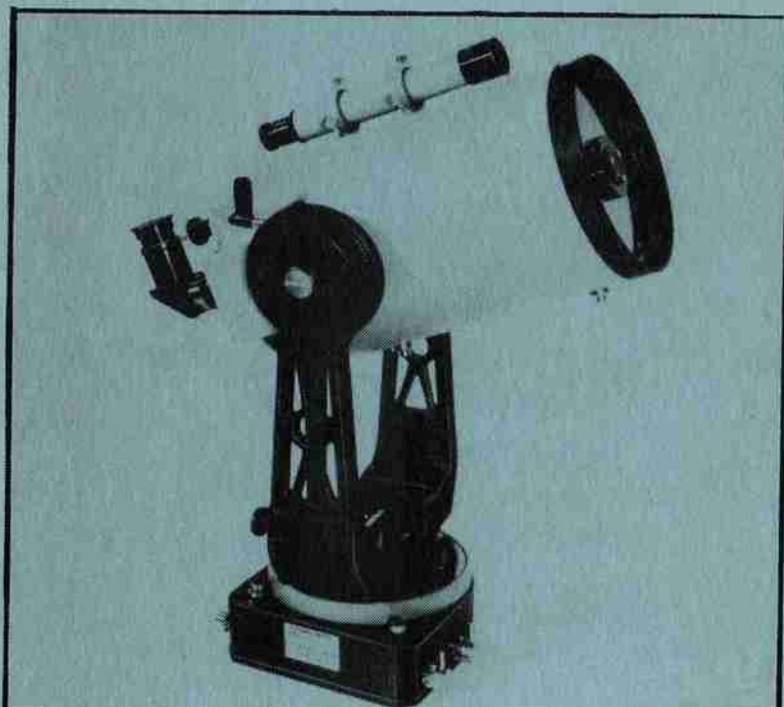
$3.00

Instruction Manual For Dynamax® 8 and Dynamax® 6



Criterion Manufacturing Company
620 Oakwood Avenue
West Hartford, Ct. 06110

Instruction Manual
For Dynamax® 8 and
Dynamax® 6

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620 Oakwood Avenue
West Hartford, Ct. 06110

Note: Please read Chapters 1, 2 and 3 before using your new Dynamax.

CAUTION:

NEVER ATTEMPT TO LOOK AT THE SUN THROUGH YOUR DYNAMAX OR FINDER SCOPE WITHOUT PROPER SOLAR OBSERVING EQUIPMENT! INSTANT AND PERMANENT EYE DAMAGE WILL RESULT.

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Index To Accessories

* *Note:* Criterion carries a complete line of accessories to complement your instrument's capabilities — many of which are not mentioned in this manual. For a complete list and description of the many accessories we offer, please refer to our catalog and price list. Accessories not listed in this manual are provided with complete separate instructions for use. *All* accessories are completely interchangeable and may be used with either the Dynamax 6 or 8 without modification.

Congratulations . . .

On becoming the owner of a new Dynamax telescope. You have wisely purchased the finest instrument money can buy and although you will be anxious to start using it at once, we must ask you to first read this instruction manual thoroughly (especially Chapters 1, 2 and 3) in order to avoid possible damage and/or poor performance which may result from misuse. Your Dynamax has been precision manufactured to Criterion's uncompromising standards and has flawlessly passed rigid performance tests far more difficult than it would ever be subjected to in normal use. We know you will want to preserve this high level of superb performance by learning how to use your new instrument properly and by observing the few simple precautions outlined in this manual.

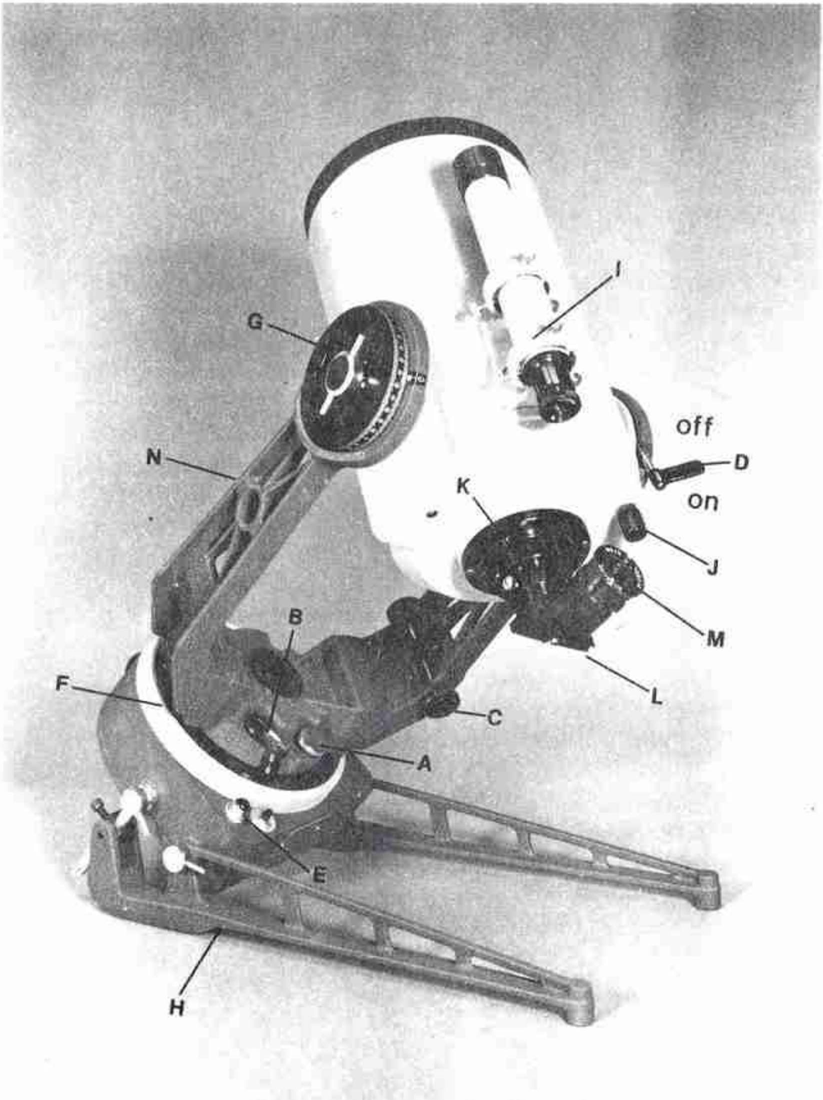
The wonderful thing about your Dynamax is that its versatility can open up many new fields for the hobbyist. Use it as a telephoto lens, planetary or deep sky astro-camera, long range microscope, terrestial observing scope or astronomical telescope. You will undoubtedly find yourself using it more frequently than expected, for things you never considered before. Just looking around your own backyard can be a thrilling experience for your whole family as the Dynamax clearly reveals fine details you've never seen before.

Yes, your new multipurpose Dynamax does many things superbly, and its amazing optical performance constantly astonishes everyone. We at Criterion are indeed proud to have built this fine precision instrument for you and sincerely extend to you our best wishes for a lifetime of observing pleasures.

Shown above is the Dynamax 8 on the Criterion Field Tripod — an optional accessory that provides a stable yet lightweight means of setting up your Dynamax for field use. The tripod comes complete with a handy carrying case and accommodates either the Dynamax 8 or the Dynamax 6.

Recommended Reading Material

1. Brown, Sam, *All About Telescopes*. Sky Publishing.
2. Keene, George T., *Star Gazing with Telescope & Camera*. AMPHOTO, Garden City, N.Y.
3. Paul, Dr. Henry, *Outer Space Photography*. AMPHOTO
4. Brown, Peter L., *Astronomy In Color*. MacMillan Publishing Co., Inc., N.Y.
5. Muller, Paul, *Concise Encyclopedia of Astronomy*. Follet Publishing, Chi.
6. Norton, A.P. and Inglis, J.G., *Norton's Star Atlas and Telescope Handbook*. Sky Publishing Co.
7. *Sky & Telescope*, Sky Publishing Co., 49-50-51 Bay State Rd., Cambridge, Mass. 02138.
8. *Astronomy*, Circulation Services, 640 North LaSalle St., 6th floor, Chicago, Ill. 60610.
9. Eastman Kodak Company, Rochester, N.Y. 14650. Ask for *"Index to Kodak Information"*.
10. Sky Publishing Co., 49-50-51 Bay State Rd., Cambridge, Mass. 02138. Ask for *"Scanning the Skies"*.



A) Right Ascension Knob
B) Right Ascension Brake Lever
C) Declination Control Knob
D) Declination Brake lever
E) Clock Drive Indicator Lamp and On-Off Switch
F) Right Ascension Setting Circle
G) Declination Setting Circle
H) Latitude Adjusters
I) Finderscope
J) Focus Control
K) Eyepiece Adapter
L) Star Diagonal
M) Eyepiece
N) Fork Arm

Chapter 1 — Getting Acquainted With Your New Dynamax

Before using your new Dynamax, you should become thoroughly familiar with the proper operation of each of its major components which we will now discuss in detail. This is best done indoors, and we suggest that you place the Dynamax on a level table directly in front of you, then sit down and carefully study the following information regarding each component carefully before doing anything else. Chapters one, two and three outline all of the necessary information to get started with your new Dynamax, and once you have gained some experience with the major controls and their proper use, you will be ready to take your first look.

The Manual Controls

The Dynamax is supplied with manual controls on both axes. In the event you are not familiar with astronomical terminology, these axes are referred to as Right Ascension (R.A.) and Declination (DEC.). The Right Ascension axis permits the telescope to move *horizontally* (EAST-WEST), and the Declination Axis permits *vertical* (NORTH-SOUTH) motion. Also the R.A. axis is attached to the clock drive at the base of the telescope. A manual control knob and brake is supplied for both R.A. and DEC.

R.A. Control Knob

The R.A. control knob is located at the base of the instrument adjacent to the R.A. brake lever. The control knob is used to accurately center an object to be observed through the main telescope or for "Panning" the sky or landscapes. This control automatically overrides the clock drive and may be used with the drive ON or OFF without damage to the instrument. However, note that the R.A. knob cannot be used when the brake lever is 'ON".

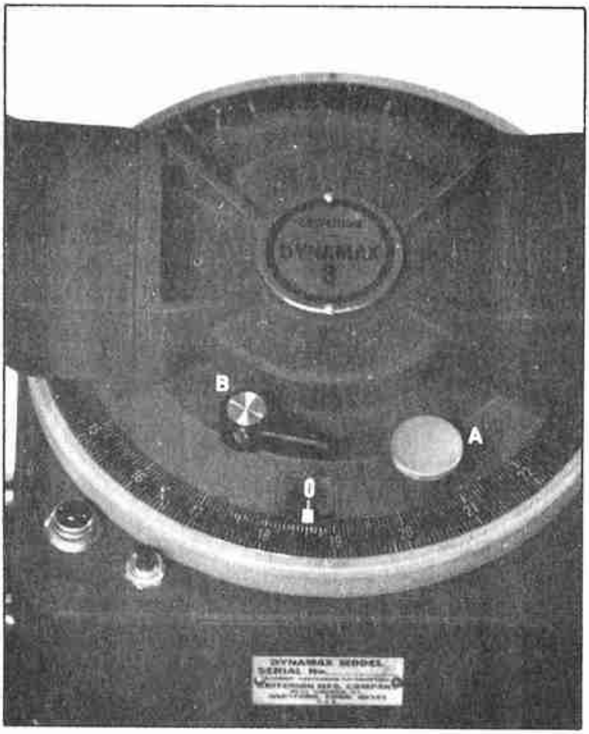
Important Note:

ALWAYS BE SURE THE R.A. BRAKE LEVER IS OFF BEFORE

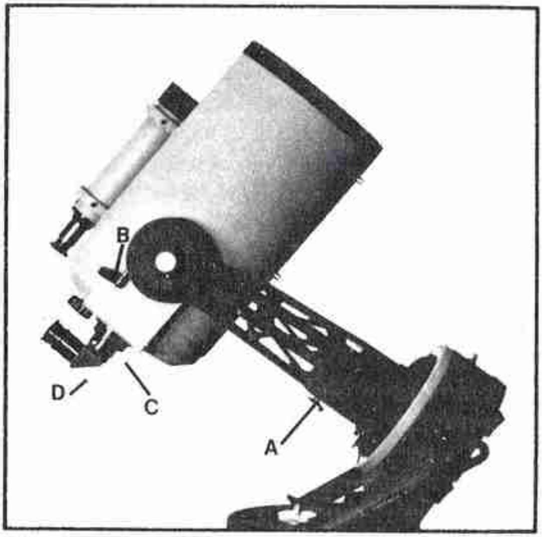
USING THE R.A. CONTROL KNOB OR BEFORE MANUALLY MOVING THE TELESCOPE IN R.A. NEVER FORCE THE R.A. KNOB OR TELESCOPE TO TURN UNLESS THE BRAKE LEVER IS OFF OR DAMAGE MAY RESULT.

R.A. Brake Lever

The R.A. brake lever is used to lock the instrument on the R.A. axis. It is also used to engage the clock drive when the drive is operating as explained in the instructions for the clock drive. The brake is "off" when the lever is pointing towards the R.A. control knob. To lock the telescope in R.A., or to engage the clock-drive, swing the lever to the left (clockwise). Remember, the R.A. control knob *cannot* be used while the brake is on and forcing the knob with the brake engaged may result in damage. Always be sure the brake is *off* when using the R.A. control knob, or when moving the telescope manually in R.A. With the brake *off* the telescope may be swung freely around the R.A. axis to any desired position.



(A) — R.A. Control Knob (B) — R.A. Brake Lever (shown in the "off" position).



(A) DEC. Control Knob
(B) DEC. Brake Lever (shown in the "off" position)
(C) Eyepiece Adapter
(D) Star Diagonal

Declination Control Knob

The DEC. control knob is located near the bottom of the right hand fork arm and permits fine vertical positioning of the instrument in declination. You will use it to accurately center an object to be viewed or for making fine declination adjustments during long-exposure astrophotographs. You should note that this control has a *limited travel* as indicated by the position of the small threaded block located on the inside of the fork arm. As the control knob is turned, the small block will move along the threads attached to the knob, which in turn will move the telescope in declination. When the block reaches either end of its travel (as limited by the wall of the fork arm casting), the knob will no longer operate. DO NOT FORCE THE KNOB TO GO ANY FURTHER. Simply re-set the block (by turning the knob in the opposite direction) to the center of the fork arm casting and the control will again be ready for use. WHEN USING THE DEC. CONTROL KNOB, THE DEC. BRAKE LEVER MUST BE "ON" IN ORDER FOR THE CONTROL TO OPERATE.

The travel of the declination control is a full 10° which is more than ample for fine adjustments. Like the R.A. control, the DEC. control is intended only for fine centering etc., and coarse movements should be made by moving the telescope tube by hand.

Important Note:

NEVER MOVE THE TELESCOPE TUBE MANUALLY IN DEC. UNLESS THE DEC. BRAKE IS OFF. FORCING THE TUBE TO MOVE WITH THE BRAKE ON WILL CAUSE PREMATURE STRESS AND WEAR TO THE INTERNAL BRAKING SYSTEM. LIKEWISE, NEVER FORCE THE DEC. CONTROL KNOB TO TURN ONCE IT HAS REACHED ITS STOP IN EITHER DIRECTION OR DAMAGE MAY RESULT.

Declination Brake Lever

The DEC. brake lever is located at the top of the right hand fork arm casting. Unlike the R.A. brake (which must be OFF in order to operate the control knob), the DEC. brake must be *"ON"* in order for the control knob to operate properly and move the telescope. When the lever is pointed UP, the brake is off and the telescope tube may be swung freely through the fork arms or manually aimed at any object. To lock the telescope in declination, or to use the DEC. control knob, move the lever clockwise until it is at a *right angle* to the fork arm. To prevent undue wear or possible stripping of internal threads, DO NOT FORCE THE LEVER PAST THIS POINT. The lever is factory set so that adequate braking action is accomplished when the lever is at a right angle to the fork arms. Adjustment of the brake, should this become necessary, is described in the section on "GENERAL CARE AND MAINTENANCE".

Remember, the brake is OFF when the lever is pointed upwards and the telescope may be moved freely. The brake is ON when the lever is at a right angle to the fork arm and must be in this position for the DEC. control knob to operate. *FORCING THE LEVER MAY RESULT IN STRIPPED THREADS* (easy does it).

The Eyepiece Adapter

A 1¼" eyepiece adapter is supplied with every Dynamax. The knurled portion of the adaptor couples to the rear threads of the telescope and accommodates any standard 1¼" O.D. eyepiece. The small set screw on the adapter is used to lock the eyepiece securely in place. The eyepiece adapter and all eyepieces may be used either with or without the star diagonal in place.

The Star Diagonal

A 1¼" star diagonal is supplied with each Dynamax for comfortable observing. The star diagonal slips into the eyepiece adapter and is held firmly in any position by the adapter's set screw. Any 1¼" eyepiece can then be placed into the star diagonal which also has a set screw to lock the eyepiece in place. When using the star diagonal, always be sure to rotate it into a comfortable observing position so that you do not have to twist or strain in order to look through the eyepiece.

The optical system of the Dynamax produces images that are upside down and reversed from right to left. Using the star diagonal will produce images that are right side up, but images will still be reversed from right to left.

A porro prism is offered as an optional accessory for those who wish to have terrestrial images correctly oriented in all respects (see our catalog).

The Focus Control

The Focus control has been designed for smooth, easy use. It is located on the upper right-hand side of the eyepiece end of the telescope. To focus on *near* objects, turn the focus knob CLOCKWISE. To reach infinity or distant objects, turn the knob COUNTER-CLOCKWISE.

To find the focus of an object, it is not necessary to determine its distance. Simply rotate the control CLOCKWISE until it stops. This will be its closest focus. Then begin turning the control COUNTER-CLOCKWISE until the object starts to come into view and then adjust for sharpest detail.

During coarse focus movement, you should turn the focus control freely until the object begins to come into view. Then take pains to focus more slowly and accurately once focus is reached.

The focus control has a forward and backward "stop". When turning clockwise or counter-clockwise and the control comes to this stop, the knob will not be able to turn any further. DO NOT attempt to force the knob to go past the stop. Forcing the control beyond the stop may result in serious and permanent damage to the internal focusing mechanism of the instrument. If at the near position (clockwise stop), you cannot focus the object, it may be too close to you for the focus travel. If at far position (counter-clockwise stop), you cannot focus the object, you may have already passed focus. In this event, you should return the knob to its clockwise stop and attempt focus again. In this type of optical system, the focus can be passed quickly unless you view carefully through the eyepiece while turning the control.

Remember, always turn the control CLOCKWISE to stop and then COUNTER-CLOCKWISE until focus is reached. NEVER force the control once it has reached the end of its travel in either direction.

When focusing your instrument at high power, you may notice that the image shifts slightly in the field. This will not affect resolution in any way, and "image shift" on the order of one-quarter of the field of view at high power is normal for the focus mechanism of the Dynamax. Also, do not be concerned if the focus knob feels a bit loose, as this is necessary for smooth performance.

The Finderscope

The finderscope is used to initially locate objects you wish to view through the main telescope. It is supplied with crosshairs and its own focus adjustment.

Before using the finderscope you must first insure that the crosshairs of the finderscope coincide with the optical axis of the main telescope. This is easily accomplished by the following procedure:

Using a 30mm eyepiece, aim the telescope at a distant, stationary object (such as a streetlight, telephone pole, etc.) 200 yards or more away. Focus on the object as per section on "Focus Control", then carefully *center* the object in the field of view. Now look through the finder and adjust the six finder adjustment screws until the same object is centered on the crosshairs of the finderscope. You are now assured that any object centered on the crosshairs will also be in the field of view of the main telescope.

When adjusting the six screws which control the position of the finderscope, you will find it helpful to lock the telescope on both axes. This will prevent the instrument from slipping during adjustment which would result in improper alignment.

Since best focus varies from person to person, you should focus the finder for best results to your eyes. This is accomplished by turning the knurled eyepiece of the finderscope in either direction until best focus is achieved. A bright star image is the best target to use when adjusting the focus of the finderscope.

When locating a celestial object through the finderscope, keep BOTH eyes open. Your right eye should be looking through the finder; your left eye should be open and trained on the object you wish to view. Sweep the telescope towards the object until it enters the field of the finderscope as seen by your right eye. Continue adjustment of the telescope (still keeping both eyes open) until the object as seen by your left eye is superimposed upon the crosshairs of the finderscope, as seen by your right eye. This method is the fastest and easiest way to locate a celestial object once the technique is mastered. Using a bright star or planet, practice this method until it becomes easy, remembering to keep both eyes open at all times.

Chapter 2 — Your "First Look"

Now that you are acquainted with the proper use of each major component, it's time to take your first look through the magnificent optical system of your new Dynamax. This is best done indoors for greater ease and comfort, provided, of course, you have a room long enough to allow the instrument to reach near focus. If you own a Dynamax 6, a most impressive first look can be obtained by focusing on a new dollar bill taped to a wall 10 feet or more away. For best results, be sure the bill is well illuminated by a nearby lamp or light bulb. Tiny buds or flowers on indoor houseplants are also exceptionally good targets that will serve to constantly amaze yourself and your friends. As you look around your own home, you will no doubt find many interesting objects to explore and your new Dynamax will show you details in these objects you never noticed before.

However, at this point we must interject a word of caution: *NEVER LOOK THROUGH WINDOWS OF ANY KIND.* Ordinary window glass is optically very crude and will seriously distort resolution, rendering blurry images that cannot be brought to a sharp focus. So whatever you choose to look at, be sure your target and telescope are BOTH either completely indoors or outdoors. Likewise, *NEVER LOOK THROUGH OPEN WINDOWS.* When you open a window, the warm air that will escape through it will cause wavy and shimmering images even to the unaided eye, let alone to the powerful Dynamax, which will magnify this distortion many times over. Therefore, always avoid viewing through windows whether *open* or *closed;* we want your first look to be an impressive one.

After you have become thoroughly familiar with focusing on indoor targets, you shuld try the instrument outdoors. However, if it is cold outside, you must first allow ample time for the Dynamax to become adjusted to the ambient temperature as explained in Chapter 9, page 45. Please read this section carefully before using the telescope outdoors for best results.

There are many outdoor objects that will provide endless viewing pleasures for your entire family. As a start, you might explore your own backyard garden at 30 feet, or the fine detail in small birds that might visit your backyard feeder. As you will soon discover, there are thousands of objects to observe in almost any countryside landscape, and in this setting, your Dynamax will provide thrilling views of nature at its best. The city dweller, on the other hand, might spend countless hours exploring the incredible wealth of detail in the tops of older skyscrapers. In New York City, for instance, there are many such buildings you may wish to investigate, and we're sure that you will be amazed at the details you will see that are totally invisible to the naked eye.

Chapter 3 — Using Your Dynamax — Operational Summary

General Observing Procedure:

1. Screw the eyepiece adapter onto the telescope and insert the star diagonal. Use your lowest power (50 or 30 mm) eyepiece.

2. Place the Dynamax on a solid, flat surface so that it cannot rock on its base.

3. Release *both* the R.A. and DEC. Brakes so that the telescope can swing freely on both axes.

4. Keep one hand on one of the fork arms and the other hand on the star diagonal or eyepiece adapter. Move the telescope freely both horizontally and vertically using both hands until the object of interest is seen in the finderscope and centered on the crosshairs.

5. Engage R.A. and DEC. Brake levers so that the telescope is locked in place on target.

6. Look through the 50 mm or 30 mm eyepiece and focus carefully on the object as outlined in the section on the Focus Control.

7. After you focus on the object, you may wish to sweep across it or fine position it in the field of view. To do this, release the R.A. brake lever and use the DEC. and R.A. control knob for further positioning on both axes. (Remember when using the R.A. control knob, the R.A. brake must be *OFF* — when using the DEC. control knob, the brake must be *ON* in order for the control knobs to operate).

8. If you wish to view the object at a greater magnification, simply replace your low power eyepiece with an eyepiece of shorter focal length.

9. When turning to a new object to be viewed, be sure to release both the R.A. and DEC. Brake levers and repeat steps 3 - 7.

Celestial Observing Procedure:

1. Screw the eyepiece adapter onto the telescope and insert the star diagonal. Use your lowest power (50 mm or 30 mm) eyepiece.

2. Place the Dynamax on the latitude adjusters, tripod or pier and align the instrument to POLARIS as described in the section on "Orienting the Mount for Astronomical Use".

3. Turn on the electric clock drive so that it is running and ready for use. Release both the R.A. and DEC. brakes so that the telescope can swing freely on both axes.

4. Keep one hand on one of the fork arms and the other on the star diagonal or eyepiece adapter. Move the telescope freely in R.A. and DEC. using both hands until the celestial object is centered on the crosshairs of the finderscope. (Be sure to use the finderscope properly as outlined in the section on "The Finderscope" as this will save you much time and effort).

5. Engage the R.A. and DEC. brake levers so that the telescope is locked on target. When the R.A. lever is engaged, the electric clock drive will automatically begin tracking the object.

6. Focus carefully on the object using the 50 mm or the 30 mm eyepiece as outlined in the section on "The Focus Control".

7. After focusing, you may want to precisely center the object in the field of view if it is not centered already. To do this, you will use the R.A. and DEC. control knobs. *Be sure to release the R.A. brake lever before using the R.A. control knob.* Once the object is fine positioned to your satisfaction, re-engage the R.A. brake lever and the electric clock drive will automatically keep the object in the field of view for observation and study.

8. If you wish to view the object at a greater magnification, replace the low power eyepiece with an eyepiece of shorter focal length (see section on "Eyepieces").

9. When turning to a new object, be sure to release both the R.A. and DEC. brake levers and repeat steps 4 - 7.

Chapter 4 — The Clock Drive

A precision electric clock drive is installed in the base of your Dynamax telescope. It is used to precisely counteract the earth's rotation so that celestial objects you wish to observe will appear "motionless" in the field of view.

To energize the clock drive, simply plug the cord into a 110V. A.C. outlet. Depress the small switch on the left side of the base and the clock drive will begin operating as indicated by the red pilot lamp, which should respond with a faint glow.

DO NOT EXPECT TO SEE ANY MOVEMENT OF THE TELESCOPE WHEN THE DRIVE IS SWITCHED ON.

You must remember that the telescope drive is designed to track celestial objects by counteracting the earth's rotation. Accordingly, the clock drive will move the telescope at only one revolution every 24 hours, the same rate at which the earth rotates. This means that the motion of the clock drive will be undetectable, just as the movement of the stars themselves or the hour-hand of a watch is also undetectable.

To insure that the drive is, in fact, operating, place an eyepiece in the telescope and focus on a stationary object. Switch the drive on, engage the R.A. brake lever, and view through the eyepiece. If the drive is operating properly, the object will move out of the field of view at a slow but steady pace.

Another method is to place a small piece of tape or a small pencil mark on the large grey ring which surrounds the periphery of the R.A. setting circle. Set the R.A. Circle so that your tape or pencil mark is centered on "O". Switch on the drive and the setting circle will move one line every four minutes.

NO MOVEMENT WILL BE DETECTABLE BETWEEN THE SETTING CIRCLE AND ITS VERNIER INDICATOR WHILE THE DRIVE IS RUNNING.

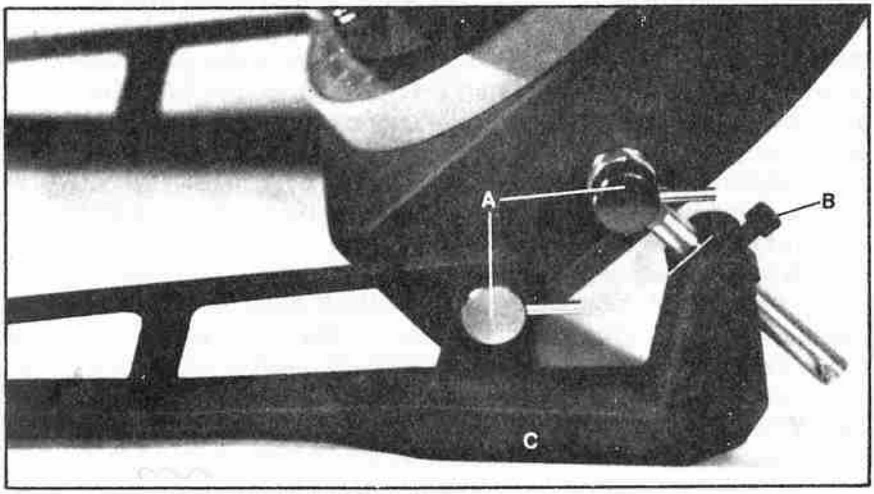
This is due to the fact that the R.A. circle moves *simultaneously with* the telescope as soon as the drive is on. Therefore, if any motion is to be detected, the reference point must be made on the stationary grey ring around the R.A. Circle.

WHEN USING THE CLOCK DRIVE, THE R.A. BRAKE LEVER

MUST BE ENGAGED IN ORDER FOR THE TELESCOPE TO TRACK. When moving to a new object, disengage the R.A. brake lever and you can then manually move the telescope to any desired position while the drive is running, without damage to the drive. As soon as the R.A. brake is disengaged, any manual movement in R.A. will automatically override the drive mechanism. Once the telescope is centered again on a new object to be tracked, engage the R.A. brake lever and the telescope will once again automatically follow the object.

WHEN TRACKING A CELESTIAL OBJECT, THE TELESCOPE MUST BE PROPERLY ORIENTED ON POLARIS. READ CAREFULLY THE SECTION ON "ORIENTING THE MOUNT FOR ASTRONOMICAL USE".

Chapter 5 — The Latitude Adjusters



(A) Fastener Bolts
(B) Tilt Adjustment
(C) Latitude Adjuster Leg

In order to properly track a celestial object, the Dynamax must be tilted back in an "equatorial" position. The degree of tilt will correspond directly to your latitude on earth. The latitude adjusters provide a means of tilting the telescope back on any level surface or table top.

To install the adjusters, lay the telescope on its side. This will allow easy access to the four latitude adjuster studs located on both sides of the telescope base. The studs protrude from the base and each stud has a washer and fastener bolt. Unscrew only the bolts and leave the washers in place. Attach the latitude adjusters onto the studs by means of the two holes supplied in each adjuster and then screw in the fastener bolts. Tighten the bolts hand-tight, but DO NOT tighten too much, as this is not necessary and could result in shearing the pin which protrudes from each fastener bolt. Be sure that the four washers are on the inside of the adjusters, that is, nearest to the telescope base.

Be sure to set the telescope down on its side when attaching the adjusters as this will allow you to attach one adjuster at a time quite easily. Also keep in mind that the base of the telescope may be swiveled while the telescope is on its side, so that you can install one adjuster and then swivel the base around for easy accessibility to the other studs.

Once the adjusters are installed, the angle of the tilt may be adjusted by loosening the ¼-20 socket screw bolt on each adjuster leg with an allen wrench. Once the desired degree of tilt is achieved, tighten this bolt securely as the entire weight of the instrument is supported by it. NEVER loosen these two bolts without holding the instrument in place or the weight of the instrument will cause it to fall. In the event this were to accidentally happen, a locking pin is attached to each of the adjuster shafts to prevent the telescope from falling completely off the latitude adjusters.

The latitude adjusters are only used for astronomical observations — for terrestial viewing, the telescope is set flat on its base (altazimuth position).

Note: The adjusters are not intended for serious astronomical work or astrophotography, but are used with the Dynamax as a handy, portable means of setting up the instrument for casual observing. The serious astronomer or astrophotographer will require Criterion's field tripod or permanent pier, both of which are offered as optional accessories, and complete separate instructions are provided with each of these units.

Chapter 6 — Orienting The Mount For Astronomical Use

Visual Alignment On Polaris

The purpose of the clock drive is to precisely counteract the rotation of the earth so that stars will appear "motionless" while under observation. This cannot be accomplished, however, unless the telescope's polar axis is properly aimed at the North Celestial Pole. The Polar Axis is the central axis of rotation of the clock drive and lies in a plane halfway between and parallel with the fork arms. The North Celestial pole is the central axis of rotation of the earth, around which all the stars appear to rotate each night in concentric circles. In order to achieve proper tracking accuracy, we must, therefore, match the rotational axis of the clock drive (polar axis) with the rotational axis of the Earth (defined by the North Celestial Pole). This is done by tilting the telescope back on its latitude adjusters or tripod and sighting on the star Polaris (North Star). Polaris is the nearest star to the North Celestial Pole.

The degree of tilt required will correspond directly with your latitude on Earth.

The first task in aligning the mount to the Pole is to locate Polaris in the night sky. Polaris is the last star in the handle of the "Little Dipper" and the two stars at the front of the "Big Dipper" point directly to it as in Fig. 1 and 2 below:

FIG. 1

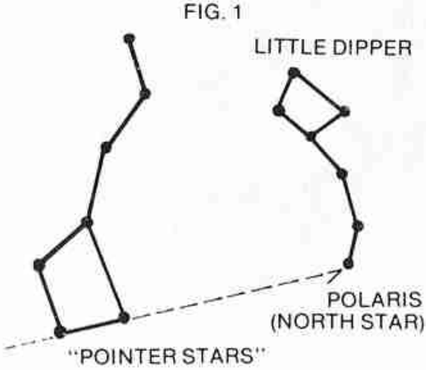
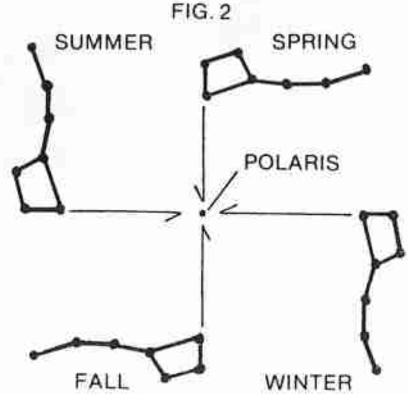


FIG. 2



Note that the Big Dipper will not always be positioned as in Fig. 1. The position of the Dipper will depend upon the time of year as well as local time as shown in Fig. 2.

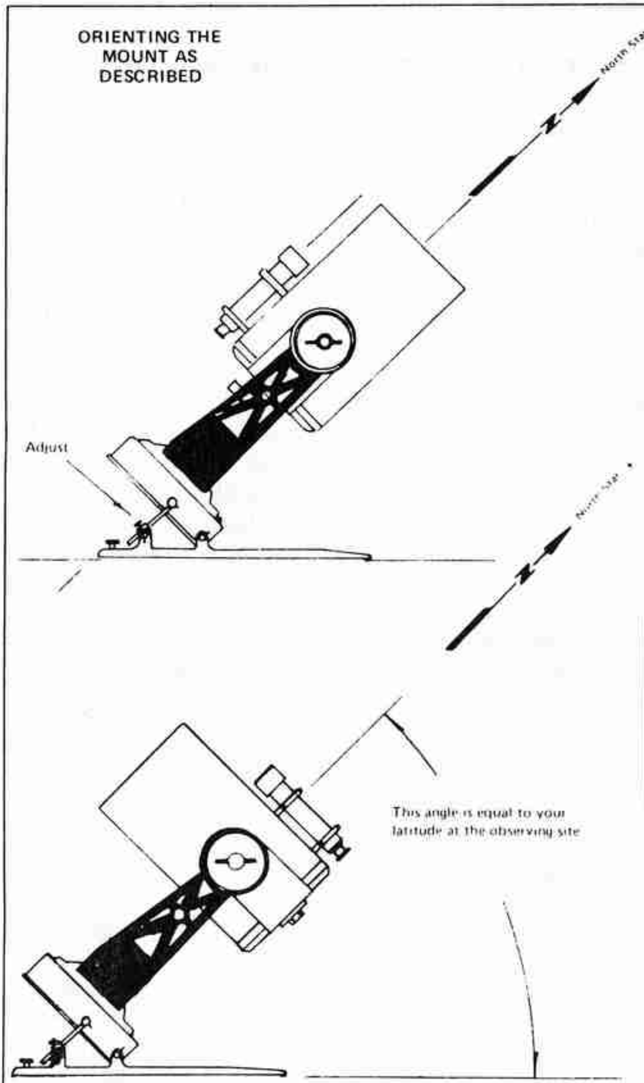
To align the mount on Polaris, follow the instructions outlined below:

1. Set up the instrument where Polaris can be clearly seen. Attach the latitude adjusters or place the instrument on the Criterion field tripod or Permanent pier. Be sure that your finderscope is properly aligned with the optical axis of the telescope as outlined in the section entitled "The Finderscope".
2. Position the telescope as in Fig. 3 so that the telescope tube is perfectly parallel with the fork arms.
3. Lock the instrument in both R.A. and DEC. so that it cannot rotate on either axis.
4. Without disturbing the telescope's position as set up in Step 2, Fig. 3, shift the entire mounting East or West toward Polaris and adjust the degree of tilt on your latitude adjusters, tripod or pier until Polaris enters the field of view of your finderscope. (This will be easier if you first sight along the barrel until you are in the general vicinity of Polaris, then look through the finder).
5. Continue fine adjustments (as in Step 4) until Polaris is centered on the finderscope's crosshairs and the telescope is still positioned as in Fig. 3.

Once this setting is accomplished, *do not* disturb the position of the latitude adjusters, tripod or pier. Objects you wish to view will be located by movement in R.A. and DEC. only. Rotational

Fig. 3. Aligning the Mount to Polaris.

movement around these two axes will allow you to aim the telescope at any object in the sky *without* having to disturb the orientation of the mount as set up in the above procedures.

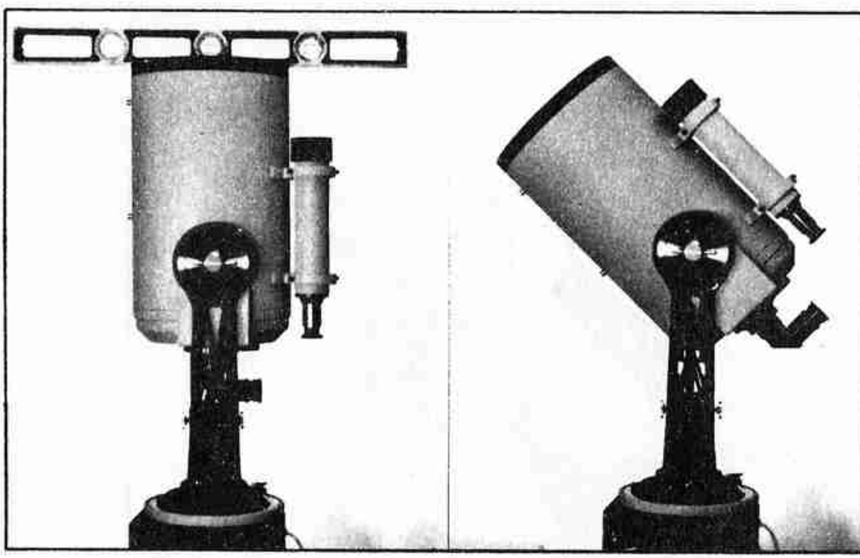


In order to follow the stars and celestial objects, the mount must be correctly oriented so that its polar axis is lined up on Polaris. The polar axis lies on a line through the center of the fork arms. Electric drive rate will be affected if mount is not in alignment. When correctly aligned, the star will appear motionless in the field during study with drive "on".

An Alternate Method . . .
Using A Level To Orient The Mount

If you have a large carpenter's level, you can use it to adjust the telescope's angle of tilt indoors. Since the degree of tilt corresponds directly with your latitude on earth, you should first contact your local town hall or a nearby airport for information regarding the exact latitude of your observing site. Once this is established, you will use the level as follows:

1. Choose a table top that is precisely level and place the Dynamax on the table resting flat on its base.
2. Point the tube straight up and place the level across the rim of the front corrector lens cell. Orient the level on this rim so that it is centered halfway between the fork arms and "lined up" with the telescope's movement in DEC.
3. Adjust the telescope in DEC. until the tube is level on this axis. (Do not be concerned with leveling in R.A.).
4. Set the DEC. circle to 90° and then place the Dynamax on the latitude adjusters or tripod.
5. Move the telescope tube in DEC. until the DEC. setting circle reads the *complement* of the angle of your



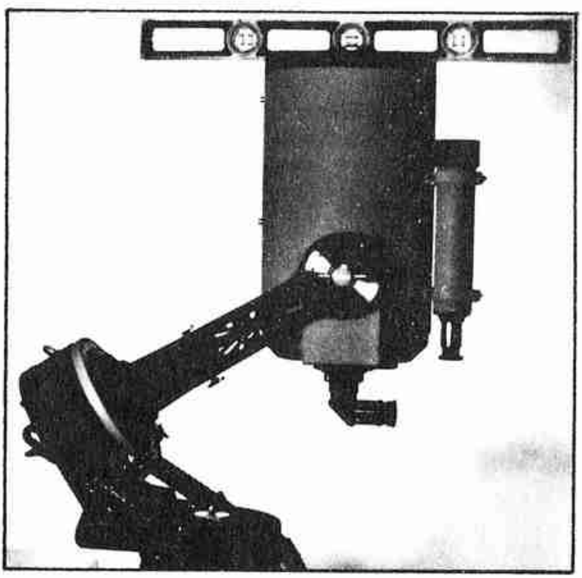
Step 1. Level the tube in declination.
Step 2. Move the tube until the DEC. circle reads the *complement* of your latitude.

latitude.

6. Finally, adjust the angle of tilt on the latitude adjusters or tripod until the rim of the corrector lens cell is once again level (be sure again to orient the level on the rim as described in Step 2).

Once the above steps have been accomplished, your mount should be inclined to the correct altitude of the North Celestial Pole, and you will now only have to aim the telescope true North in order to be properly oriented. This is best done by using Polaris as a reference, and you will take the telescope outdoors and shift the base East or West until Polaris can be centered on the finder's crosshairs by sweeping the telescope vertically in declination only.

NOTE: Since the above leveling process has been initially established using a level table, you should note that your observing platform must also be precisely level in order for this method to be truly accurate. Also, this leveling method of orienting the mount relies solely upon leveling of the declination axis *only* and careful attention should be paid to the positioning of the level (as in Step 2), which must be lined up with the telescope's declination movement. It is not necessary to attempt leveling on the R.A. axis as any deviation from level on this axis is compensated by your azimuth adjustment to Polaris.



Step 3. Adjust the telescope's angle of tilt until the tube is again level in DEC.

Helpful Facts And Hints On Polar Alignment

Accuracy In Polar Alignment:

Even though Polaris lies approximately.8 degrees *away* from the *true* North Celestial Pole, aligning the mount to Polaris will be quite sufficient when you are using the Dynamax for casual observing. When the clock drive is switched on, any object being viewed should remain in the field of view of a low powered eyepiece with only an occasional minor adjustment of the R.A. and DEC. controls from time to time. The better the polar alignment, the fewer will be the adjustments necessary to keep the star centered in the field of view.

How accurate should polar alignment be? This really depends upon your requirements. For example, if you want to simply take a "quick look" at the moon or a planet or two, and will be using low power eyepieces, then a "ballpark" position of the telescope with respect to Polaris should be good enough. For a more serious stargazing session, greater pains should be taken to insure good polar alignment. Use of high powered eyepieces will also necessitate better alignment because the higher the power, the smaller will be the field of view and, therefore, any slight drifting of a star image will be much more noticeable at higher powers.

Making Polar Alignment Easier

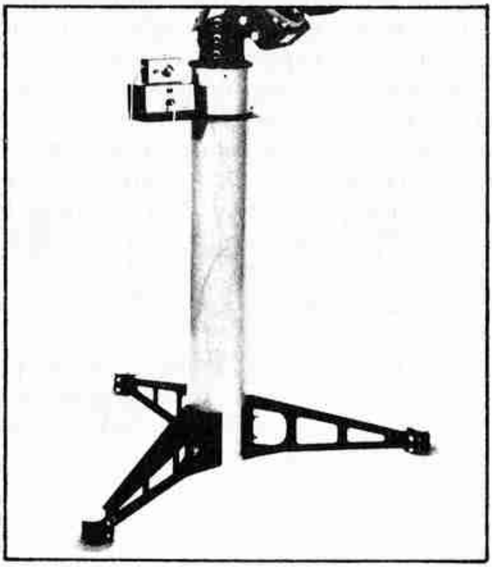
If you are using the latitude adjusters, do not disturb their latitude setting after each use. Provided you use them on the *same level surface* each night, the degree of tilt will never need to be adjusted again (provided, of course, the initial adjustment was satisfactory). Therefore, the only task to be carried out before each observing session will be to point the Dynamax North (towards Polaris). Resetting of the latitude adjustment will only become necessary if the observing site is moved to a new latitude.

When using the optional field tripod, the above suggestion again applies — do not disturb the latitude setting after each use. You will then only need to point the telescope North (towards Polaris) and the latitude setting will be correct provided: (1) the initial latitude setting was correct and carried out with the tripod's base plate level, (2) the base plate is leveled at each use, (3) the general location of the observing site has not changed with respect to your latitude on earth. Use your ingenuity and try to find other ways of making polar alignment faster and easier that are tailored to your particular situation and requirements — less time and effort spent setting up your Dynamax means more time and effort can go into its use!

The Permanent Pier

You can completely eliminate the need to orient your mount each night if you have a stable, outdoor platform that is permanently aligned to the North Celestial Pole. For this, Criterion offers the optional Permanent Pier. The Permanent Pier is ideal for the homeowner with a suitable observing site in his backyard, and an invaluable asset to the astrophotographer who will constantly require super-precise polar alignment for extreme tracking accuracy.

Several nights are spent carefully aligning the pier's tiltable platform to the true North Celestial Pole (preferably using the "advanced" method of polar-alignment explained later on). Once this is accomplished, the pier will be left outdoors permanently, and no further polar adjustments will ever again be necessary. Whenever you wish to use the Dynamax for either observing or astrophotography, you simply place the Dynamax onto the pier's tilted platform (by means of the three hand knobs supplied), switch on the clock drive, and within *minutes* you are ready to begin. At the end of each observing session, the Dynamax is removed from the platform and taken indoors in as little time as it took to attach it; the pier remains outdoors "always ready" to be put instantly to use.



The Permanent Pier

By using the permanent pier, you will never again need to orient your mount at the outset of each observing session. Precise polar alignment is assured each time you use it, provided the pier's original position is correct and remains undisturbed. The pier's handsome finish is fully weather resistant and designed for permanent outdoor use without the need for protection of any kind.

Polar Alignment vs. Clock Drive

If polar alignment is grossly incorrect, stars will quickly drift out of the field of view. If this occurs, you may be misled into thinking that your clock drive motors are running too fast or too slow. This will not be the case.

Important Note:

IT IS ELECTRICALLY AND MECHANICALLY IMPOSSIBLE FOR THE CLOCK DRIVE MOTORS TO TURN FASTER OR SLOWER THAN THEIR SPECIFIED RATE WITHOUT SPECIAL ELECTRONIC EQUIPMENT. IF STARS DRIFT QUICKLY OUT OF THE FIELD OF VIEW, THE CLOCK DRIVE IS NOT AT FAULT — YOUR POLAR ALIGNMENT IS INCORRECT AND MUST BE CAREFULLY RECHECKED.

Because you will be using the Dynamax clock drive with your 110 V household current, Criterion has incorporated *synchronous* motors into the clock drive. A synchronous motor cannot be slowed down even if you experience a voltage drop in your electrical lines while observing. Mechanically, it is also impossible to slow down the motors because of special internal gearing. Even in the case of severe mechanical binding, the motors will not slow down, but instead they will completely *stop functioning* altogether. Accordingly, as long as the motors are running, they can only be turning at the correct rate of speed.

Tracking The Moon And Planets

Don't worry if the moon or planets seem to drift more than stars do. This is because these objects traverse the sky at a *slightly* different rate than the stars, and therefore, occasional minor adjustments in R.A. and DEC. will be required to keep them centered in the field.

The moon, for instance, moves at the Lunar rate, the planets at the Planetary rate, and stars move at the true Sidereal rate. The difference between these rates is very slight indeed, but is clearly illustrated by watching the moon's ever changing position with respect to the constellations and planets from night to night.

The Drive Corrector

If you could speed up or slow down the clock drive motors of your Dynamax, you would then be able to adjust the speed of the clock drive to presicely track at the Lunar, Planetary or Sidereal rates mentioned previously. Additionally, you would be able to compensate for the drifting of a celestial object caused by imperfect polar alignment. For this reason, Criterion offers the *Dynatracker Unit* (complete instructions included). The Dynatracker is a variable frequency drive corrector that enables you to adjust the speed of the clock drive to precisely match the speed of any celestial object you wish to track. This specialized accessory is considered a necessity for long term astrophotography, but for visual astronomy, it becomes a valuable asset to an observer who wishes to keep the moon, stars, or planets precisely centered in the field of view for a long-term observation — even when polar alignment is imperfect. If polar misalignment is causing stars to drift in the field towards the West, you will use the Dynatracker to speed up the clock drive in order to keep them centered in the field. Conversely, if stars seem to drift to the East, the Dynatracker may be used to slow down the clock drive motors which will compensate for this difficulty. So, by using the Dynatracker, you will be able to achieve extreme tracking accuracy with your clock drive without having to spend a great deal of time on precision polar alignment.

The Criterion Dynatracker

Using The Drive Corrector

When using the Dynatracker, you will initially adjust the speed of the clock drive by placing the object you wish to observe at the *extreme edge* of the field of your highest power eyepiece. In this way, you will be able to quickly and easily detect which way the object is drifting as well as the amount of drift taking place. You will then simply adjust the Dynatracker controls as per the separate instructions provided until the object remains stationary on the edge of the field of view.

The Dynatracker is also invaluable to the Dynamax owner who wishes to use his instrument for field trips where there will be no electricity available. In this event, the Dynatracker may be used to operate the clock drive from any 12V. D.C. car or motorcycle battery. Alligator clips are supplied for this purpose as well as a handy provision that allows you to use your car's cigarette lighter. The electrical drain on your 12V battery is negligible even after a full night's observing.

An Advanced Method Of Polar Alignment Using The DEC. Setting Circle

In the previous discussions on the subject of polar alignment, we have used the star Polaris as a reference point and, as mentioned in the text, using Polaris will be quite sufficient for the average observer. We will now discuss a more complex method for those who wish to insure absolute precision in achieving perfect alignment to the true North Celesial Pole, which lies .8 degrees *away* from Polaris, and is an imaginary point in the sky.

This method is listed here only for the benefit of the serious, advanced astronomer. Using this method of polar alignment is totally *unnecessary* unless you are interested in one of the following:

A. Serious long-exposure astrophotography
B. Extreme accuracy in using the instrument's setting circles (see section on setting circles)
C. Permanent installation of the Dynamax in its equatorial position

You will need a reliable star atlas such as Norton's Star Atlas or the Nautical Almanac which will render accurate Declination readings for any given star.

There are only two requirements for precision polar alignment:

1. The Polar axis must be inclined to the exact altitude of the North Celestial Pole.
2. The Polar axis must be set true North in azimuth.

These two requirements are met by the following steps which must be carried out *in sequence:*

A. *Bring the mount into approximate equatorial alignment by following Steps 1 - 5 described earlier.*

B. Altitude Setting Of Polar Axis

Choose a bright star somewhere near the meridian such as Vega. Using your lowest power eyepiece, center the star in the field of view and set the declination circle to the correct reading for the star as listed in a reliable atlas. Now choose another star, also somewhere near the meridian, and look up the correct declination reading for this star. Move the telescope tube in declination until the setting circle reads the proper DEC. coordinate for the star and lock the tube in DEC. Now sweep the tube in R.A. and observe whether or not the star passes through the field. If not, adjust the angle of the polar axis until star can be centered by movement in *R.A. only.* When this has been accomplished, your polar axis will be precisely aligned to the altitude of the Celestial Pole (provided all DEC. readings are accurate), and all that remains is to set the polar axis true North in azimuth.

C. Azimuth Setting Of Polar Axis

Choose a bright star 40° - 50° above the Eastern or Western Horizon. Move the tube until the setting circle reads the correct declination reading for the star and lock the tube in declination. Sweep the tube in R.A. toward the star and observe if the star passes through the field. If not, shift the mount East or West in Azimuth until the star can be centered by movement in *R.A. only* at the correct declination reading.

If you desire "ultra-precision", repeat each step over again and continue fine adjustment until all three stars give exact readings on the declination setting circle.

If the telescope is adjusted so that the declination coordinates of any three stars are correctly indicated by the declination setting circle, then the polar axis of the telescope will be unquestionably precisely aligned to the True North Celestial Pole.

Chapter 7 — The Setting Circles

The Great celestial sphere of the heavens is divided into imaginary lines of Right Ascension (R.A.) and Declination (DEC.). These imaginary lines divide the celestial sphere in the same manner as lines of latitude and longitude divide the earth. The position of any celestial object can therefore be determined by its R.A. and DEC. coordinates, just as coordinates of latitude and longitude determine positions on earth.

The precision calibrated setting circles on the Dynamax enable you to use these coordinates to find celestial objects that are too faint to be detected in the finderscope.

The R.A. circle (sometimes called the "Hour" Circle) is located at the base of the Dynamax and is permanently attached to the clock drive gear mechanism. When the drive is switched on, the R.A. Circle will begin to rotate with the main drive gear inside the base housing. In this way, the R.A. Circle keeps time with the movement of the stars, and will continue to read the proper coordinates of any celestial object — even as the object moves across the sky.

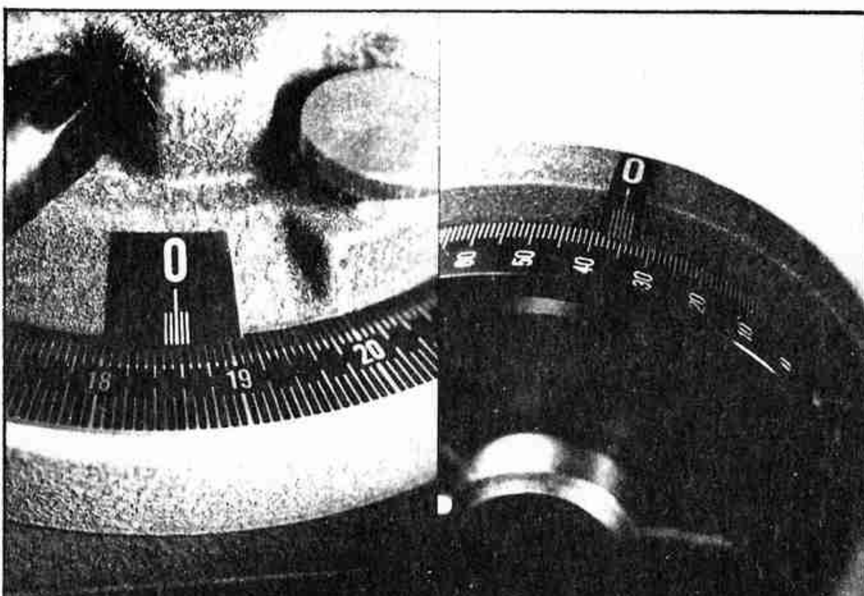
The R.A. Circle is actually a large precision sidereal clock and is read in hours and minutes. The numbered divisions 1 through 24 represent hours and each hour is divided into 5 subdivisions representing 12 minutes each. Each subdivision is further divided into 3 individual lines, each line therefore representing 4 minutes of time. The R.A. coordinate of a given star is stated in hours and minutes. For example, the star VEGA in the constellation LYRA has an R.A. coordinate of 18 hours, 35 minutes. To get the general feel of using the setting circle, try setting the circle to these coordinates indoors. The circle is "slip-adjustable" and is held in place by friction pads.

The DEC. Circle is located at the top of the left-hand fork arm and is read directly in degrees, each line representing one degree. The DEC. Circle is adjustable by loosening the large wing knob at its center. After adjustment, retighten the knob and the circle will move with the telescope tube in declination.

Using the setting circles to locate a celestial object is quite easy and is accomplished as follows:

1. Orient the mounting as precisely as possible as described in the section on "Orienting the mount for Astronomical Use".
2. Switch on the electric clock drive.
3. Pick out a bright star (preferably directly overhead) and carefully center it in the field of view. DO NOT choose a star too close to the horizon.
4. With the star centered in the field of view, rotate the R.A. setting circle until the vernier at the base of the fork arms indicates the correct R.A. coordinate of the star as listed in a reliable Star Atlas.
5. Loosen the wingknob and adjust the DEC. circle until it reads the correct DEC. coordinate of the star as listed in a reliable Atlas; then tighten the wingknob securely. Then double check that the star is still centered with both circles reading the proper coordinates.

Any celestial object you wish to view can now be located by using the setting circles. Simply look up the objects' coordinates and move the telescope in R.A. and DEC. until the vernier on each axis indicates the proper reading for that object on the circles. No further adjustment of the circles will be necessary after they are set by Steps 1 - 5 above until your next observing session, at which time Steps 1 - 5 must be repeated.



R.A. Circle Reading 18 hrs., 35 min.   DEC. Circle Reading 35.5 Degrees

Using The Circles . . .

Some Helpful Facts And Hints

* Always use your lowest power eyepiece when locating objects with the circles. This will provide a wide field of view that will leave some room for errors. Low power will also provide brighter images that will be easier to detect in the field of view.

* Don't be discouraged if your first attempts in using the circles are unsuccessful. A little patience and practice will prove to be very worthwhile once you gain some practical experience in their use, for which there is no substitute. If the object is not somewhere in the field, sweep the area by using a fractional turn of each control knob until the object is located.

* The degree of accuracy achieved with the circles is directly proportional to the accuracy of your polar alignment. The better the polar alignment, the greater will be the accuracy of the circles during use.

* Even if your polar alignment is not very accurate, you may still use the circles with excellent results by "constant resetting". This is easily done by setting both circles to the coordinates of the *nearest* bright star in the *same constellation* as the object you wish to observe. When you then move to the new coordinates of the object, the telescope will not have to be moved a great distance in the sky. In this way, you will compensate for considerable errors in polar alignment. For example, if you want to locate the "Ring Nebula" (M-57), this cbject lies in the constellation LYRA. The nearest bright star to this Nebula is VEGA, also in LYRA.

Set both circles using VEGA as a reference star as in Step 4. Since the Ring Nebula lies only a few degrees away from VEGA, it should be somewhere in the field of view when you move the telescope to its proper coordinates. To find another object in a different constellation, repeat the process by resetting both circles to the coordinates of a bright star nearest to and in the same constellation as the object you wish to locate.

* If you desire *extreme* accuracy with your circles, then there is only one "sure fire" method of aligning to the pole, and this method is discussed in the previous section "Advanced Method of Polar Alignment". Since this method actually utilizes the DEC. setting circle in positioning the mount to the *true* North Celestial Pole, achieving accurate readings will certainly be guaranteed. If you decide to use this method, follow the steps A through C (on page 35) carefully and your declination circle will be perfectly set. All that will remain will be to set the R.A. circle as in Steps 3 and 4 of this chapter.

Chapter 8 — The Eyepieces

The visual magnification of any eyepiece is calculated by dividing the focal length of the telescope by the focal length of the eyepiece you are using.

The focal length of the Dynamax is engraved on the front of the telescope tube; the focal length of all Criterion eyepieces is engraved on the eyepiece itself. All focal lengths are expressed in millimeters.

The focal length of the Dynamax 8 is 2110 mm. If we use a 30 mm focal length eyepiece with this particular instrument, the magnification will be 2110/30 = 70.3. Thus, we say the magnification of a 30 mm eyepiece when used with the Dynamax 8 is 70x. The same 30 mm eyepiece, if used with the Dynamax 6 (1524 mm focal length), will render 51x magnification (1524/30 = 50.8).

The following chart lists the magnification of various Criterion eyepieces when used with either the Dynamax 6 or 8:

Eyepiece	*Magnification*	
	Dx6	*Dx8*
50 mm Ramsden	30x	42x
32 mm Plossl	48x	65x
30 mm Achromatic Ramsden (Kellner)	51x	70x
18 mm Achromatic Ramsden (Kellner)	85x	117x
16.3 mm Wide Angle Erfle	94x	130x
12.7 mm Achromatic Ramsden (Kellner)	120x	166x
9 mm Achromatic Ramsden (Kellner)	170x	234x
7 mm Achromatic Ramsden (Kellner)	218x	300x
6 mm Orthoscopic	254x	351x
4 mm Orthoscopic	381x	527x

Laws of optical physics limit the magnification of *all* telescopes, regardless of design or manufacture. According to these laws, the greatest allowable magnification for any telescope is 60x per inch of aperture. This calculates to a maximum magnification of 360x for the Dynamax 6 and 480x for the Dynamax 8. Magnification beyond this limit will result in *serious image deterioration* and is sometimes called "empty magnification".

It is a common misconception that magnification is everything in a telescope. This is far from true, and experienced observers know that magnification should generally be kept low to moderate when observing most celestial objects in order to maintain best contrast. In fact, the nature of the human eye itself demands a careful balance between aperture (size of telescope lens) and magnification for sharpest perception of fine detail. Always keep in mind that as you increase the power, you *decrease* the field of view. Additionally, as magnification becomes *greater,* the image becomes *dimmer and dimmer.*

Choosing a proper eyepiece is indeed a critical factor in successful astronomical observing. Which magnification is best? This will depend greatly upon what you wish to observe as well as atmospheric conditions at the time of observation. The following should be used as a basic guide in choosing an eyepiece when observing the specific objects listed below:

Galaxies, Nebulae, Comets

For any of these objects, always use your lowest powered eyepiece (50 mm or 30 mm). These objects are not only very faint, but also quite large. By using the lowest power, you will maintain the widest available field of view as well as the *brightest* possible image, a key factor in viewing faint objects clearly. *Never* use high power when viewing any of these objects.

Star Clusters

Low power (50 mm or 30 mm) should again be used for the most breathtaking views, whether the cluster is of the open or globular type. Some star clusters, however, are compact and bright enough to lend themselves nicely to slightly higher magnifications (18 mm or 16.3 mm), but only when atmospheric conditions permit. Always begin your observation at low power, then experiment with medium power.

A 16.3 wide angle erfle is particularly suited to excellent views of some of the brighter compact globular clusters, such as M-13 or M-92 in Hercules on a clear, moonless night.

Planets

Planetary detail is best observed at higher powers (12.7 mm, 9 mm or higher). Choose a low to medium power eyepiece for your first observation (30 mm or 18 mm) and then continue to raise the magnification successively until the image begins to deteriorate.

As soon as you notice a slight breakdown in contrast and visible detail, move back down to the eyepiece that rendered the largest image with the most detail and best contrast before deterioration became apparent.

The degree of magnification a planetary image can withstand will depend upon atmospheric conditions. On some nights you will find an 18 mm or 12.7 mm will be as high as you can go; other nights (when the air is particularly still) you will be able to use your highest power eyepiece with no deterioration in image quality. However, be aware that even on a "perfect night" planetary details will *"fade in" and "fade out"* with minor atmospheric variations (see "Telescope vs. Atmosphere" — page 46.) Only on a *perfect* night, when the air is very still, a 7 mm eyepiece will deliver exceptional views of Saturn or Jupiter through the Dynamax 8. On the same night, a 9 mm eyepiece is highly recommended for viewing Jupiter or Saturn through the Dynamax 6. On nights when higher powers are not acceptable due to poor seeing, a 16.3 wide angle erfle will render stunning wide field, medium powered views with excellent contrast and resolution of planetary details.

Moon

Any eyepiece can be used to observe the moon. Experiment freely with all of your eyepieces. The lower powers will allow you to see vast expanses of cratered areas and lunar seas, while the higher powers will allow you to "zoom in" on individual craters or mountain ranges.

The moon is very bright, especially when full, and it is suggested that you purchase a moon filter of some kind. Such filters make lunar observation much easier on the dark adapted eye. A moon filter is available from Criterion that fits directly over any of our eyepieces.

Double Stars

Always use your highest power eyepiece when observing double stars.

The above information has been listed only as a *basic* guideline in choosing the proper eyepiece. As you gain experience with this marvelous optical system, you will undoubtedly develop your own personal preferences as to which eyepiece is best for a particular application.

Nevertheless, a *complete set* of eyepieces will certainly complement your observations and add a great deal of versatility to your instrument's optical capabilities

A "well rounded" and complete set of eyepieces would include the following focal lengths: 50mm, 30mm, 18mm, 12.7mm, 9mm and 6mm.

Of course, Criterion offers many types of fine eyepieces in various focal lengths as optional equipment, and we would be happy to suggest which eyepiece(s) is best suited to your needs upon request.

Chapter 9 — Observing Facts And Hints

Since you own a Dynamax telescope, you have certainly purchased the finest optical system money can buy. The "space age" techniques that were employed to manufacture each of the optical components of your telescope, combined with the most advanced laser testing methods known today, guarantee you the ultimate in superlative optical performance. Resolution is so fine, in fact, that Dynamax owners frequently report exceeding theoretical values.

But, superfine resolution is more than just a matter of precision optical quality. There are many factors that will limit the performance of your Dynamax that you must be aware of, some of which involve the nature of the human eye itself, and others that deal with proper observational techniques that should be employed. We will now discuss some of these factors in detail.

The Optics Must Adjust To Ambient Temperature:

If you store your instrument indoors in a warm room, you must allow ample time for the optics to become adjusted to the colder outside air when brought outdoors. The amount of time this will take depends upon how cold the outside temperature is. As an example, if the inside temperature is 70° and you will be using the telescope outside in 30° weather, allow at least 30 - 45 minutes for the optics to reach thermal equilibrium. If the difference in temperatures is more extreme, more time will be required; if the difference in temperatures is less extreme, less time will be required for the optics to adjust to their surroundings.

It is a good idea to point the tube *straight up* while letting the optics adjust to the outside temperature. Since warm air rises, and since the corrector lens at the front of the telescope transmits the infrared, warm air inside the tube will rise and escape through the lens more readily when the tube is pointed straight up.

If the Dynamax is not allowed to reach thermal equilibrium, poor performance will result due to convection air currents within the telescope tube.

All telescopes, regardless of design or manufacture, will require this thermal adjustment. Many observers set up their instrument ready for use, then go back indoors where they can leisurely look up and write down various objects to be observed in comfort while the telescope is adjusting to the cold outside air.

Telescope vs. Atmosphere

The optical performance of any telescope, regardless of design or optical quality, is only as good as "seeing" will permit. Good or bad seeing depends upon the homogeneity, steadiness and transparency of the air in our atmosphere through which the telescope must "see" celestial objects.

We must keep in mind that the air in our atmosphere ranges from 10 miles thick at the Zenith (the Zenith point lies directly overhead) to over *100 miles* thick at the horizon. This massive body of air is always in motion — updrafts, downdrafts, swirls, eddies — all of which is referred to as "turbulence" and can totally obscure the fine detail you are seeking in a celestial object.

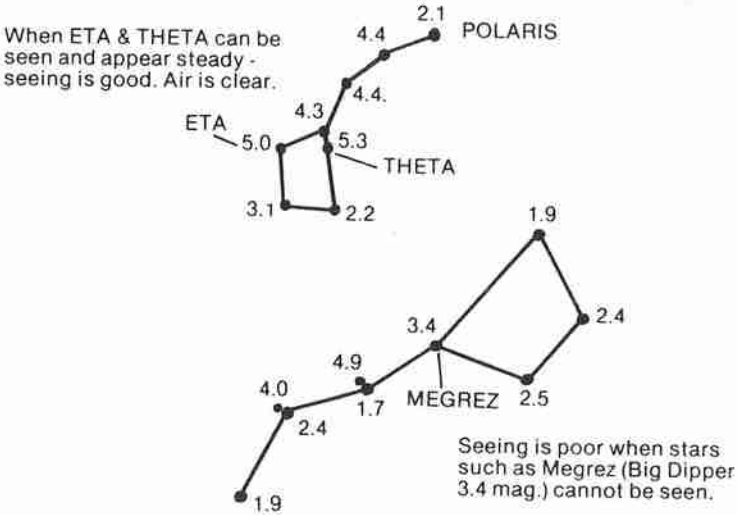
Unfortunately, we have no control over this atmospheric turbulence. We can, however, take certain steps which will at least minimize its degrading effects on our image.

First, avoid viewing images on or near the horizon (where the air is thickest); try to view objects when they have risen as high as possible in the night sky. Of course, the best viewing is at the Zenith where the air is thin. An old rule of thumb tells us "any object that isn't at least 30° or more above the horizon isn't worth viewing".

Secondly, high power magnifies your image — but it also magnifies atmospheric turbulence as well! Staying at low power will tend to minimize the poor effect of turbulence so that it is less annoying; use medium to high power eyepieces only when seeing is excellent.

There are actually two factors to consider when judging seeing conditions — *turbulence and transparency.* If the stars are "twinkling", the air is turbulent; when the stars shine with a steady light, seeing is good. You can check for turbulence by centering a bright star in the field of a medium powered eyepiece (18 or 12.7 mm). Throw the star *out of focus* and study the resultant image. You should see a bright circle of light with a black central area. If the air is turbulent, it will cause this out of focus image to appear "shimmering" and "wavy". On the other hand, when the air is steady, the out of focus image will also appear steady, showing only an occasional slight wave or ripple.

Transparency is also a key factor in judging sky conditions. Good transparency simply means the air is clear and free from clouds, haze, fog or smog. Transparency is poor when stars such as Megrez (Magnitude 3.4) in the Big Dipper cannot be seen. Transparency is excellent when stars such as Eta and Theta Minoris (Magnititude 5) in the Little Dipper can be seen clearly as illustrated below.



On a theoretically "perfect" night, the air is not only crystal clear, but also very steady. These nights are rare indeed, and it may not be necessary to wait for that "perfect" night, depending upon the object to be observed. Here are some helpful hints on what kind of "seeing" is desirable with respect to certain objects.

Galaxies, Nebula, Clusters

These objects (known as "deep sky" objects) will positively require near perfect transparency since they are extremely faint, low contrast subjects. Not only must the air be extremely clear, but also the sky must be very *dark* as well. There must be no excess streetlights, houselights, etc. in your observing area which will hamper detection of faint, nebulous detail. Also, do not observe deep sky objects in a moonlit sky. If the moon is out — it's not your night for viewing faint objects.

Although the air must be clear when observing faint objects, it does not necessarily have to be steady. Deep sky objects can withstand a certain degree of turbulence without too much ill effect, unlike extended objects such as the moon or planets where *steadiness* is the prime consideration.

Some galaxies and nebula are so dim that their presence will be *undetectable* unless the sky is very dark and clear. The moon and planets, however, will not require this degree of transparency because they are very bright. Believe it or not, it is actually preferable that the air be slightly hazy when observing planetary detail, because the haze will act as a natural "filter" which can actually improve contrast on some of the brighter planets such as Jupiter. A slight haze or thin fog also usually indicates that the air is steady and *steadiness* is the prime factor in successfully observing fine detail on the moon or planets. However, even with steady air, planetary detail will not be constantly apparent, but instead, detail will "fade in" and "out" with minor atmospheric variations. You must, therefore, look carefully and wait for that elusive moment when all the detail seems to "fade in".

Double stars also require good, steady air. Excessive turbulence in the air will cause a star image to "swell" to a size much larger than normal, and appear "broken up" into many small "boiling" points of light. This swelling and boiling effect will certainly prohibit splitting close doubles on nights of poor seeing. So, once again, steadiness of the air will be more important than transparency when observing double stars, as most double stars are bright enough to withstand a slight haze in the air.

When can we expect good seeing? Many astronomers note that the best seeing often occurs 24 to 48 hours after the passage of a cold front, at which time the air becomes very clear and still. Also, turbulence is more likely to be at a minimum between midnight and sunrise, with best seeing often occuring shortly before dawn. Other astronomers report best seeing for moon and planets occurs right at sunset when temperature reached during the day has not yet begun to drop for the night. Finally, a mild steady breeze is sometimes helpful in minimizing turbulence. However, all of the above information is quite variable and will differ with your geographical location. With practical experience, you will soon learn which time and conditions render the best seeing in your particular area.

There are many other factors that can hinder telescope performance. Avoid looking over the roofs of houses or buildings where heat will apt to be rising as well as interverning smokestacks or chimneys. Also, avoid looking over pavement, whether concrete or black top, as this becomes heated during the day and heat from these sources continues to rise during the night. Finally, never observe through windows, whether open or closed.

Eyes Must Be Dark Adapted

When observing faint celestial objects such as star clusters, galaxies, and nebula, the human eye must be at its maximum sensitivity to visible light. Maximum sensitivity is reached by simply letting the eyes adapt to the dark. This will take at least 15 minutes, but the eye does not become *fully* dark adapted for half an hour. If the weather is cold, you can dark adapt your eyes by staying comfortably indoors in a dark room. Meanwhile, the telescope is set up outside and it also is adapting to the cold weather (as mentioned earlier).

The eye is least sensitive to the color red when dark adapted, and most sensitive to blue or green. For this reason, *always* use a red filter on your flashlight if you want to look at maps, notes or setting circles. Using red light for illumination will maintain your "night eyes", enabling you to detect faint objects with maximum sensitivity.

Brighter objects, such as the moon or planets, will not require dark adapting prior to observation.

Averted Vision

Averted vision is a technique used by experienced astronomers to increase visual acuity by one or two magnitudes when observing faint celestial objects. Especially useful when observing star clusters, this technique involves centering the object in the field of view, then glancing to one side of the field instead of looking directly at the centered object. This technique is extremely helpful when observing faint objects because the outer portion of the human eye is more sensitive to low light levels than the central portion.

Additionally, certain parts of the outer portion of your eye may be more sensitive than others. When observing a faint object, gaze all around it to find out which part of your eye seems most sensitive.

Position Your Eye Properly

For best results, your eye should be positioned neither too near or too far from the exit pupil of the eyepiece. If your eye is too far away from the eyepiece, you will not be seeing the entire field of view. If too close to the eyepiece, you may not see anything at all. The distance between the eyepiece and eye will vary with the eyepiece you are using, high power requiring a closer eye position than low power for best results. With this in mind, experiment by placing your eye at varying distances from the eyepiece to determine which position seems best for you.

Finally, the eye must always be *centered* in relation to the eyepiece, but at no time should it actually touch the eyepiece during observation. You may find it useful to cup your hands around the eyepiece to guide you until your eye is properly centered.

On Wearing Glasses

Whether you should wear your glasses or not during observation is a matter of personal preference. Try viewing with and without your glasses to determine what is best for you.

Generally speaking, far sighted people will get better views by removing their glasses. Near sighted people, on the other hand, should probably observe with glasses on. However, extremely near sighted people may find that they cannot get close enough to the eyepiece (especially a high power eyepiece) with their glasses on. One remedy is to move back from the eyepiece a bit and sacrifice some of the field of view. The other alternative is to use an eyepiece with an extended eye relief. Criterion can supply a 50 mm Hastings eyepiece which is designed especially for those who encounter this type of difficulty. Incidentally, the 50 mm Hastings is also ideal when used for eyepiece projection photography because of its large exit pupil. The price of the 50 mm Hastings can be found on Criterion price lists and is generally kept in stock as an accessory item.

Eye vs. Photograph

The beginning astronomer must learn to develop an "eye" for observing. Do not expect all celestial objects to look exactly like their photographs that appear in books or magazines. Unlike the human eye, which only sees light momentarily, photographic emulsion accumulates and stores light during exposure. The longer the exposure, the more detail is "built up" and recorded on film. We can, therefore, expect that celestial photographs will often clearly reveal details that are too faint to be seen visually by the observer. Since the eye cannot record and "build up" light as film does, you will have to learn to look very carefully for those faint wisps of detail that are detected only by the fully dark adapted and "trained eye" of the skilled observer.

In some cases, celestial objects viewed through the telescope will not be the same color as portrayed by photographs. This phenomenon is caused by the difference in spectral response between the eye and color film. A good example is the Orion Nebula (M-42) which is almost always primarily red and purple in photographs, yet when visually observed through the telescope, it appears primarily green to the eye of most people (some people see only white). The mystery of this color difference is solved when we consider that the spectral response of the human eye becomes most sensitive to green or blue, and least sensitive to red, when fully dark adapted. Most color film, on the other hand, is more sensitive to the red region of the spectrum and hence records more red than green. So, a good question arises: "What then is the *true* color of the Orion Nebula?" We will leave this question unanswered as excellent food for thought!

The Orion Nebula is a fine example of an object that does not appear identical to its photos in various other respects as well. When observed visually, for instance, you can clearly see four bright stars in the center of the Nebula which are commonly referred to as the "trapezium". yet, the trapezium is not visible in photographs because it is always greatly overexposed photographically. In order to record the faint wisps of nebulosity at the outer edges of the Nebula, the astrophotographer must necessarily *overexpose* the brighter central region that contains the trapezium, thereby causing the four stars to be totally "washed out" of the photograph. So where the eye clearly shows four stars — the photographs show a large overexposed white area.

We mention all of the above information in order to help avoid confusion when you compare photographs to actual observations of a celestial object. Keeping all of this in mind will hopefully help achieve a better understanding of the proper relationship between eye and photograph.

Dewing Of The Front Lens

On certain nights, you may notice dew forming on your front lens, especially in damp climates. When this occurs, you will notice a sharp decrease in brightness and clarity of the image you are observing. You may wipe the dew away using a soft tissue provided the lens is not extremely dirty; just be sure to wipe *gently* so as not to scratch the delicate surface of the lens. Dew can also be removed by blowing a warm stream of air from a portable hair dryer over the surface of the lens. However, in both cases above, the dew will undoubtedly continue to form within several minutes after you remove it. For this reason, it is preferable to *prevent* the dew from forming at the outset of an observing session. This will require what is commonly known as a "dewcap".

Dewcaps need not be fancy or expensive. It is not necessary to purchase one because you can fabricate your own, in most cases, for under $2.00. Most stationery stores sell "posterboard", which is commonly used in grammar schools for children's art and science projects. Black poster material is available in various sizes and thicknesses and can be easily wrapped around the front of the telescope tube and taped in place. It is generally quite durable and very inexpensive.

An excellent dewcap may also be made from black plastic sheet. Once again, plastic sheet is commonly available in various sizes and thicknesses, and is very durable and inexpensive. Another suggestion is to use blotter board.

Regardless of the material being used, the method of fabrication will be the same. Simply wrap the material around the front barrel and tape it in place with masking tape. It is preferable but not absolutely necessary that the material is a flat black for best results. If you cannot locate black material, spray the inside surface with flat black paint. The dewcap should protrude at least 6" or more from the front lens — there is no limit to maximum length (generally the longer, the better). Just be sure that the dewcap is taped in such a manner that it is reasonably concentric with the tube and that the seam is overlapped.

What other materials can be used? When you are "in a hurry", just about anything will do. We have seen many amateurs using ordinary cardboard, and it is also not uncommon to simply wrap a few sheets of newspaper around the tube! In all of the cases above, dew will positively be avoided without going to any great expense, unless you live in an excessively damp climate.

Bringing The Telescope Indoors

Dew might also form on the front lens when the instrument is brought indoors after a night of observing. This process is quite normal and there is no cause for alarm. When this occurs, *do not* wipe the lens dry. Just set the instrument down at a safe distance from sources of extreme heat such as a fireplace, and the dew will dry and disappear all by itself within 15 minutes or so after the lens readjusts to room temperature. No residue of any kind will be left by the dew, and dew formation can never injure your lens in any way. However, you should *not* place the lens cover over the lens nor should you put the Dynamax into its case until the lens is dew-free.

The Importance Of Being Relaxed

The final lens of any visual telescope is the human eye itself.

This "living" optical system depends upon a complex network of blood vessels and capillaries in order to maintain maximum sensitivity of the nerve cells and retina. The astronomer must therefore avoid uncomfortable, contorted positions that strain the body and prohibit proper blood flow, which the eye relies upon for nourishment. Even twisting the head too much will constrict the neck arteries and hence diminish the eye's overall efficiency and sensitivity. We must, therefore, learn to be comfortable while observing and, above all, relaxed.

A heavy duty outdoor table of some kind (large plank picnic table, etc.) seems ideal for observing comfort. You can relax in a seated position, rest your arms on the table, and also have a convenient place for your maps and notes. Just be sure the table you will be using is sufficiently solid and sturdy enough to adequately support the Dynamax on its latitude adjusters. A stable platform is essential in order to maintain a steady image for careful observation and study.

Many people, however, do not have the availability of a sturdy outdoor table — and you can't bring one along on a field trip to a dark, remote observing site! For this reason, Criterion offers the field tripod as an optional accessory. Since this tripod is adjustable in height, we suggest that you use it in conjunction with a lightweight lawnchair. Adjust the height of the tripod so that the telescope eyepiece is at a favorable position when you are comfortably seated. On the other hand, if you prefer a standing position, extend the tripod's "telescoping legs" as far as necessary until you can look comfortably through the eyepiece without excessive bending, squatting or other contorted positions. Always try to assume an observing position that is relaxed and "natural", and one that seems most comfortable for you.

Whether you use a "table top" or tripod, be sure to rotate the convenient star diagonal in the eyepiece adapter until it is suitably placed. This will save a crick in the neck and make it easier to center your eye over the eyepiece. Then focus carefully, engage the clock drive, and completely remove your hands from the telescope. Relax and study the object carefully. Because of "seeing" conditions (mentioned earlier), planetary detail will "fade in and out". When you are comfortably seated and relaxed, you can study a planetary image for extended periods of time without strain, and patiently await those times when the atmosphere momentarily becomes still and allows fine details to "fade in". Take a long time scrutinizing the image and observe patiently; the longer you observe, the better are your chances of catching that elusive yet priceless moment of perfect "seeing" when the finest detail is allowed to pass through the atmosphere.

To avoid eyestrain, it is also suggested that you try to keep both eyes open while observing. This is hard to do — even with practice; so to make it easier, try cupping your hand over one eye while both eyes are open. This will allow your eyes to be less strained and more relaxed, thereby adding better perception to your observing. We also feel that strapping an eyepatch over one eye is a totally overlooked but excellent idea which makes keeping both eyes open while observing easiest of all. Of course, friends may think you look silly, but if you are obserivng alone in your own backyard, who will ever know the difference?

Chapter 10 — Interesting Celestial Objects

The Dynamax is in its equatorial position and set on Polaris, clock drive is on, eyepieces are ready and waiting, and seeing is good. But what do you look at now that you know how to use the instrument? Well, the first thing you should do is procure a reliable atlas such as *"Norton's Star Atlas"* (see recommended reading) which contains a list of interesting objects to observe in each constellation and shows you their relative celestial positions. But you are probably anxious to put your new Dynamax to work at once, so we list here a few of the more "famous" objects that newcomers will enjoy viewing.

Moon And Planets

The Moon

Of first interest to the new astronomer, the moon must head the list. Lunar details are a constant source of marvel for even the experienced, and can be studied for hours on end. Start off with your low to medium power eyepieces.

Jupiter

This huge, fascinating planet provides endless enjoyment for any observer. Study this object carefully — look for horizontal bands across the planet and notice the changing positions of the four bright moons. Jupiter is well placed in the winter sky.

Saturn

Probably the most unique object in all the heavens, this remarkable planet boasts a beautiful system of concentric rings. Faint belts can sometimes be seen on the planet's disc and also look for the shadow of the planet on the rings. Saturn is always an impressive object through the telescope and many people comment that they have never forgotten their first view of Saturn. Take a good long "first look" as you will also probably never forget it. Well placed in the winter sky.

Nebulae

Great Orion Nebula (M-42)

One of the brightest nebula, this object is located in the middle of Orion's sword and may be detected with the naked eye as a "hazy" star. its glowing, gaseous cloud structure surrounds four bright stars known as the "trapezium". Well placed in the winter sky., CONSTELLATION ORION (R.A. 5h 32m, DEC. -5° 25′).

Ring Nebula (M-57)

This outstanding object lies almost directly overhead throughout the summer. Approximately 5000 light years away, it is interesting to keep in mind that the light from this nebula as seen in your eyepiece, departed for earth back in prehistoric times! The ring nebula is so named by its shape — an almost perfect "smoke ring", of glowing dust and gas suspended in outer space. Well placed in the summer sky. CONSTELLATION LYRA (R.A. 18h 52m, DEC. +32° 58′).

Dumbell Nebula (M-27)

A gaseous nebula appropriately named for its interesting shape which somewhat resembles a dumbell. This large, bright nebula lies just southeast of the bottom part of the "Northern Cross" (the constellation Cygnus is often referred to as the Northern Cross). Well placed in the summer sky. CONSTELLATION VULPECULA (R.A. 19h 57m, DEC. +22° 35′).

Star Clusters

Great Globular Cluster in Hercules (M-13)

Perhaps the finest globular cluster in the sky, this object is made up of hundreds of thousands of stars tightly compacted together in a circular shape. This stunning concentration of stars with a glowing central core is sure to always be a breathtaking sight at low to medium powers. Well placed in the summer sky. CONSTELLATION HERCULES (R.A. 16h 40m, DEC. +36° 33′).

M-92 in Hercules

Another fine example of a compact globular cluster, this object resembles M-13, but is smaller and more compact. Well placed in the summer sky. CONSTELLATION HERCULES (R.A. 17h 16m, DEC. +43° 12′).

Double Cluster in Perseus

This object contains two large open clusters located in the Northern sky, and separated by only ¼ degree. Sweep across the area at low power and explore both clusters for a most impressive sight. The Double Cluster is bright enough to be seen as a hazy patch of light with the naked eye. Well placed in the winter sky. CONSTELLATION PERSEUS (R.A. 2h 19m, DEC. +56° 54′).

M-37 in Auriga

A fine, rich cluster — striking in appearance when viewed at low power. The brightest star, near the center is reddish. This beautiful array of stars lies in Auriga, which is just north of Orion. Well placed in the winter sky. CONSTELLATION AURIGA (R.A. 5h 49m, DEC. +32° 32′).

There are thousands of other interesting objects to observe and a good star atlas will tell you what they are and where to find them. But please keep in mind that locating and observing celestial objects is a skill that must be fully developed. And, as with most skills, there is simply no substitute for experience, knowledge, perseverance and patience. In order to be truly rewarding, the hobby of astronomy requires not only these attributes but also good seeing and high visual acuity.

So we cannot just take a quick glance in the eyepiece and expect to automatically see detail in a celestial object. Instead, we must carefully study the image with a good deal of patience and concentration, waiting for those elusive moments of good seeing.

And, finally remember that the air must be very *steady* when observing planetary detail. It is not necessary to have perfect *transparency*. Deep sky objects, on the other hand, will require excellent *transparency* and very *dark* skies (steadiness is not a prime concern).

Chapter 11 — Photography With Your Dynamax

Adapting Your Camera:

If you own a 35mm SLR (single lens reflex) camera with a fully removable lens and a focal plane shutter you may wish to explore the exciting field of astrophotography or daytime telephotography with your Dynamax. First, however, you will need a universal "T" thread adapter for your camera. This is a low cost item available at most camera stores and widely used among professional photographers. Criterion stocks these adapters for many 35mm brand name cameras (see price list), but if for some reason we do not carry the adapter for your particular camera, you can obtain one at your local photo dealer. Just be sure to ask for a *universal "T" Thread adapter* for your camera and bring the camera along to avoid any mistakes. *(Do not ask for a "T" mount* adapter which is something entirely different.) A "T" thread adapter is simply a knurled aluminum ring fitted with an appropriate (either bayonet or screw type) lens mount for your particular camera. The inside of the adapter will be machined with universal "T" threads which will enable you to couple your camera to the "T"-threads found on all Criterion photographic accessories.

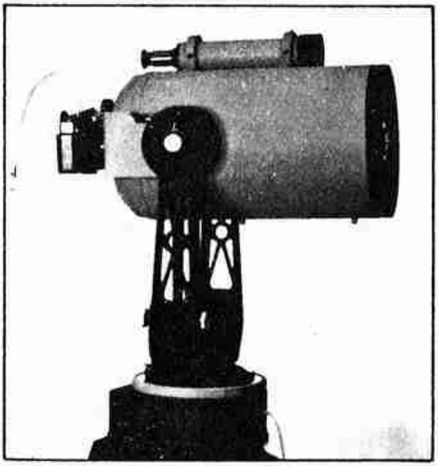
By utilizing the "T" thread system almost any 35mm camera can be used with the Dynamax. However, the camera *must* be of the single lens reflex type or there will be no way to focus the image. Also, cameras with a compur shutter cannot be used because the lens can't be removed and, consequently, there will be no means of attaching the camera body to the telescope.

Larger format (2¼ x 2¼) cameras can also be used with the Dynamax, but a "T" thread adapter for larger cameras may be difficult to obtain. In many cases, an adapter must be custom made at a local machine shop — but first you should seek the advice of a reliable photo dealer in your area as to the easiest way of obtaining one.

Using The Dynamax As A Telephoto Lens:

With the addition of a 35mm camera body, the Dynamax telescope becomes the world's sharpest long range telephoto lens. In this configuration, the camera lens is removed and replaced by your "T" thread adapter. This in turn enables you to couple the camera body to the *Criterion cassegrain focus adapter* which will place the film plane at the f/10 cassegrain focus of the Dynamax optical system.

The cassegrain focus adapter consists of a knurled ring that attaches to the rear threads of the Dynamax (in place of the eye-



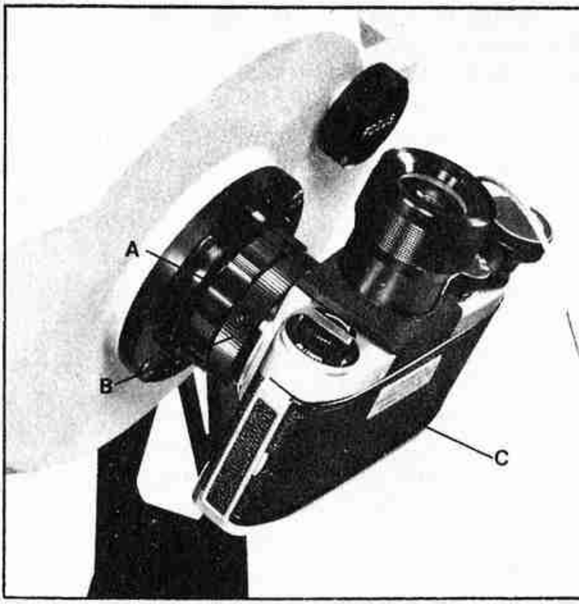
The Dynamax Telephoto System

piece adapter), and incorporates a "T" thread on one end that will accept a T-thread adapter for your particular camera. The Dynamax thus becomes the camera lens.

TO ATTACH YOUR CAMERA TO THE DYNAMAX FOR TELEPHOTO USE:

1) Unscrew eyepiece adapter from the Dynamax thereby exposing rear threads.
2) Screw the knurled ring of the cassegrain focus adapter onto rear threads.
3) Remove the lens from your camera and replace it with a universal "T" thread adapter.
4) Screw camera onto the "T" threads of the cassegrain focus adapter.

NOTE: The Cassegrain focus adapter is a "slip ring" type fitting. Loosening the large knurled portion of the adapter will allow you to swivel the camera into any desired position.



A) Cassegrain Focus Adapter
B) Universal "T"-Thread Adapter
C) Camera Body

Once the camera is attached to the Dynamax, as described, you are ready to photograph as follows:

1) Locate target in finderscope and center on crosshairs.
2) Look through the camera's viewfinder and focus the image very carefully on the groundglass.
3) Set camera shutter speed for a correct exposure (explained below).
4) Lock mirror up (if camera has this provision) to minimize vibration.
5) Using a cable release, make the exposure.

The relatively fast f/10 photographic speed of the 1524 mm Dynamax 6 or 2000 mm Dynamax 8 optical systems will allow you to shoot sunlit objects at shutter speeds of 1/125 to 1/2000 of a second with fast color films such as GAF 500 (ASA 500) or High speed Ektachrome (ASA160 — Kodak will "force process" this film at ASA 400 at your request). Compared to a 50mm camera lens, the Dynamax 6 will render 30x and the Dynamax 8 will render 40x magnification at the camera's focal plane.

Correct exposure is best obtained by using a camera with a built in, "through the lens" light meter. Most of the better 35mm cameras available today have this feature, such as Nikon, Canon, Minolta, etc. Many of these cameras, however, have light meters

that couple directly to a lens diaphragm built into the lens supplied with the camera. For this reason you will have to consult your camera instruction manual for any necessary adjustments that will compensate for the lack of a lens diaphragm coupling when using the light meter in conjunction with telephoto lenses.
The adjustment is usually very simple; the Nikon F/2, for instance, merely requires pushing the coupling pin into the light meter with your fingernail. After this adjustment is completed, you can use the camera with any telephoto lens and obtain a correct exposure by adjusting shutter-speed and using the light meter in the usual way. The Canon F 1 has a similar adjustment that is also very simple — you merely lock the "depth of field" lever in place and the meter is ready for telephoto use.

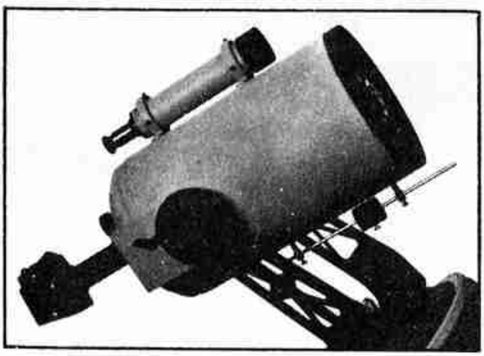
Once you have made the required adjustment (if one is necessary) simply attach your camera to the Dynamax and adjust shutter speed until the light meter indicates a correct exposure.

If you do not have a built in, "through the lens" light meter, you will have to use an incident light meter. Set the meter to F/10 to obtain the proper shutter speed.

Finally, be sure to lock the mirror up (If your camera has this provision) before exposure. This will eliminate the slight vibration caused by "Mirror slap" in the camera body.

Chapter 12
Astrophotography With The Dynamax

The fascinating and rewarding hobby of astrophotography offers a wide variety of challenges. There is Lunar and planetary photography, constellation and wide field photography, and deep sky photography. And, while it is true that each of the above requires a different type of photographic technique, all forms of astrophotography share one thing in common — they rely on the electric clock drive to accurately track the celestial object during exposure. Accordingly, Criterion offers two optional accessories which will insure peak efficiency and maximum accuracy of your clock drive during astrophotographic exposures — the counterweight set and the drive corrector.



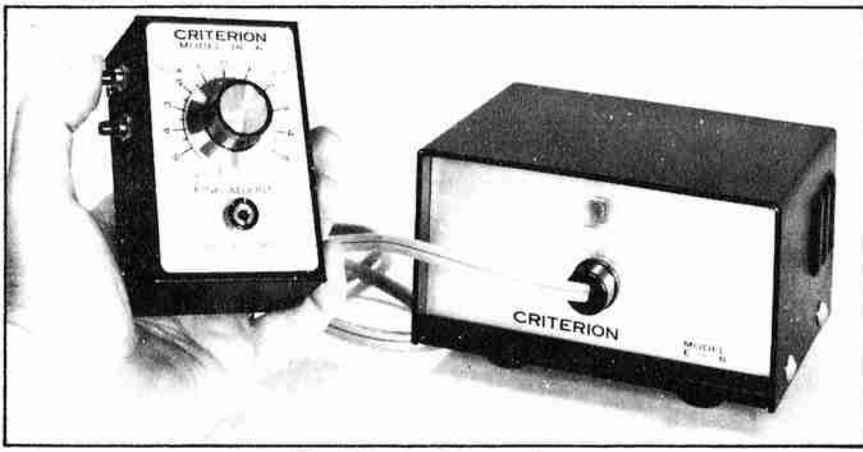
The counterweight set attached to the Dynamax tube.

Counterweight Set:

The extra weight of your camera and accessories coupled to the Dynamax will cause an unbalanced load on the electric clock drive. Although this cannot harm the clock drive mechanism, (due to built in safety clutches,) the accuracy of the clock drive may be affected unless the unbalanced load is offset. For this reason Criterion offers the counterweight set, which enables you to add extra weight to the front of the telescope tube, thereby counterbalancing the added weight of extra equipment attached to the back of the tube.

The counterweight set consists of two threaded fittings, counterweight rod, and one counterweight. The two threaded fittings supplied with the counterweight set couple directly to the two special fittings built into the underside of every Dynamax telescope tube. The counterweight rod is then slid through the fittings and the counterweight is positioned on the rod as desired.

Sliding the counterweight towards the front or back of the telescope will restore proper balance when extra photographic equipment is added to the Dynamax. The position of the counterweight will be determined by the amount of camera equipment and its distance from the rear of the telescope tube. In some cases, it may be necessary to extend the counterweight beyond the front end of the telescope in order to achieve a balanced condition.



The Criterion Dynatracker

The Drive Corrector:

The Criterion drive corrector (trademarked DYNATRACKER) allows you to speed up or slow down the driving rate of the clock drive motors, to compensate for what is known as "image drift" during astrophotographic exposures. Image drift can be minimized by precise polar orientation of the fork mount, but even then, there are other factors that will cause a celestial object to drift in the field of view by an amount that is so slight, the observer will never notice it visually. Film, however, records even the slightest movement as a disastrous blur, so the astrophotographer must not just minimize image drift but rather *eliminate* it completely if the astrophotograph is to be of truly high quality.

What are some of the factors that cause this slight drifting of a celestial object during an exposure? One factor to consider is that different celestial objects apparently move across the sky at slightly different rates of speed. The moon travels at the lunar rate, planets at the planetary rate, and stars travel at the Sidereal rate.

But perhaps the most frequent cause of image drift is atmospheric refraction. We have previously mentioned that the layer of air directly overhead is substantially thinner than the layer of air at the horizon. This means that light from a celestial object will be refracted at different angles as the object moves across the sky through varying thicknesses of air. These changes in the angle of refraction create slight changes in the rate of a celestial object during an astrophotographic exposure.

Finally, inhomogeneities in the upper stratosphere as well as the shifting of large air masses in the lower atmosphere will also vary the angle of refraction, thereby causing slight oscillations of a stellar image.

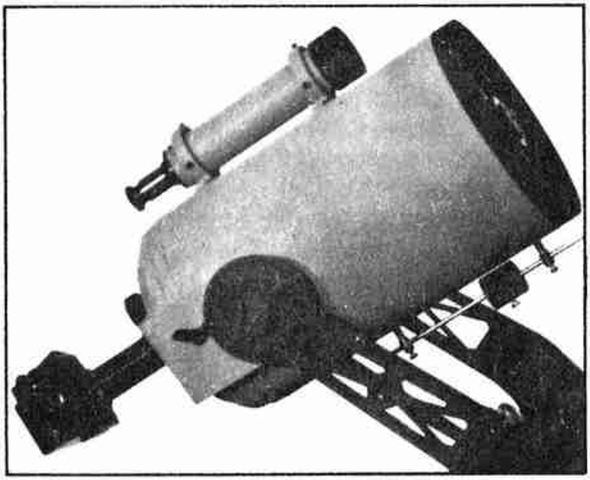
Image drift is fully compensated by using the Criterion Dynatracker (separate instructions are included with this unit). The Dynatracker can be operated from either a 110V AC or 12V DC power supply and enables you to regulate and adjust the driving rate of the clock drive motors to eliminate image drift in R.A. during an astrophotographic exposure. Image drift in Dec. is corrected by using the manual Dec. control knob.

Deep sky photography of faint galaxies, clusters and nebulae, will require exposures of 15 minutes up to an hour or more, so a drive corrector becomes a necessity for this application as image drift will definitely become apparent over such long periods of time.

Lunar and planetary photography on the other hand, requires relatively short exposures (up to 15 seconds) so image drift will not be as significant. Although this means that a drive corrector is not absolutely necessary for this particular application, using the Dynatracker is highly recommended as it will insure precision tracking of the moon or planets at the true lunar or planetary rate.

(For more information on the Dynatracker — see "Facts and Hints on Polar Alignment" — page 29.)

To summarize, the astrophotographer must concern himself with precision tracking requirements which are of little or no significance to the visual astronomer. In most cases, the degree of accuracy with which you track the celestial object during the exposure will determine the quality of the finished portrait. Using the optional counterweight set and Dynatracker Unit will enable you to meet the precision tracking requirements (provided your polar alignment is accurate) and, keeping this in mind, we are now prepared to discuss the various types of astrophotography and the proper photographic techniques and accessories that will be used for best results in each case.



Dynamax ready for planetary photography.

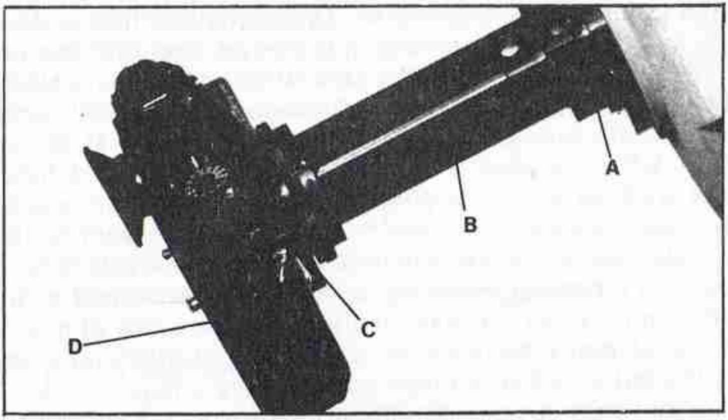
Planetary Photography:

At the f/10 cassegrain focus of your Dynamax, photographic planetary images will be too small to render suitable detail on a 35mm negative. Darkroom enlargement of this tiny image will only result in excessive grain that becomes most objectionable in the finished portrait. The planetary photographer must therefore obtain a magnified image on the negative by using higher power. For this reason, Criterion offers the Telextender, which provides a means of utilizing a high power eyepiece to enlarge the image before it reaches the film plane of your camera. The eyepiece first magnifies the cassegrain focus image and then projects it onto the film. The result — a larger planetary image that shows greater detail, requiring little or no enlargement. This photographic technique is commonly referred to as the *eyepiece* projection method.

The Telextender is basically a long tube that threads over the eyepiece adapter where an eyepiece is held in place. One end of the telextender is externally machined with "T" threads that will couple to your "T" thread camera adapter.

To set up the Dynamax for planetary photography using the Telextender:

1) Attach the eyepiece adapter to the rear threads of the Dynamax.
2) Insert an eyepiece into the adapter and tighten set screw.



A) Eyepiece Adapter
B) Telextender Tube
C) Universal "T"-Thread Adapter
D) Camera Body

3) Screw Telextender tube onto the eyepiece adapter threads.
4) Remove the lens from your camera and replace it with a universal "T" thread adapter.
5) Screw camera onto the "T" threads of the Telextender tube.

Once the Dynamax is set up as above, the exposure is made as follows:

1) Orient the mounting to track as accurately as possible and switch on the clock drive. Locate planet in finder-scope.
2) Look through camera and focus image very carefully on the camera's groundglass.
3) Set your camera shutter speed and cable release for a time exposure.
4) Hold a piece of cardboard (painted flat black) or other material in front of the telescope lens to block out all incoming light to the camera.
5) Using cable release, open camera shutter and wait a few seconds for any residual vibration to settle out.
6) Remove cardboard from front of telescope and "count out" your exposure in seconds.
7) When exposure is completed, again place the cardboard in front of the telescope lens and then close your camera shutter.

Exposure times of the planets will vary from 1 to 5 seconds with High Speed Ektachrome using a 12.7 mm eyepiece. With slower films, such as Kodachrome, exposure times will be slower

— on the order of 5 to 15 seconds. Unfortunately, trial and error is the only sure way to obtain correct exposure times for the planets which will vary with atmospheric conditions, celestial position and the planet's distance from earth. Therefore, we recommend that you *bracket all your shots.* Keep a careful record of the photographs and their relative exposure times so that next time you will have a better idea of the right exposure based upon previous results. You might start out, for instance with an 18mm or 12.7mm for a projection eyepiece. Then take two or three photographs each using a 2 second exposure, repeat with a 3 second exposure, 4 seconds, etc. Go all the way up and down the scale of exposures and shoot as many pictures as possible. The more pictures you take — the better are your chances of getting one good one.

To avoid unnecessary disappointment, you should not expect to get a "perfect" photograph on your first attempt. Even professional astronomers follow a universally accepted "golden rule" of astrophotography; to get one good astronomical photograph — take a lot of pictures and be prepared to throw most of them away!

Finally, remember that when you use the eyepiece projection method, you are operating at a very high power, and therefore, vibration of the camera shutter will become quite noticeable. For this reason, we have suggested placing a piece of cardboard (sprayed flat black) in front of the telescope which will effectively take the place of the camera shutter. Using the cardboard as a shutter is an accepted way of eliminating vibration in planetary photography and this method is the one most commonly used among professional photographers.

Lunar Photography

The moon may be photographed at the f/10 cassegrain focus of your Dynamax or you may also use the eyepiece projection method for "high power" photography of lunar detail.

Cassegrain focus photography of the moon is accomplished by setting up the Dynamax as a telephoto lens as described earlier. This method, of course, will allow much faster shutter speeds than will the eyepiece projection method. For instance, an f/10 cassegrain focus photograph of the full moon on High Speed Ektachrome might require a shutter speed of only 1/250 second. On the other hand, using the telextender with a 30mm eyepiece for projection will probably require 1/15 second.

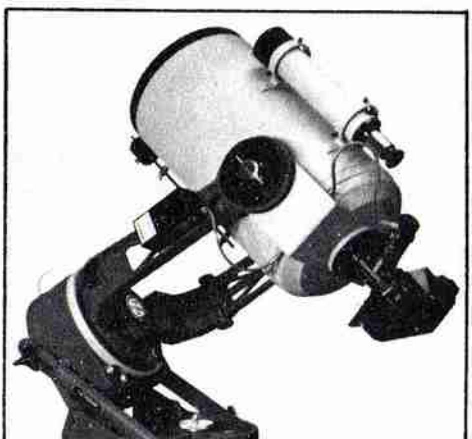
Whether you use the telextender tube for eyepiece projection or shoot the moon at cassegrain focus, correct exposure will be obtained by trial and error and "bracketing" your shots. Exposure times will vary with the phases of the moon as well as its relative celestial position and atmospheric conditions, so it is indeed difficult to determine a precise shutter speed.

We suggest the beginner start out by shooting the full moon — at cassegrain focus using High Speed Ektachrome. Start out with a shutter speed of 1/250 second, then take photos at successively slower speeds of 1/125, 1/60, 1/30, etc. Likewise, be sure to also try faster speeds of 1/500, 1/1000. Once again, keep careful records of each photo to determine which shutter speed gave the best exposure, and take as many pictures as possible.

Deep Sky Photography

Deep sky photography of galaxies, nebulae and star clusters is perhaps the most rewarding form of astrophotography. However, exposure times will be quite lengthy (15 min. up to an hour or more) so the deep sky astrophotographer must be prepared to contend with precision tracking requirements which become very significant over such a long period of time. Tracking errors caused by "image drift" must be completely eliminated (see previous section on the drive corrector) if the astrophotograph is to be of truly high quality.

Unlike visual observation, where a slight drifting of a celestial object goes unnoticed by the human eye, the photograph permanently records and "remembers" even the most minute tracking error. So we learn that patience, perseverance, and above all, super-precise tracking, will be the keys to successful deep sky photography.



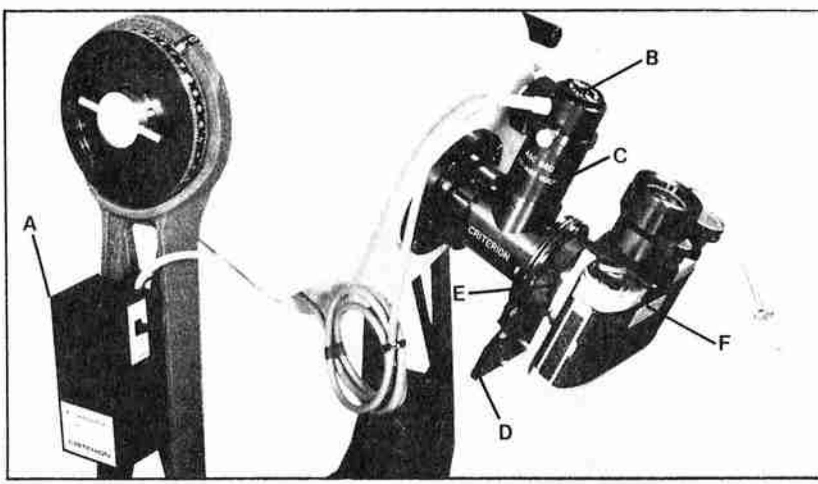
Dynamax ready for long-exposure deep sky photography.

The Off Axis Guider

When performing deep sky photography, the Dynamax owner can easily correct for image drift in R.A. by using the Dynatracker to electronically speed up or slow down the driving motors in the clock drive. Image drift in DEC. is easily corrected by manually adjusting the DEC. slow motion control knob which is purposely designed to provide extremely fine manual adjustment on this axis.

But, if we cannot actually see the image drift occuring, how will we know when to make a correction? Well, in order to *visually monitor* tracking accuracy during the exposure, Criterion has developed a valuable astrophotographic accessory — the off axis guider (complete instructions included). By using the off axis guider, you will be able to detect image drift as it occurs and quickly adjust the telescope's position on either axis to bring it back "on" target. In this way you will carefully guide the telescope throughout the duration of exposure.

The guider couples to the rear threads of the Dynamax in place of the eyepiece adapter, and positions the film plane of your camera at the f/10 cassegrain focus of the Dynamax. A tiny prism is mounted just ahead of the camera which deflects an off axis star image up to a powerful 9mm illuminated reticle eyepiece positioned at a right angle to the film plane. (The prism incidentally, in no way affects the photograph as it is internally mounted in the guider at the outside *edge* of the 35mm frame.)



A) Illuminator Power Pack
B) Illuminated Reticle Eyepiece
C) Off Axis Guider
D) Manual Shutter
E) Universal "T"-Thread Adapter
F) Camera Body

Once you have located a guide star of suitable brightness, you can easily detect even the slightest amount of image drift by centering the star on the illuminated crosshairs of the 9mm eyepiece and then monitoring its position in relation to the crosshairs constantly. If the guide star drifts off the crosshairs in R.A., you will use the "fast-slow" buttons of the Dynatracker to electronically re-center it again. If the guide star drifts in DEC., you will use the manual DEC. slow motion control knob for re-centering on this axis. Your goal is to simply keep the guide star perfectly centered on the crosshairs throughout the duration of exposure, thereby assuring a perfectly guided astrophotograph.

The Off Axis Guider comes complete with a 9mm illustrated reticle eyepiece, variable illuminator power pack and its own special shutter. The shutter is used when the guide star drifts too far from the center of the crosshairs. When this occurs, the shutter can be quickly closed, thereby instantly halting the exposure. This will allow re-centering of the guide star without any effect on the camera or photograph. After the guide star is brought back to the center of the crosshairs, the shutter is opened and the exposure continued.

Photography of deep sky objects such as galaxies, nebulae and star clusters is always performed at the f/10 cassegrain focus of the Dynamax. At f/10, you are using the fastest available photographic speed which offers the least amount of exposure time. But even at f/10, many deep sky objects are so faint that exposures of 30 minutes up to an hour (or more) will be necessary to capture suitable detail on the negative.

These lengthy exposure times pose a difficulty with respect to choice of film. Specifically, most commercially available films will not withstand exposures greater than 20-30 min. because of "reciprocity failure". Reciprocity failure is the inability of film to respond to low light levels over long periods of time and more importantly, the film's response to low light levels will not be proportional to exposure time. This means that the film simply *stops recording* detail after a certain amount of time (in most cases 15-30 min. is the limit). As an example you might photograph the Orion Nebula with Tri-X film using three different exposure times of, let's say 15 minutes, 30 minutes and one hour. Logically, the one hour exposure should record the most detail — but because of the reciprocity failure of Tri-X film, the 30 minutes and one hour exposure will probably record no more nebulosity than did the original 15 minute exposure! In other words, the film simply stopped responding after 15 min. — additional exposure time did not record any additional nebulosity or detail in the finished portrait.

There are several ways to combat reciprocity failure. The most direct remedy is to use a film made especially for astrophotography. Kodak Spectroscopic film (type 103-A, 103-AE or 103-F) can be obtained by writing to Eastman Kodak Co. who will supply full information on this specialized photographic emulsion. The Kodak Spectroscopic series of film has virtually *no* reciprocity failure — the longer the exposure the more detail it records, and it will continue to respond to low light levels even after many hours. However, it does have several drawbacks. First of all, it is very expensive and is usually sold only in bulk (100 foot rolls), secondly, you will have to develop it yourself, and finally, it is offered only in black and white.

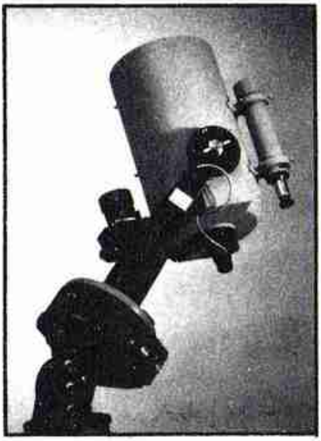
For color astrophotography, our best and only recommendation is to use Fujichrome R-100. This particular film has low reciprocity failure and will record just about all of the detail you will need with exposure times up to 30 minutes. But before you become too deeply concerned with choice of film, you should probably consider a specialized accessory which provides an excellent way of dealing with the problem of reciprocity failure — the focal reducer.

The Focal Reducer:

If exposures can be held to approximately 15 min., reciprocity failure of the film will be essentially eliminated. Additionally, a 15 min. exposure will greatly minimize the poor effects of atmospheric scintillation and should certainly reduce the amount of guiding errors in the finished portrait. In short, many of the problems associated with long duration astrophotography are remedied by using brief exposures. For this reason, Criterion has developed the *focal reducer* which is offered as an optional accessory, (complete instructions included). The focal reducer is a special lens that doubles the f/10 photographic speed of your Dynamax to f/5. At f/5, a nebula is *four times* brighter than at f/10, thereby reducing exposure time by a factor of 4. This means that a 15 minute exposure at f/5, will record just as much nebulosity and detail as a *one hour* exposure at f/10! Consequently, the shorter exposure times enable you to use almost any black and white or color film without concern for reciprocity failure when using the focal reducer.

The focal reducer is housed in a ring which couples to the rear threads of the axis guider (it will also couple to the cassegrain focus adapter) your camera is then coupled to the focal reducer by means of a "T" thread adapter.

Using the focal reducer will also reduce your image scale and this will result in a vignetted circular format on the negative. However, this smaller image scale will provide greater resolution at f/5 than would be achieved in a larger image scale at f/10, so although the image at f/5 is smaller, it may be greatly enlarged without loss of resolution. Many of the brighter nebulae will be beautifully recorded in color using 15-20 min. exposures on films such as Fujichrome R-100, fainter galaxies may require 20-30 minutes on the same film when using the focal reducer.



Constellation photography with the Dynamax using a standard 50mm camera lens, Criterion Power Pack, and illuminated reticle eyepiece.

Constellation And Wide Field Photography:

You can obtain stunning, wide field astrophotos of star fields and constellations by mounting your 35mm camera and lens on top (or bottom) of the Dynamax telescope tube. In this configuration, the clock drive provides a stable platform which tracks the stars during exposure, and the standard 50mm lens supplied with most 35mm SLR cameras provides wide angle portraits of the heavens at relatively fast photographic speeds of f/2 or less. Mounting the camera on the telescope tube is accomplished by using the "piggy back camera mount" offered as an optional accessory. This item couples to the rear threads of the Dynamax tube and is held securely in place by the eyepiece adapter. It may be positioned on either the top or bottom of the tube — we recommend mounting your camera on the bottom (as illustrated) to maintain a lower center of gravity.

Guiding is accomplished by placing an illuminated reticle eyepiece directly into the star diagonal or eyepiece adapter (the illuminated reticle eyepiece is included with the Criterion Off Axis Guider — but is also sold separately).

You will make your exposure using the same technique described in the section on Deep Sky Photography; the goal will be to keep the guide star centered on the illuminated crosshairs throughout the exposure by using the declination slow motion control and Dynatracker to make necessary corrections for image drift on either axis.

To summarize the procedure:

1) Attach "piggyback camera mount" to rear threads of Dynamax.
2) Couple camera and lens on the mount by means of the ¼-20 screw provided.
3) Make sure camera lens is set "wide open" (minimum f/stop) and set shutter speed for a time exposure.
4) Locate suitable guide star and center on the illuminated crosshairs — be sure camera lens is focused at infinity.
5) Using cable release, open camera shutter.
6) Use the Dynatracker and DEC. Slow motion control to keep guide star centered on the crosshairs throughout the exposure.
7) When exposure is completed, close camera shutter using cable release.

Exposure times will vary with lens and film speed. You should first experiment with exposures of 10 to 15 minutes, then move up to 25 to 30 minutes, if the first experimental pictures show no guiding errors.

Some recommended black and white films are plus-X and Tri-X, while GAF 200 and GAF 500 are excellent choices of color film for this particular application.

Chapter 13 — Photographic Facts And Hints

Focusing:

Probably the most frequent difficulty encountered by the Dynamax owner on his first photographic endeavors is the problem of focus. For example, the new owner may wish to attempt planetary photography, in which case he will place an eyepiece in the adapter, attach the telextender tube and finally, couple his 35mm SLR camera in place. Now the Dynamax is ready and it is time to focus on the planet and take the pictures. But for some strange reason, no matter how carefully the Dynamax is focused, the planet appears dim and slightly blurred, rendering little or no detail through the camera's viewfinder.

Well, the reason for this is quite simple — the groundglass of the reflex camera is too coarse-grained to achieve proper focus. All cameras use a groundglass focusing screen upon which to focus the image formed by the camera lens, and the term "groundglass" means just that — a piece of glass that is ground and not polished. The optical result of this is the same as if the front lens of your Dynamax was ground and not polished here at the factory — a total loss of resolution and definition due to a serious decrease in overall light transmission.

Of course, the ground glass focusing screen of your camera works well with the standard lens supplied with the camera — but then you are not working with extremely low light levels and ultra-high magnifications which demand polished surfaces for maximum transmission of fine detail. Therefore, we must improve the optical transmission of the groundglass if best focus is to be achieved.

There are three remedies we can suggest here. The first is to purchase a camera that has the option of interchangeable focusing screens. The Nikon F2, for instance, has a complete line of interchangeable focusing screens for many different purposes. For astrophotography, we recommend the Nikon type C or type M focusing screens, both of which have large clear spots in the center for focusing in low light levels. We have had much success with the Type C screen which enables you to see all the detail you would normally see when using the Dynamax visually.

Also, the 35mm Miranda Laborec is a highly recommended camera that comes supplied with a clear screen for astrophotography and this camera is advertised in such publications as *Sky & Telescope* magazine. If you do decide to purchase a 35mm SLR camera, a major factor in your choice should be the option of a clear focusing screen. However, if you already own a 35mm camera with a fixed focusing screen that cannot be removed, there are still two suggestions that will cure the focusing problem. The first is to focus carefully on a bright star before going to the object you wish to photograph. Focusing on a bright star is quite easy, even on groundglass, and you will simply assume the focus will be the same when you center the object and shoot the picture.

The final suggestion is to place a drop of light oil on the groundglass and rub it in gently with your finger. The oil should provide a temporary crystal clear focusing screen until it dries.

When using the Dynamax as a daytime telephoto lens, you will note that the subject appears dimmer through a camera as opposed to the brightness and clarity revealed by a visual eyepiece. Once again — the groundglass focusing screen is the culprit — but as long as you can still accurately focus, you will not need to modify or change the focusing screen.

Seeing:

The problem of poor seeing caused by a moving turbulent atmosphere were previously discussed in the section entitled "Observing facts and hints". When using the Dynamax for astrophotography, the same atmospheric difficulties will be encountered, so we highly recommend carefully reading this section again.

For deep sky astrophotography, you will require extremely dark, clear and steady skies. Most importantly, there must be no lights of any kind in the area (including light from the moon). Stray light will ruin the astrophotograph by "fogging" the film, causing the background of the finished portrait to be gray rather than black.

With respect to planetary photography, we have previously mentioned the fact that lunar and planetary detail will visually "fade in" and "fade out" with minor variations in the homogeniety of the upper atmosphere. Obviously, this will also occur while you are photographing, and the only way to obtain a successful lunar or planetary photo is to shoot as many pictures as possible and throw most of them away. This will eliminate the variable of atmospheric disturbances by means of the law of averages. In other words, some of your shots will be taken just as the detail is "fading in", others will be taken just as the atmosphere is causing the detail to "fade out". The more pictures you take, the better are your chances of getting a good one. In this respect, there is a large element of just plain "luck" in successful lunar or planetary photography but with some perseverance in the matter, you will eventually obtain excellent results.

Finally, when using the Dynamax as a daytime telephoto lens, avoid photographing over any source of heat waves that will destroy resolution such as black-top roads, chimneys, large bodies of water, etc. Any source where heat waves are apt to be rising must be out of the telescope's line of sight. If you must photograph something where heat waves are rising, at least try to wait until shortly before sunset or shortly after sunrise to take the picture. At these times of day, heat waves may be less prevelant. Experience will eventually teach you which time of day is best for your needs and geographical location. Generally speaking, however, noontime is usually the worst time to photograph, as the sun's rays have had all morning to heat the atmosphere and earth, causing terrestial images to appear as dancing and shimmering through the powerful lens system of your Dynamax.

Vibration Of The Camera:

When you depress the shutter release button on your 35mm SLR camera, both shutter and mirror are internally activated. There is little vibration caused by the movement of the shutter itself, but movement of the camera's reflex mirror on the other hand, may affect the quality of your picture.

In order to eliminate this vibration (commonly known in the trade, as "mirror slap") we suggest that you first compose and focus the picture through the camera and then *lock the mirror up* before you release the shutter. Most of the available 35mm SLR cameras have a mirror lock and you should consult your instruction manual for details on the proper use of this feature.

Processing The Film:

If you do not process your own photographs, you will undoubtedly have them professionally developed by a large company such as Kodak. In this case, the film will be put through an automatic developing machine. But before this happens, an operator must set the automatic machinery to splice the film precisely at the edge of each separate frame. This is done by using the first photograph of the roll as a reference to establish where the first frame begins and ends. But, if you have sent Kodak a roll of astrophotographs, the operator might not be able to recognize where the first frame begins, because an astrophotographic negative is deceptively "empty" to anyone other than an astrophotographer. Your beautiful picture of Jupiter might just appear to the operator as a small dot on a roll of underdeveloped film! What happens then? Usually the operator simply *guesses* where to splice the film. The result — your picture of Jupiter will be returned fully processed — but may be *cut in half* by the automatic machine which had no way of referencing the first frame.

In order to avoid this kind of disaster, we suggest the following:

> After you load your camera, make sure the *first picture* is a daytime shot of anything that is easily recognized — such as your house or yard. Then shoot your astrophotos and finish the roll by making the *last picture* a daytime shot also. By so doing, the operator who processes your film will have a recognizable first and last picture to work with that will establish the slicing position of each frame.

The other alternative is to request that the film be developed in roll form and that the roll should be returned *uncut*. If you are using color slide film, you can then cut and mount the slides yourself.

Polar Alignment

Successful astrophotography requires precision polar alignment for maximum tracking accuracy during the exposure. Achieving truly precise orientation to the North Celestial Pole can certainly take a good deal of time, and for this reason, we suggest that the serious astrophotographer investigate the distinct advantages offered by the optional permanent pier. The pier eliminates the need to orient your mount each time you use the instrument and the only time necessary to set-up will be the few minutes it takes to attach the Dynamax to the pier's tilted platform. The pier's large diameter, thick walled, rigid pipe offers an exceptionally solid support for maximum stability. For more information see "Facts and Hints on Polar Alignment" — page 30.

Chapter 14 — Optical Care And Maintenance

Cleaning The Front Lens:

You should only clean the front corrector lens when it becomes *absolutely necessary.* Too many people insist upon keeping their lens totally dust free, cleaning it after virtually every use. This constant cleaning does more harm than good and increases the risk of injury to this delicate optical surface. Since dust is everywhere and its formation on the lens unavoidable, learn to live with it. In practice it would take a huge layer of dust to actually affect the telescope's overall performance. Let a little dust stay on the lens — its effect on your observations will be negligible.

Of course, you will avoid dust collection on your optics when not in use by simply keeping the dust cover on the telescope at all times. Also, always be sure to *cap the rear-cell opening* to avoid dust collection on the internal optical components.

When cleaning does eventually become necessary, first remove loose dust particles with a soft camel's hair brush. Just be sure to use minimum pressure and brush very lightly with gentle strokes. Perhaps a much safer alternative to the brush is the enema syringe, available at all drugstores. Pumping the syringe with the nozzle directed towards the glass creates an airstream that provides an effective means of removing loose dust particles without having to actually touch the lens surface.

Once the majority of loose dust and dirt has been removed, use soft cotton or facial tissue dipped in *plain water.* Just barely touch the lens with the wet cotton or tissue and "float" the grime off the lens using single gentle strokes from the center outwards. *Never* use the same cotton swab or tissue to clean the entire surface — but instead *use a fresh tissue or cotton swab after each stroke.* After the lens is thoroughly cleansed by the wet cotton swabs or tissues, it can be gently rubbed dry and clean with dry cotton or tissue and final inspection can take place. Any loose lint particles left over by the final cleaning can be removed by light strokes of a camel's hair brush or more preferably, by the gentle airstream of an enema syringe.

Remember, dip the cotton or tissue in just plain water, use a new cotton swab or tissue after each single stroke and always wipe gently — never rub the lens with hard, vigorous circular motions commonly used to clean eyeglasses and the like. Finally, never use *eyeglass lens tissue* as it is silicone treated and may cause scratches nor should detergents or glass cleaners of any kind be used as they might leave a film on the glass surface.

Cleaning Coated Optics:

Lenses coated with magnesium flouride should be treated with the utmost respect. Avoid cleaning coated optics until the situation deems it absolutely necessary, as the coating must be extremely thin in order to be effective (its thickness is actually measured in millionths of an inch). Although modern day technology offers coatings that are far more durable than in the past, not even modern day coatings can withstand *constant* rubbing without deterioration, so special care must be taken.

To clean a coated lens, mix a 50-50 solution of isopropyl alcohol and distilled water. Then clean the lens by the same procedure previously outlined, using this solution in lieu of plain water. Be sure to first remove all loose dust and dirt as outlined in the procedure, and most importantly, be as *gentle* as possible when cleaning coated optics, keeping in mind the fact that the coating is durable, but very thin. Gently *stroke* the lens with the cotton or tissue — never *rub* the surface with circular motions.

Cleaning The Eyepieces

The eyepieces should preferably be kept in a dust free container when not in use. Should cleaning become necessary, first remove loose particles with a brush or enema syringe, then clean the top lens and bottom lens of the eyepiece using Q-Tips dipped in plain water or a 50-50 solution of water and isopropyl alcohol. Then use a dry Q-tip to wipe the eyepiece lens clean and dry.

Internal Cleaning

It is extremely important to always *cap the rear cell opening* with the plastic cap provided with your Dynamax. This opening is the only possible way dust can reach the internal optics as the front of the telescope is tightly sealed by the corrector lens. Provided this opening is always tightly capped, the internal optics should never need cleaning or re-aluminizing even after a lifetime use.

However, should the inside of the corrector by some chance, ever require cleaning, you should call or write Criterion for special separate instructions concerning this. We hesitate to include these special instructions in this manual because it is rare that anyone should ever need them.

Furthermore, internal cleaning necessitates removal of the front corrector lens, which is highly undesirable unless absolutely necessary.

Dew Formation On The Lens:

The formation of dew on the front lens has been previously discussed in Chapter 9 (p. 51) of this manual. Please read this section carefully if you haven't already, and note that a "dewcap" will prevent dew formation while the telescope is in use. However, when the telescope is brought indoors from the cold to a warm room, the corrector lens might again become frosted over with dew. When this occurs, *do not* wipe the dew off the lens. Place the instrument at a safe distance from any extreme heat sources such as a fire place, and let the dew dry all by itself — a process which normally takes about 15 minutes. Also, do not put the dust cover over the lens until it has dried, nor should you put the Dynamax into its case unless the lens is dew-free.

Examining The Optics

When cleaning the optics of your Dynamax, you may notice a hairline scratch or sleek on the corrector, secondary or primary optics. There is no need to be concerned, as these "beauty defects" cannot affect the optical performance of your telescope in any way.

Important Note:

DO NOT evaluate the condition of the internal optics by shining a flashlight down the tube at night. When a flashlight is used, the minor amount of normal scattering that you will see is greatly magnified and therefore will appear much greater than it actually is under these conditions (especially considering the eye is dark adapted). Unfortunately, it is impossible for *any* aluminized surface to render 100% reflectivity; likewise, it is also impossible for the corrector lens to render 100% light transmission. Therefore, a small percentage of scattering is quite normal in *all telescopes* — regardless of the design or manufacture.

However, when a flashlight is directed down the tube at night, this normal amount of total scatter becomes unproportional to the total amount of reflectivity, and therefore, will appear greater than it actually is. For this reason a "flashlight test" is considered an unfair evaluation of the optical surfaces as it can cause even flawless optics to appear cosmetically substandard.

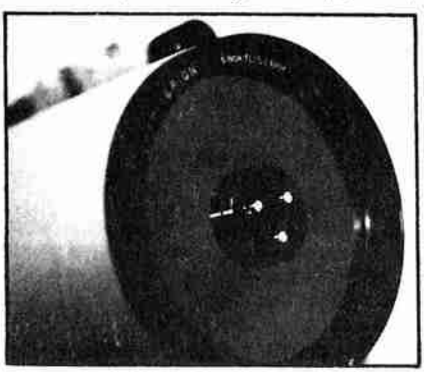
Optical Collimation

The optical performance of your Dynamax can be seriously affected if the optics are out of collimation. The term collimation simply refers to the optical alignment of the primary, secondary and corrector lens, all three of which must have their respective optical centers in correct relationship with each other and, furthermore, must be symmetrical with the telescope's optical axis. Your Dynamax was precision collimated here at the factory using advanced laser techniques. However, if the instrument has been mishandled or subjected to sustained vibration, it may require minor re-adjustment.

The primary mirror and corrector lens are both mechanically frozen in permanent alignment and cannot be adjusted, nor can they ever go out of alignment. Therefore, the only possible collimation adjustment that will ever be required will be adjustment of the secondary mirror, and this is controlled by the three screws on the front of the secondary housing.

Collimation *cannot* be checked by visually looking down the front or back end of the tube. The only way to determine correct or incorrect collimation is by examination of a real star image in the night sky.

To check collimation, first be sure your telescope has reached thermal equilibrium with the night air as explained in Chapter 9. Then center a bright star near the Zenith (you can also use Polaris) in the field of view of a 30mm eyepiece. *Defocus* the star image until the resultant circle of light is expanded to approximately ¼ of the field of view, and study this out of focus circle carefully. If the instrument is properly collimated, the black inner shadow of the secondary housing will appear perfectly centered within the out of



To collimate the Dynamax you must first remove the protective front cover on the secondary holder by means of the three screws shown here. When removed, the cover reveals three more screws used for collimating the instrument as explained in the text.

focus circle as in fig. A. p. 84. On the other hand, if the shadow is not concentric with the out of focus circle as in Fig. B, your instrument, is in need of collimation.

To re-collimate the instrument, first remove the protective front cover on the secondary holder by means of the three screws which secure the cover in place (the cover prevents accidental tampering of the secondary adjustment and conceals the "real" adjustment screws that can only be utilized when the cover is removed.) Once the cover is removed, look through the 30mm eyepiece at the out of focus circle and carefully determine and note the direction towards which the shadow is off center. Then use the R.A. and DEC. slow motion controls to move the out of focus circle in the direction that the shadow is off center until the out of focus circle is on the edge of the field of view (see Fig. C). Now simply go to the front of the instrument and adjust the three screws on the secondary housing until the out of focus circle is brought back to the center of the field, (see Fig. D).

Important:

ADJUSTMENT OF THE SECONDARY SCREWS IS EXTREMELY SENSITIVE. USE ONLY SMALL FRACTIONS OF A TURN ON EACH SCREW AND OBSERVE THE EFFECT ON THE IMAGE AFTER EACH ADJUSTMENT. DO NOT FORCE THE SCREWS OR PERMANENT DAMAGE MAY RESULT.

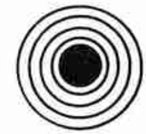
The adjustment screws must not be overtightened nor should they be too loose. Therefore if one screw becomes too tight during adjustment, loosen the other two. Conversely, if one screw is becoming too loose, you will tighten the other two. The screws should only be tight enough to hold the secondary mirror firmly in place and must not be overtigthened.

Repeat the collimation procedure, if necessary, using your 30mm eyepiece until the out of focus circle is perfectly concentric with the inner shadow of the secondary housing as shown in fig. A. As a final check, replace the 30mm eyepiece with your highest powered eyepiece and check the collimation again. Then, if necessary, repeat the collimation procedure using high power for maximum accuracy.

Note:

COLLIMATION is always performed with the star image *defocused* as outlined above. However, we have included focused star images in figures A and B so that you will recognize a collimation problem when using the telescope for normal observations on focused images.

When a focused star shows a "flare" to one side as illustrated in fig. B, the instrument is out of collimation and will require adjustment.

	OUT OF FOCUS	IN FOCUS
Figure A Properly Collimated System		
Figure B Out of Collimation		

CHECKING COLLIMATION — To check the collimation of your Dynamax, *defocus* a bright star image. If the out of focus circle appears as in fig. B, the instrument is in need of collimation.

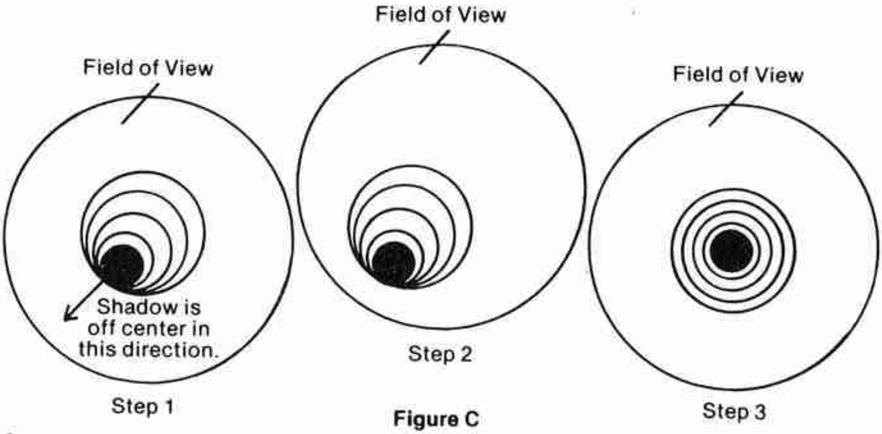


Figure C

Step 1 — Determine the direction towards which the inner shadow is off center.
Step 2 — Using the R.A. and DEC. controls, move the out of focus circle to the edge of the field of view in the direction that the shadow is off center.
Step 3 — Adjust the 3 screws on the secondary holder until the out of focus circle is brought back to the center of the field. Repeat steps 1 - 3 if necessary.

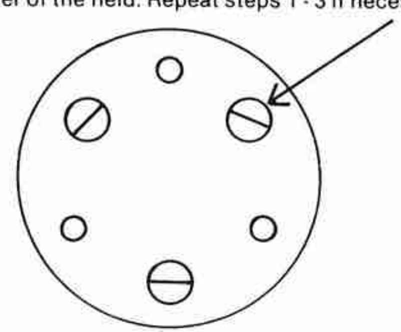


Figure D

Illustrates the appearance of the front secondary holder with the protective cover removed. The arrow indicates the proper screw to adjust in steps 1 - 3 above.

Chapter 15 — General Care And Maintenance

* Do not put your Dynamax into its protective carrying case if it is covered with dew. Let it dry off first at a safe distance from extreme heat such as a fireplace.

* If the paint on your tube or mount becomes soiled, you may clean it using popular liquid cleaners such as "409" or "Fantastic" both of which are available in handy spray bottles. To avoid rubbing the dirt in, frequently use fresh sides of a clean rag as you pick up the grime.

* The handsome metal legs of the optional Dynamax Field tripod are gold anodized aluminum. From time to time, you may wish to increase their lustre and preserve their gold finish by polishing them with a general purpose metal polish (just be sure it can be used on aluminum surfaces). A common household metal polish such as "Noxon" works quite well and should be readily available at most local stores.

* Both the R.A. and DEC. brake mechanisms will wear in time just as the brakes on your car will wear. For this reason, we have designed both of these mechanisms to be easily re-adjusted by the owner, and if slippage is ever noticed, the brakes should be tightened.

R.A. Brake Lever Adjustment

The R.A. brake is factory set to give a firm braking action and should rarely need re-adjustment. If after much use, the braking action decreases and some slippage is not noticeable, there is a simple provision for adjustment. You will note a set screw on one side of the plastic brake lever. Loosen this screw and draw the lever off. Then tighten remaining socket cap screw down with an allen wrench to the tightness desired. Be careful not to tighten too much or the brake lever will not be able to completely disengage during use. Now replace the plastic cap with its lever as far over to the left as possible so that it touches the metal wall of the base casting. This is done to insure that you will never tighten past this point. Tighten set screw and the brake lever will again be operable.

DEC. Brake Lever Adjustment

The DEC. brake lever may occasionally require slight adjustment in order to maintain good braking action when positioned at right angle to the fork arm. This adjustment would become evident should you ever notice that more than a right angle position is necessary to adequately lock the telescope in declination. You will note a "button head" type socket screw holds the lever onto the locking shaft. To re-position the lever, simply loosen this screw using a standard allen wrench and re-position the lever on the shaft until adequate braking action is achieved when the lever is moved to the "ON" position (right angle to the fork arm). As in the case of R.A. brake adjustment, do not tighten the brake too much or it will not disengage when moved to the "UP" or OFF position. Also, if the lever is forced too tightly, internal stripping of threads may result.

Your Dynamax is virtually maintenance free and built to exceed a lifetime of use with normal care. With the exception of the adjustable brake levers, no other Dynamax component should ever need adjustment of any kind, so you should *never attempt any adjustments* other than those outlined in this manual. If you encounter any type of difficulty with the instrument, *call or write Criterion immediately for a solution to the problem.*

Almost all problems can be easily remedied by a simple phone call which brings you the expert advice of one of our trained specialists who knows the instrument "inside and out". Never attempt to remedy the problem yourself without first obtaining special advice and instructions from one of our technicians.

Returning The Instrument For Service

It should never be necessary to return your instrument for service. As mentioned above, virtually any and all problems or difficulties that may be encountered can be easily handled by mail or by telephone. Therefore, always call or write us first for a remedy to the problem before returning the instrument to our factory. If one of our technicians decides that the instrument should be returned, you will be advised accordingly along with appropriate instructions regarding the best method of shipment back to us. In all cases, be sure the instrument is properly packaged for safe arrival, using as much extra packing material as possible. You must also be sure to enclose a detailed letter explaining the exact nature of the difficulty or problem you have encountered.

Always be sure to first obtain authorization before returning the instrument as our factory personnel can only accept packages that have been properly *authorized* for return by one of our staff.

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