not go on, check the following:

a. Check the "External/Internal" switch on the LX3 power panel for the correct setting. (See Page 4 of this Instruction Manual for proper setting.)

b. Check all electrical connections.

c. Try using the telescope with a different power source (an automobile battery or the AC Converter), to verify that the Power Cell is the source of the problem. If the telescope does not operate using a separate power supply, then refer to "Trouble Shooting the LX3 Quartz Drive", Page 17 of this Instruction Manual.

d. If you have determined that the Power Cell is not working, be sure that the Power Cell is fully charged.

e. Inspect the fuse in the Power Cell wire harness. Open the cardboard separator inside the case and twist open the fuse holder to inspect the fuse. If bad, replace with a 20 amp fuse.

Power Cell Storage.

If you intend to store the Power Cell for extended periods of time, a few simple reminders can prolong the life of the Power Cell. First, always store the Power Cell in a fully charged condition. The charger can be left charging indefinitely. Always store in a cool place, and recharge the Power Cell every three to six months.

2. Single/Dual-Axis Drive Corrector

The Meade "plug-in" drive corrector for the LX3 Schmidt-Cassegrain telescope is designed to be used either as a single-axis only (Right Ascension) drive corrector or dual-axis (Right Ascension and Declination). The dual-axis mode requires only the addition of the Model 38 Declination Motor; the "N" and "S" buttons on the handbox will not function unless the Model 38 Declination Motor is attached.

Operation

a. Crystal Mode

When the slide switch (#2, Fig. 7) is on the "Crystal" position, the Quartz crystal in the LX3 Drive is controlling the telescope's tracking speed. The "E" and "W" buttons override the Quartz crystal to speed up or slow down the tracking speed as long as the button is pressed. When the button is released, the Quartz crystal resumes control. Note: In the "Crystal" mode, the variable speed knob (#3, Fig. 7) is non-functional. This mode of operation is best suited for photographing deep-space objects that move at the sidereal rate.

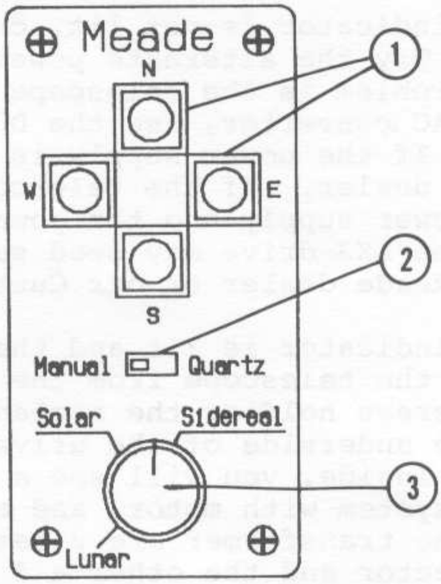


Fig. 7: Model 36 Drive Corrector

(1) Control Buttons
(2) Quartz/Manual Slide Switch
(3) Variable Speed Knob

b. Manual Mode

Moving the slide switch to the "Manual" position transfers the tracking speed control from the Quartz crystal to the variable speed knob. This knob will vary the drive frequency from 57Hz to 62Hz, which covers the Lunar, Solar, and Planetary rates. The Lunar and Solar rate positions are marked for reference. As in the "Crystal" mode, the "E" and "W" buttons override the variable knob to speed up and slow down the drive rate.

c. Dual-Axis

To use the Meade drive corrector in the dual-axis mode, simply plug in the optional Model 38 Declination Motor. The "N" and "S" buttons are automatically activated.

For more information on guiding and photography, see "Photographic Accessories for the Model 2080" in the Model 2080/2120 Instruction Manual.

H. TROUBLE-SHOOTING THE LX3 QUARTZ DRIVE

The LX3 Quartz Drive is thoroughly tested at the factory, and should not require any servicing. However, should the LX3 drive fail to operate, please follow these simple instructions:

1. Check to make sure that the Internal/External switch is properly set. If the drive corrector handbox is not attached, the slide switch must be set to "Internal".

2. If the power indicator is not lit, check all electrical connections. Try the alternate power supply to determine if the problem is the telescope or the power source. If using the AC converter, use the DC power cable and car battery. If the power supply is the problem, return to your Meade dealer. If the telescope does not operate with either power supply and the power indicator does not light, then the LX3 drive may need servicing. Please contact your Meade dealer or our Customer Service Department.

3. If the power indicator is lit and the telescope fails to track, unplug the telescope from the power source. Remove the 4 small screws holding the rectangular cover plate located on the underside of the drive base, and remove the cover plate. Inside, you will see a power transformer, the LX worm gear system with motor, and a small circuit board. Attached to the transformer are 2 sets of wires; 1 set has a 2 wire connector and the other a 3 wire connector. Check to make sure both sets of wires are connected. If not, replace the connectors on the transformer pins. The 2 wire connector can go on either way, and the 3 wire connector can only go on one way. Replace the cover plate. If the drive still does not function, see your Meade dealer.

Meade

Meade Instruments Corporation

1675 Toronto Way, Costa Mesa, California 92626 U.S.A. □ (714) 556-2291 □ Cable Address: "MEADOPTIC" Costa Mesa

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