TELESCOPE INSTRUCTION MANUAL

THE OPTICAL CRAFTSMEN, INC.
3537 Old Conejo Road, Suite 106
Newbury Park, California 91320

(805) 499-6732

You may want to mark the tube with masking tape or a felt marking pen to show where the front of one of the saddle rings is located to aid you in re-balancing later.

If you make no additions to the equipment on the telescope, you will not have to re-balance.

Your telescope tube assembly can be rotated in the saddle by grasping the bottom of the tube and turning. A little practice will overcome any difficulties you may have the first time you try it. Be sure the saddle rings are loose enough to allow the tube to rotate. Also try to prevent the tube from sliding up or down in the saddle while you rotate it. (Here's where your mark on the tube will come in handy.)

COLLIMATING OF MIRRORS:

When you receive your telescope, and any time after you have cleaned your mirrors, you may have to collimate (optically align). (If you replace the mirrors as closely as possible to the way they came out, this will not be difficult.) It is best to have a friend help you with this; one of you can turn the adjusting screws while the other watches the results. However, collimating can be done alone. First, point the telescope toward the sky, then remove the eyepiece from the focuser and rack the focusing tube all the way out. Now look into the focuser tube. You will see several circles which are: (1) the inside of the focusing tube, (2) a reflection of the inside of the large main telescope tube, (3) a reflection of the main mirror in its cell at the bottom of the tube, and (4) the diagonal mirror. The idea of collimating the optics is to get all of these images centered.

First, the diagonal mirror (secondary) must be centered with respect to the draw tube, by moving it up or down, or tilting it from side to side and front to back.

To adjust, hold your head back several inches from the draw tube and center your eye over the draw tube. Then make the necessary combination of adjustments until the secondary mirror appears centered and round behind the focuser. When done, do not tighten the screws until the next step is complete.

Next, rack the draw tube all the way in and, with your eye right up to the draw tube, rotate the secondary holder until the reflected image of the primary mirror is exactly centered in the secondary. Gently tighten the 3-4 adjusting screws a little at a time until snug enough to prevent movement of the secondary. Be careful not to over-tighten.

Now you are ready to collimate the main mirror. Have your friend turn one of the three adjusting screws on the mirror cell. Looking into the focusing tube, you will see one more reflection--that of the diagonal mirror in the main mirror. It will probably be off center, but as your friend turns the screws, it will move. Have him try first one screw and then another until the reflection of the diagonal is in the center of the main mirror reflection. This completes alignment. If your telescope has locking bolts on the mirror cell, these should be tightened sufficiently to secure the main mirror in position. Overtightening can break the mirror cell, or strip the threads.

ALIGNING THE FINDER:

If you have re-collimated the mirrors, you will have to check and possibly adjust your finder alignment. If an object does not appear in the center of your low power eyepiece field when it is on the finder crosshairs, you will have to adjust the finder bracket thumb screws to bring it in correctly. Check back and forth from eyepiece to finder when doing this to make sure you don't move the eyepiece off the subject. Be sure to pick an object at least several hundred feet away to eliminate a parallex problem. The moon, Jupiter, Saturn, or a bright star will serve well at night.

MAGNIFICATIONS:

Your telescope comes complete with one or more oculars for obtaining different powers to suit the seeing or object being studied. Remember, use low or medium powers for deep sky objects, and medium to high powers for planets and the moon, as seeing conditions permit. (Specific powers of the oculars supplied with your telescope are given on a separate data sheet enclosed with this manual.)

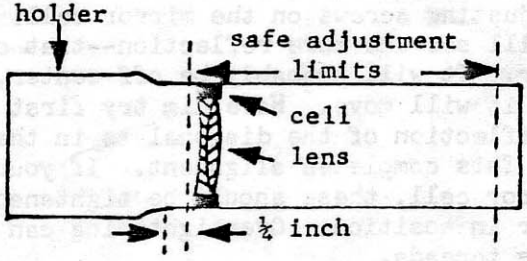
The oculars provided may include a Barlow lens and tube assembly. The Barlow is used in conjunction with an ocular to obtain higher magnifications when desired, seeing conditions permitting. The Barlow's amplification range is about 1.5x to 3x. The amplification is determined by the position of the Barlow lens within the holder with respect to the ocular. When the lens is all the way to the bottom of its holder (farthest from the ocular) its amplification is about 3x. All the way to the top of the narrow portion of the holder (closest to the ocular) its amplification is about 1.5x.

A wooden dowel is supplied with the Barlow. To adjust the amplification of the Barlow, push the black cell holding the Barlow lens up or down within the holder with the wooden dowel. Take care not to push on the lens itself.

To use your Barlow, slip the eyepiece (ocular) into the large end of the Barlow tube; the combined Barlow/eyepiece then goes into the focuser on the telescope.

When adjusting the Barlow, never push the lens out of the holder. It is a good idea never to try adjusting the Barlow any further than $\frac{1}{4}$ inch from the bottom of enlarged portion of the holder (see drawing).

NOTE: The lens is fixed loosely within an inner cell for optimum optical performance. Some rattling is normal.



BARLOW LENS AND HOLDER

USING YOUR MOTOR DRIVE

Your synchronous motor drive enables you to follow celestial objects without readjusting the telescope every few minutes. It is set at a precise rate, as determined by the precision gears, to counteract the Earth's rotation and track sky objects correctly.

Of course, you must be sure your polar axis is pointed north, towards the North Celestial Pole, before your telescope will track properly.

NOTE: The North Celestial Pole does not correspond exactly to the position of Polaris; Polaris is actually nearly one degree from the true pole. Refer to any astronomy text for details. Also, be sure your polar axis is set correctly for your latitude. (See figure 2)

NOTE: Telescopes shipped directly to you from the factory have the correct latitude pre-set. You need only change it if you use your telescope in a different location with a different latitude.

The motor drive comes with a clutch consisting of a nylon bushing or bearings, depending on the model, and three or more set screws on the worm gear hub. These are found inside the motor housing. The set screws should be just tight enough to prevent slippage and should offer some resistance to movement of the telescope about the polar axis. Do not tighten the screws down excessively hard; you will add unnecessary friction to the telescope movement and you may strip the threads out of the worm gear hub.

If at any time you notice the motor is running but the telescope is not driving, and you are certain the instrument is properly balanced and lined up on the celestial pole, then the clutch is probably slipping.

To operate the motor drive, plug the cord into any 115 volt, 60 cycle outlet. The telescope will follow the stars. You can point the instrument to any object in the sky with the motor running, without harming the motor, gears, or clutch in any way. As soon as you release the tube, the motor drive will resume driving through the clutch.

The motor consumes about 3 watts; long extension cords can be used if necessary without loss of voltage. An inverter can be used to power the motor from your car's cigarette lighter socket on field trips. Be sure to get one which furnishes 60 cycles, and will run about 20 watts continuously.

SETTING THE POLAR AXIS:

For proper tracking of sky objects it is essential that your telescope be set correctly for the latitude of your place of observation.

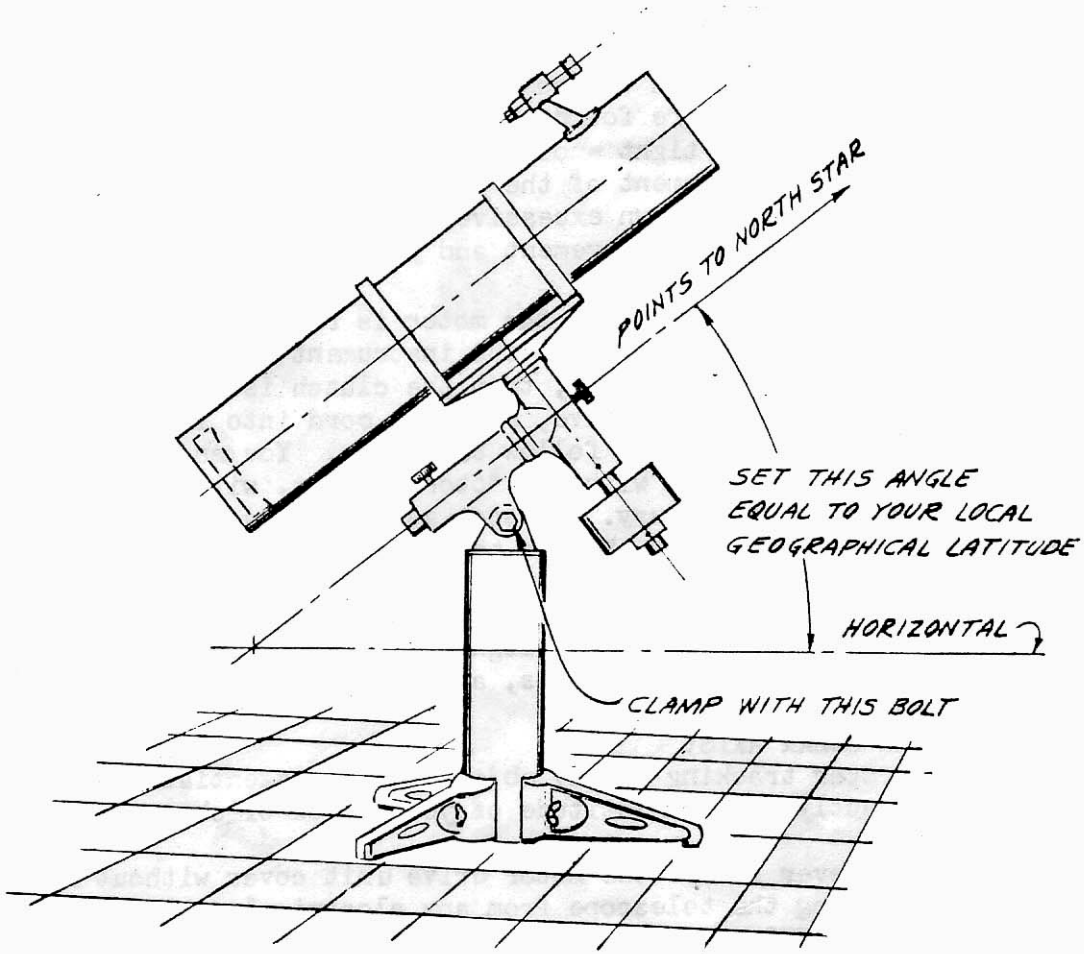
CAUTION: Never remove the motor drive unit cover without first unplugging or disconnecting the telescope from any electrical outlet or power source. THE OPTICAL CRAFTSMEN, Inc; cannot assume responsibility for any personal injury or damage to the telescope or other personal property resulting from tampering with wiring inside the motor drive unit, or from making motor drive adjustments while the telescope is connected to an electrical power source.

First, set up your telescope on level ground, with the pedestal perpendicular. Using an Allen wrench, loosen the cap screw located in the side of the equatorial head near the main bolt holding the saddle and tube assembly in the equatorial head. With two large wrenches,

carefully loosen the main bolt in the equatorial head just enough so that the saddle and tube assembly can be tilted forward or backward in the equatorial mount. Using the protractor, set the angle of the polar axis shaft housing above horizontal to the degrees of latitude for your location. (figure 2)

Tighten the allen head cap screw near the main bolt and then the main bolt.

Figure 2:



SETTING THE POLAR AXIS

BALANCING THE TELESCOPE WITH MOUNTED ACCESSORIES:

Your telescope must be balanced about the polar and declination axes in order to function properly and not excessively load the motor. If you add a camera, guide scope, or other accessories, you will have to rebalance the telescope. To do this, first check the balance of the tube in the saddle. If it sags downward at either end, just slide it in the saddle until it is balanced (see section "Balancing the Tube Assembly").

Disconnect the telescope from any electrical power source. Remove the four upper sheet metal screws holding the housing on the motor drive. Use the Allen wrench provided to loosen the six set screws around the hub of the large worm gear. This enables the telescope to turn freely about the polar axis. With your accessories mounted, move the counter weight on the declination axis until the entire telescope balances. Retighten the six set screws a little at a time until there is a little drag when you move the telescope in right ascension. DO NOT OVER-TIGHTEN. Each set screw should be tightened about the same amount.(Discoverer models have three)

It may be necessary to remove the motor to reach one of the set screws. Do not remove the bracket holding the small worm, shaft and motor. Instead, remove the motor from the bracket by unscrewing the two 4-40 screws holding the motor. Note that one of the screws holds a wire clamp in place.

When replacing the motor, be certain the two spur gears mesh properly. When the motor is tightened down, there should be about 1/32 inch of rotation of the large spur gear. A little looseness here is important to preserve the life of the motor drive and will not show up in the operation of the telescope.

If you add a very heavy camera or guide scope, you will probably have to add an equal amount of weight mounted on the other side of the telescope tube, at the bottom, to keep the tube assembly itself balanced. Otherwise, as you rotate the tube in the saddle, it will cause the telescope to go out of balance as the heavy camera, etc., is placed in different positions. (This may not be necessary in some of the larger models.)

If you are going to use your telescope for both photography and visual work, a helpful hint would be to mark the declination shaft in two places to indicate where the counter weight should be for photography (with camera mounted), and where it should be for visual observing.

CLAMPING SCREWS:

Your telescope may be provided with clamping screws on either or both the polar and declination axes. Telescopes with motor drives have a shortened clamping screw so it cannot touch the polar axis. This prevents accidental tightening which would destroy the motor gears. The declination slow motion control has the same provision because it could not work if tightened.

CAUTION: All axial clamping screws are to be set finger tight only. Do not use a wrench or pliers as the screws are soft metal so they will not score the shafts. They break easily. Their function is to supply friction only--not immobility! We assume no responsibility for damage caused by excessive tightening of these clamping screws.

USING THE SETTING CIRCLES:

To use your setting circles, be sure your telescope is lined up true North, as previously stated with the motor drive running. The best way to use your circles is to write on a card, or memorize, the right ascension and declination coordinates of one or two well-placed easily observed bright stars. We suggest Vega and Capella, since one or the other is always visible at any hour of any night of the year.

Vega	18h	35m RA	+38°44" Dec.
Capella	5h	13m RA	+45°57" Dec.

Example: Capella is high in the northeastern sky; get it into the center of your finder. Check your declination circle--it should read nearly 46° (estimate minutes). It might need slight adjustment; loosen the set screw on the circle hub and reset to the correct figure. Now, slip the RA circle (on the worm drive gear) until 5h 13m (estimate minutes) appears under the uppermost pointer. From this setting, the motor will now carry the RA circle all evening and it will read direct in the sky as long as the motor is running. Check other stars and you will see how it works. Be sure not to move the RA circle after the initial setting.

Always use lowest power eyepieces when hunting for objects with your setting circles. The circles enable you to come very close to the actual location; after finding it you may switch to higher power.

As you cross the meridian and switch the telescope over from east to west, the second pointer will assume the correct reading on the circle. A little practice will make everything clear.

CLEANING OF OPTICS:

Do not touch the surfaces of the mirrors or eyepieces. Always keep covers on your telescope when you are not using it. Store the telescope indoors, away from dust and moisture. About once or twice a year, you may want to clean the mirror. Carefully take out the main mirror cell by removing the three retaining screws which hold it in the tube. Completely remove the edge clamps holding the mirror in the cell. Now carefully lift the mirror out of the cell. Be careful not to touch the front surface of the mirror. Carefully blow off loose dust. Place the mirror under a gentle stream of warm water from a faucet and, without rubbing, rinse off the surface several times. Then mix a little mild detergent in a half cup of water and sprinkle a little of this on the surface of the mirror. Let it soak a while; then rinse and repeat until the mirror looks clean. Now gently wipe the remaining dirt off with clean cotton wetted with distilled water or a good grade of isopropyl alchohol. Rinse again and pat dry with cotton. Do not scour the mirror or you will scratch it.

The diagonal mirror can be removed and cleaned in the same way. Eyepieces may be gently breathed upon and wiped carefully with clean cotton or a good lens tissue, barely moistened. Do not use eyeglass cleaning tissues. Good lens tissues can be obtained in most camera shops. Never disassemble the oculars or Barlow. We cannot guarantee the oculars if you disassemble them.

When you replace the mirror in its cell, don't clamp it tight. The cell should only hold the mirror, and not act as a vise. After the mirror is in the cell and edge clamp screws are tight, you should be able to rotate the mirror by grasping the edge and turning. If you cannot turn the mirror easily, loosen the three clamps and retighten the screws.

OBSERVING THE SUN:

CAUTION: NEVER ATTEMPT TO OBSERVE THE SUN THROUGH ANY TELESCOPE OR OPTICAL INSTRUMENT WITHOUT A PROPER SOLAR FILTER. THE INTENSE HEAT AND LIGHT WILL PERMANENTLY DAMAGE YOUR EYE IN A FRACTION OF A SECOND. THIS APPLIES TO THE FINDER TELESCOPE AS WELL; JUST AS MUCH DAMAGE WILL BE CAUSED WHEN LOOKING THROUGH IT AS THROUGH THE LARGER TELESCOPE. NEVER LEAVE THE TELESCOPE OUTSIDE UNATTENDED WHERE CHILDREN CAN POINT IT AT THE SUN. DO NOT USE A DARK GLASS OVER THE EYEPIECE; THE HEAT WILL CRACK THE FILTER AND BURN YOUR RETINA!

USE OF OPTIONAL ACCESSORIES:

For astrophotography, it is normally preferable to remove the lens from your 35MM camera, using the camera body only for "eyepiece projection." This method is used usually to achieve greater magnifications when photographing the moon and planets.

For photographing larger objects the "prime focus" method may be preferred. Neither camera lens nor eyepiece is required in this method; the image from the main mirror is brought directly to focus at the film plane of the camera body.

In both methods some experimentation may be necessary before you find the most useful positions and settings for your camera. If you find that your camera cannot be brought to focus, when using the prime focus method, it may be necessary to bring the film plane out farther by moving the main mirror cell forward in the telescope tube. To accomplish this, remove the mirror cell from the tube. Drill three new holes in the tube approximately $1\frac{1}{2}$ inches forward of the old ones, and relocate the mirror cell in these holes. You will have to recollimate the optics. (The limited space of this manual will not permit detailed coverage of astrophotography. For more information, please consult any good work on astrophotography.)

Declination Slow Motion Control--This unit is mounted directly under the front end of the tube saddle, and consists of a spring-loaded threaded rod and control arm system, with hand knobs at each side for convenience. When setting up your telescope, make sure this unit is facing forward.

The declination slow motion control is useful for centering objects in the field in declination, and is particularly helpful in making minor adjustments when using high powers on the planets and the moon.

SOME POINTERS ABOUT USING YOUR TELESCOPE:

Your telescope is a reflector--which means that it utilizes a concave paraboloidal mirror to gather light. This is the principle of the 200 inch telescope at Palomar and most other large astronomical telescopes. Light from the main mirror at the bottom of the tube is reflected back up through the tube to the smaller diagonal mirror near the top end. The diagonal mirror then sends the light out the side of the telescope tube, where an image is formed. This image is then examined and magnified with an eyepiece.

If you wear glasses, and do not have astigmatism, take them off when using the telescope, if possible. If your glasses are corrected for astigmatism, you may have to leave them on. Point the telescope in the general direction of the object you wish to observe. The moon is the easiest to begin with. Be sure your lowest power eyepiece is in the focuser on the main telescope. Bring the object you are seeking into the field of the finder and get it on the intersection of the crosshairs. Now, if you look into the eyepiece of the main telescope, you should see the object. It will probably not appear sharp, but by turning the knob on the focuser you will be able to find the position where the object becomes sharp and clear. If the object is not seen (and the telescope is focused), refer to the section "Aligning the Finder". Keep your eyes quite close to the eyepiece but not so close that you may touch it. If possible, try to learn the technique of observing with both eyes open as this helps prevent fatigue caused by squinting.

You will soon notice that an astronomical telescope shows an inverted image. This is of no consequence when looking at objects in the sky; charts of the moon and planets are drawn inverted as seen by the astronomer. For terrestial use, you may purchase an erecting eyepiece or stand with your back toward the object and it will appear right side up.

Your telescope has an equatorial mount, which gives you the very real advantage of being able to track objects across the sky with just one motion. You should always set up your equatorial mount so that the polar axis points north, toward Polaris, the North Star. Make sure that your polar axis is set to your local geographical latitude, as explained in the section "Setting the Polar Axis".

Always set your telescope up out of doors. Never try to observe from inside a house or through a window; heat currents and the distortions in window glass will make it impossible to obtain clear images. Set your telescope up in as dark and sheltered a spot as possible. Try to keep away from artificial lights which may shine into the telescope tube or directly into the eye. It is best to set the telescope up to the south of and as far from nearby structures, such as buildings, walls or autos. mountains or desert areas where there are no distracting lights. We recommend your getting your telescope as far away as possible from city lights and haze when observing nebulae, clusters and galaxies. Planets and the moon may be seen well from almost any site, but the deep sky objects

demand black skies. You will never know the true beauty of the Orion nebula (M42), the Andromeda galaxy (M31), the Hercules cluster (M13), or the Lagoon nebula (M8) until you have observed them on a clear night far from bothersome man-made lights.

You will soon find that some nights are much better than others for observing. On crisp, brilliant nights when the stars sparkle and twinkle beautifully, forget about high power. The twinkling means violent turbulence overhead and your telescope will magnify this, just as it magnifies the object you are observing. On such nights, the moon and planets will "swim" as if you were watching them through a curtain of falling water. When you encounter bad "seeing" like this, use lowest powers and observe nebulae and clusters.

The best nights for planetary and lunar study are the still, steady ones when the stars do not twinkle. Such nights are usually slightly hazy or foggy, but if the haze is not too thick, it will not spoil your viewing. On the contrary, it usually stabilizes the atmosphere and causes good "seeing". On such nights, try medium and higher powers. Planetary detail is the hardest of all to see clearly. You need excellent seeing and a practiced eye. The beginner is usually disappointed in planetary study--seeing little. But after he looks at Jupiter for ten or fifteen minutes, he gradually becomes a good observer and then may wish to try his hand at sketching the belts of Jupiter or the rings of Saturn.

Remember that stars are not magnified into discs. They always look like points of light, no matter how large the telescope. The telescope makes them brighter-not bigger. Of course, on nights of bad seeing, the star images will appear swollen and distorted.

Try to set up your telescope where you do not have to observe directly across the roof of a house. A building will radiate heat for many hours after dark and cause poor seeing. In the summertime, an asphalt driveway will remain warm for many hours and give rise to heat currents that will spoil the seeing. The best place to set up is on a lawn, away from buildings.

Never try to observe objects near the horizon. You are then looking through a greater distance of the earth's atmospheric blanket, and this contains the turbulence and obscuring material such as haze and smog. Best observing will be done on objects near the zenith where they are steadier and brighter.

It is well to set the telescope up outside fifteen or twenty minutes before starting to observe so the optics can adjust slightly to temperature differences. Your eyes will require ten or fifteen minutes to become adapted to the darkness, also. If you want to refer to star maps or charts, use a red flashlight which will not cause the eye to lose sensitivity to low light levels as will an ordinary flashlight.

When looking for objects, always start with low power on the telescope. In fact, you will find low power most satisfactory for most observing--just as most experienced astronomers do. Beginners usually want

to use the highest possible magnifications on every object they observe and are quickly disappointed. Remember, as you increase power, brightness of the image decreases. On a bright object, such as the moon or Jupiter, you may use high power, but faint objects, like nebulae and clusters, will be shown to advantage only with low powers.

The moon is the brightest and most interesting object to the new telescope user. You will see thousands of craters on it. The best time to view the moon is near first or last quarter when the shadows are favorably placed. Although most beginners think the full moon should be the most interesting, this is not the case. It is disappointing in the telescope because there are no shadows to make contrast and detail visible and the light is dazzling. On good nights you may use your higher power eyepiece on the moon.

Next to the moon, the planets are the brightest and perhaps most interesting objects. You will see the rings of Saturn, Jupiter's cloud belts and moons, the polar caps and deserts of Mars, and the phases of Venus and Mercury; you will also be able to see the disc of Uranus and locate Neptune. There is not room here for a comprehensive discussion of planetary detail, but you should obtain a good book like NORTON'S STAR ATLAS for more data. The planets move around the sky from month to month, whereas the stars appear to remain fixed in the same relative positions. Checking your local newspaper or almanac will help you locate the brighter planets.

Some of the most beautiful objects of all are the Deep Sky Objects--the nebulae, clusters and galaxies. The accompanying Messier Catalog lists over a hundred of these which may be located on any good star maps by plotting in their right ascensions and declinations. Declination is the distance north or south of the equator (celestial) on the charts. Right Ascension is the distance east or west and goes from 0 to 23 hours. Some of the more beautiful Messier objects are M42, the Orion nebula; M27, the Dumbbell nebula; M35 and M37, star clusters. Norton's Star Atlas lists hundreds of other objects, with complete descriptions.