ASSEMBLY / USER INSTRUCTIONS

# SIMMONS®


TELESCOPE
MODEL 6450

| EYE PIECE | MAGNIFICATION | MAGNIFICATION WITH BARLOW |
|---|---|---|
| 20mm | 45 X | 90 X |
| 6mm | 150 X | 300 X |
| 4mm | 225X | 450 X |

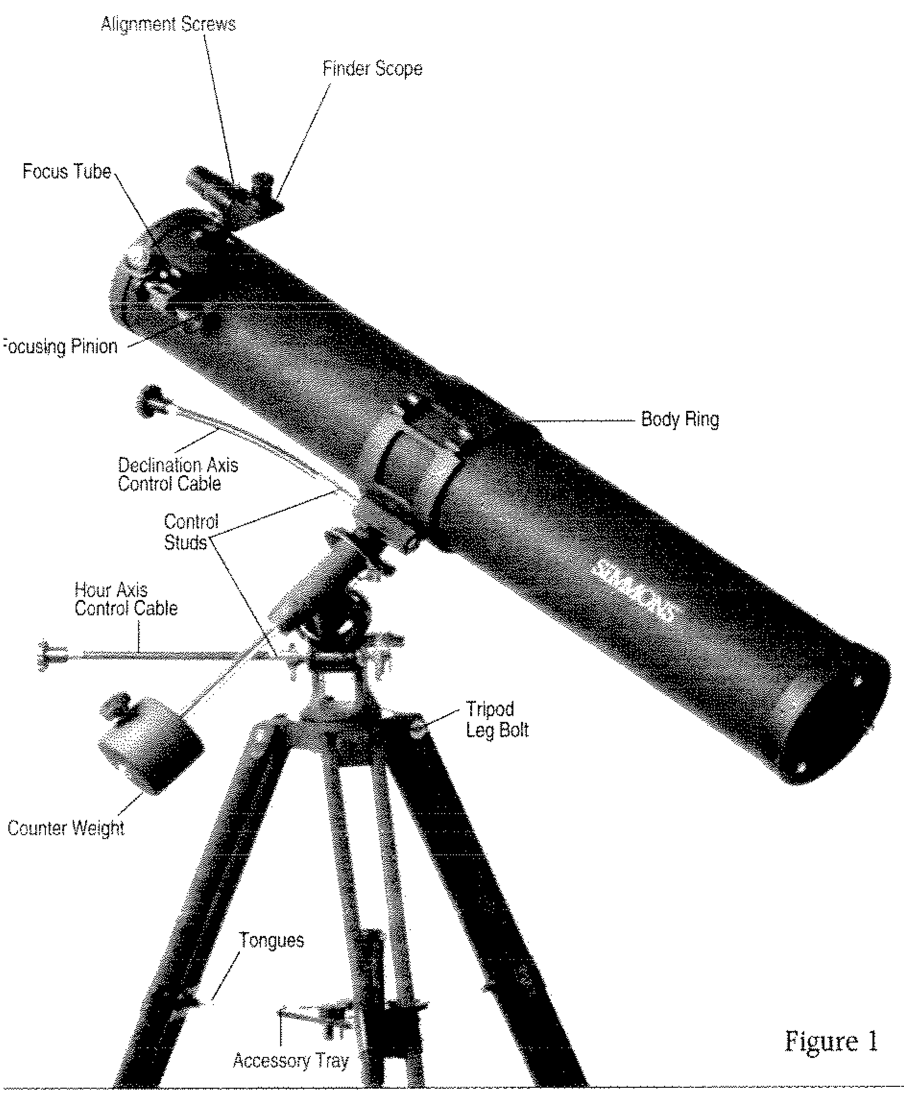

Figure 1

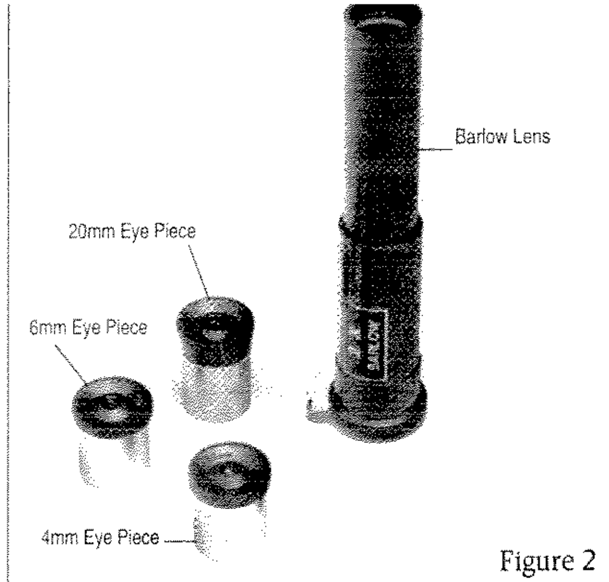

Figure 2

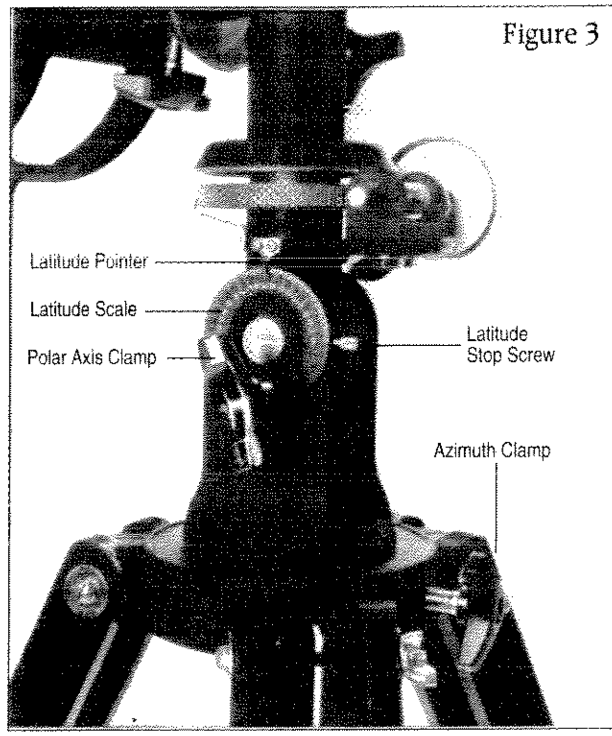

Figure 3

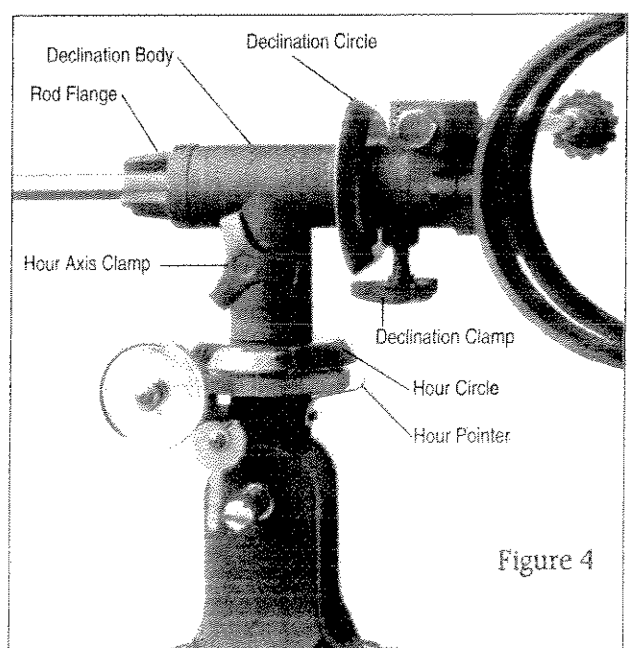

Figure 4

## SPECIFICATIONS

| Focal Length | Diameter | F Ratio | Dawes Limit | Limiting Magnitude | Light Gathering Power |
|---|---|---|---|---|---|
| 900mm (35.4") | 114mm (4.5") | 7.87 | 1.1 Arc Seconds | 12.3 | 225 |

# TELESCOPE MODEL 6450 ASSEMBLY & USER INSTRUCTIONS

**CAUTION**

CAUTION: VIEWING THE SUN WITH THIS TELESCOPE OR EVEN WITH THE NAKED EYE CAN RESULT IN BLINDNESS OR OTHER SERIOUS EYE DAMAGE WHICH MAY BE PERMANENT.

ASSEMBLY **Note:** A flathead and phillips head screwdriver along with a set of pliers will be helpful during assembly. Also, there will be a brown cardboard box containing several parts. This box will be referred to as the parts box during assembly.

1) Remove all parts from box. When removing parts, the telescope body will be attached to the equatorial mount. These two parts must be detached before assembly begins. To detach: loosen the screws on the telescope body ring and remove telescope body. After the telescope body has been detached, remove plastic bagging from body and discard in a safe place. **Note:** Tripod legs are located beneath all parts in the bottom of the box.

2) Take the tripod legs and extend equally. Stabilize legs by tightening the two (2) wing nuts on the lower end of each tripod leg.

3) Attach tripod legs to mount base by sliding leg bolts (located at the top of the tripod legs) upward into leg bolt channels. Be sure accessory tray tongues are facing inward. Tighten the wingnuts on leg bolts (figure 1).

4) Attach accessory tray to tongues located on the inside of tripod legs. Use the small bolts, washers and wingnuts located in the parts box. Be sure to place a washer between the screw head and accessory tray and a washer between the tongue and the wingnut (figure 1). Insert bolts head side up and screw on wingnuts.

5) Locate the two (2) counter weights (these are stored in separate boxes). Loosen counter weight clamp screw, slide silver metal rod (located in the parts box) through weights to about mid-length. While holding weights screw rod into rod flange located on the declination body (figure 4). Retighten counterweight clamp screws.

6) Attach the two (2) slow motion control cables to the control studs (figure 1).

7) Loosen the declination clamp screw, rotate body ring from it's vertical position to a horizontal position, and retighten the declination clamp screw.

8) Take the telescope body and position it inside the body rings, so that the focus tube is vertical and located above the slow motion control cables. Then, again position telescope body so that it is centered lengthwise in body rings (figure 8). Remove large dust cap from the forward end of the telescope and small cap from focusing tube.

9) Remove the two knurled nuts for the finderscope from main body, located near the focus tube.

10) Position the finderscope bracket (located in styrofoam box) over the mounting screw and replace the knurled nuts (figure 1).

11) Insert the 20mm eyepiece into focus tube. Lightly tighten the two set screws to secure eyepiece.

Assembly is now complete, but the finderscope must be aligned with the main telescope. For the sake of ease, alignment should be done in the day time.

## FINDERSCOPE ALIGNMENT

1) Loosen the azimuth clamp, (figure 3) sight along the main body tube and turn the telescope to the left or right as needed to aim at a distant object (1/4 mile or more). Retighten azimuth clamp.

2) To make up/down adjustments, loosen the declination clamp and rotate telescope about it's vertical axis, retighten declination clamp.

3) Look into the eyepiece and rotate the pinion knob (figure 1) to focus image of target which will appear upside down. (Note: If eyepiece is in an uncomfortable position for you, adjust the tripod or rotate the main body tube within the ring or both.) Center the target object in field of view by turning the two control cables (figure 1).

4) Rotate the finderscope within it's mounting bracket to place the eyepiece in a comfortable viewing position. Look into the finder eyepiece and adjust the three alignment screws (in bracket) to center the target object on the cross hairs.

5) Replace the 20mm eyepiece with the 6mm eyepiece. Recenter target object and readjust the finderscope. Do these procedures as many times as needed in order to achieve good alignment between the main body and the finderscope.

The finderscope should now be reasonably aligned and the objects appearing at or near the center of the crosshair will be within the field of view of the main telescope.

## USING YOUR TELESCOPE

If you have performed the assembly steps as outlined, the telescope is set up and ready for viewing terrestrial (earth) objects. Orientation of the image as seen through the eyepiece and the finderscope will be dependent upon the position (angle) of the eyepiece to the object being viewed.

Since your telescope is designed primarily for astronomical viewing, corrected imaging is not important. The required lens system to erect the image has been omitted. This arrangement allows more light to reach the eye with the added advantage of seeing fainter deep space objects.

## ASTRONOMICAL OBSERVATIONS

Your telescope is equipped with an equatorial mount which makes locating and tracking celestial objects, particularly those that can not be seen without a telescope, easier than other types of mounts.

If you have observed some of the brighter stars or planets with your telescope set up for terrestrial viewing, you discovered that tracking was not easy. Constant adjustment of the vertical and horizontal axes was required to keep the star or planet in view.

With an equatorial mount, only one axis needs adjustment for proper tracking. To take advantage of this feature of the mount, it must be changed from the terrestrial mode to it's astronomical configuration.

Astronomical set up is not difficult, but does involve several procedural steps and there is some new terminology to learn. It might be helpful to first learn the how's and why's of an equatorial mount for a better understanding of the procedure.

The earth rotates from west to east about it's polar axis (an imaginary line extending through the poles into space) which is tilted 23.5 degrees in respect to the ecliptic. These two factors result in the apparent motion of the stars rising in the east, moving southward as they climb higher until they cross your meridian (an imaginary line extending from pole to pole and passing overhead) then descending moving northward to set in the west.

To eliminate the need for constant vertical and horizontal adjustments to track stars, the mount is tilted to match the earth's tilt (figure 5). The amount of required tilt is dependent upon the observer's latitude. In addition to matching polar tilt, the mount must be aligned on the true north/south line. These two adjustments are known as polar angle (tilt) and polar alignment (north/south).

When polar angle and alignment are correct, tracking becomes a matter of advancing the telescope westward to counteract the eastward rotation of the earth.

## SETTING UP FOR ASTRONOMICAL OBSERVATIONS

The following procedure will prepare the mount for astronomical tracking.

1) Demount telescope and counter weights.

2) Level tripod.

3) From a map or other source (county surveyor's office, atlas, airport control tower, planetarium, etc.) determine the latitude of your location. **Note:** You will need your latitude and longitude for astronomical tracking and will need to be changed as the telescope is transported from location to location.

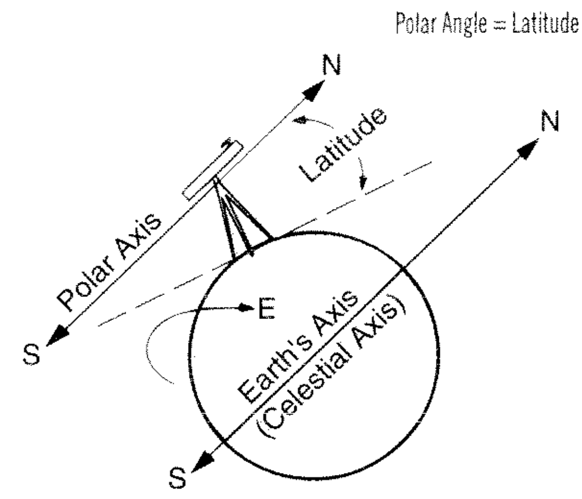


Figure 5

4) Loosen the polar axis clamp screw and set the polar angle to your latitude as indicated by the pointer. Note: For latitudes between 0 and 35 degrees a polar axis stop screw is provided to relieve strain on the clamp screw. Turning the screw counter clockwise from it's seated position progressively raises the lower limit at which the polar angle can be set. Retighten the polar axis clamp screw when correct angle is set (figure 3).

5) Loosen azimuth clamp screw and rotate mount so that the upper end of the polar axis is to the north. Retighten azimuth screw (figure 6). An exact north/south alignment is not required at this time. Final alignment in azimuth will be made later using the north star as a guide. NOTE: The use of a small level will facilitate steps 6 to 10.

6) Loosen hour axis clamp screw (figure 4) and adjust the hour axis to level (horizontally) the declination body, retighten clamp (figure 6). Body rings should be on the east side of mount.

7) Loosen declination clamp screw (figure 4), rotate body rings to a vertical position and level. Check declination pointer to see if it is indicating your latitude. If not, bend the pointer slightly, (figure 6). NOTE: Before bending, check to be sure that the tripod, declination body and body rings are all level and correctly positioned.

8) Rotate body rings 90 degrees. The declination pointer should now indicate your co-latitude (co-latitude is 90 degrees minus your latitude. Example: Latitude 30 degrees, co-latitude is 90-30=60 degrees (figure 7).

9) Loosen hour axis clamp, rotate body ring 180 degrees to the west of the mount, reset ring to the horizontal position. The declination pointer should indicate your co-latitude. If not, rebend pointer to correct one half of the error.

10) Move body rings back to east side of mount and check to see if the corrected co-latitude is indicated. If not, repeat steps 8 and 9.

11) Tighten locking screws and remount telescope and weights.

12) Loosen declination lock and body ring clamp screws. The telescope should remain in position. If not, slide the telescope within the ring so it remains in any set position (i.e. balance the telescope fore and aft). Retighten both lock screws (figure 8). Note: Padding on body rings may make it difficult to adjust telescope body.

13) Loosen the hour axis lock screw, the telescope should remain in position. If not, adjust the counter weight to counter balance the telescope (figure 8).

The telescope is now properly balanced and set up for astronomical tracking. The above procedure does not need to be done again unless you change observing latitudes. The only remaining adjustments to be made are refinements in polar angle and alignment.

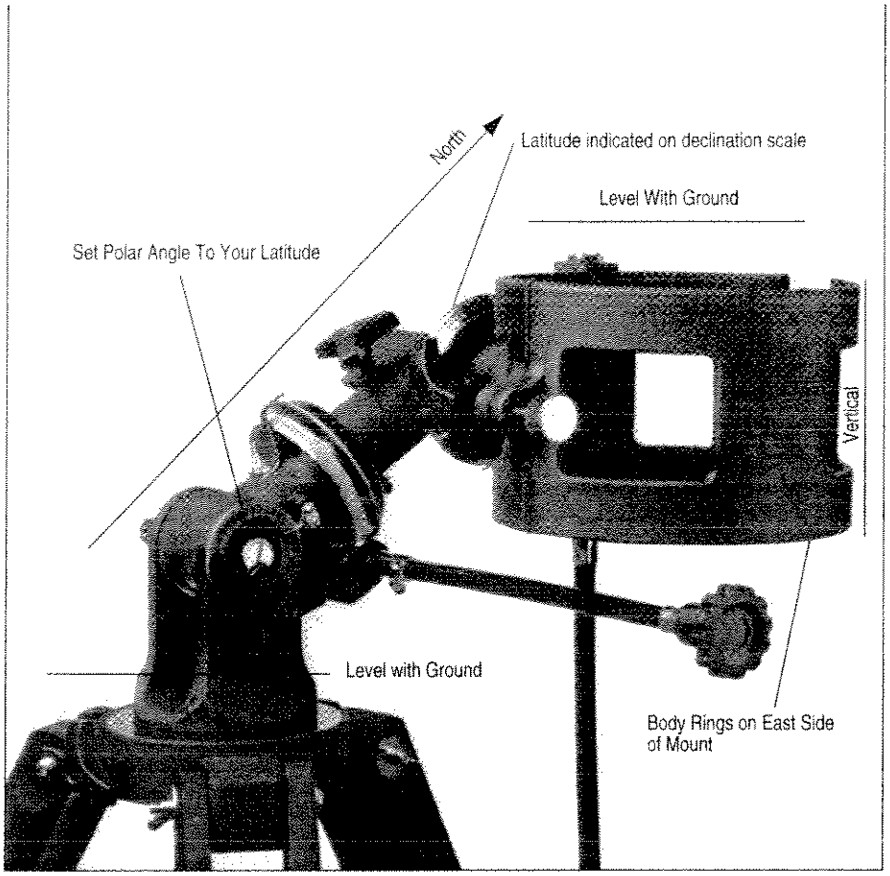


Figure 6

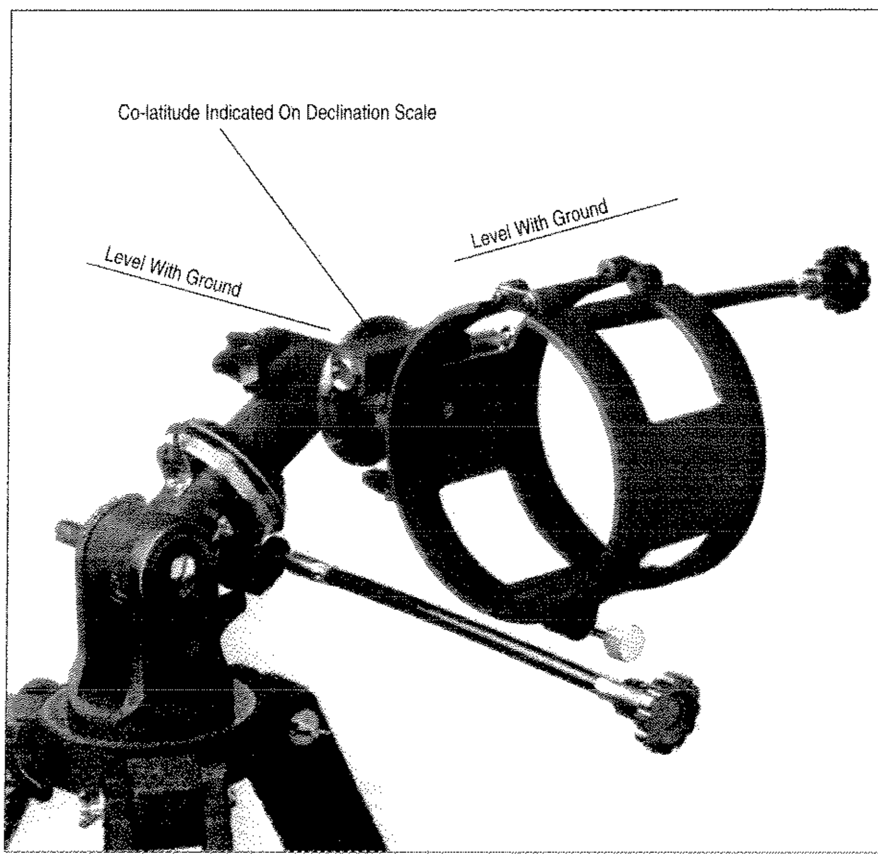


Figure 7

## POLAR ANGLE AND ALIGNMENT

1) Set your telescope up at night, loosen the declination clamp screw (figure 4), rotate the telescope to an indicated 90 degrees on the declination scale, retighten the clamp screw (figure 9).

2) Loosen the azimuth clamp screw (figure 3), rotate mount so that the telescope is pointing towards the north star (Polaris) (figure 9).

3) While looking into the 20mm eyepiece, turn the mount in azimuth and adjust the polar axis to center Polaris in the field of view. Retighten the azimuth and polar axis clamps (figure 9).

Polar angle and alignment should now be reasonably well corrected and advancement of the hour axis cable will keep stars centered in the telescope eyepiece.

## USE OF SETTING CIRCLES

All celestial objects are assigned an "address" much as are places on earth. Terrestrial addressing is by the latitude and longitude system. Latitude is the position north or south of the equator and longitude is the position east or west of Greenwich, England.

In astronomy, declination and right ascension (R.A.) are the terms used to locate position. Declination relates directly to latitude. Zero degrees declination is the celestial extension of earth's equator. Plus 90 degrees lies directly above the north pole, minus 90 over the south pole.

Right ascension is equal to longitude. Both are used to mark positions east or west of a fixed point (figure 10).

Unlike longitude which is incremented in degrees east or west of Greenwich, England (180 degrees east and 180 degrees west are the same), R.A. increases eastward from 0 hours to 23 hours, 59 minutes, 59 seconds.

The juncture of declination 0 degrees and right ascension 0 hours is known as the first point of Aries by navigators, and more commonly known as the vernal or spring equinox. There is no star at this location, it is simply a reference point where the sun crosses the equator in spring. Currently, the first point of Aries is not in Aries at all, but in Pisces and is moving toward Aquarius (figure 11).

The problem with this system is that the actual time at your location is either earlier or later than indicated on your watch, depending upon if you are east or west of your time zone meridian. If you don't know actual time, you can't determine the actual R.A. value on your meridian at any given moment.

From the above one can see that all three factors are interrelated. All three are in fact time based. It follows then, that time based corrections must be applied to your observations to locate stars and other objects.

The combined correction for location and date is called sidereal time or star time if you like.

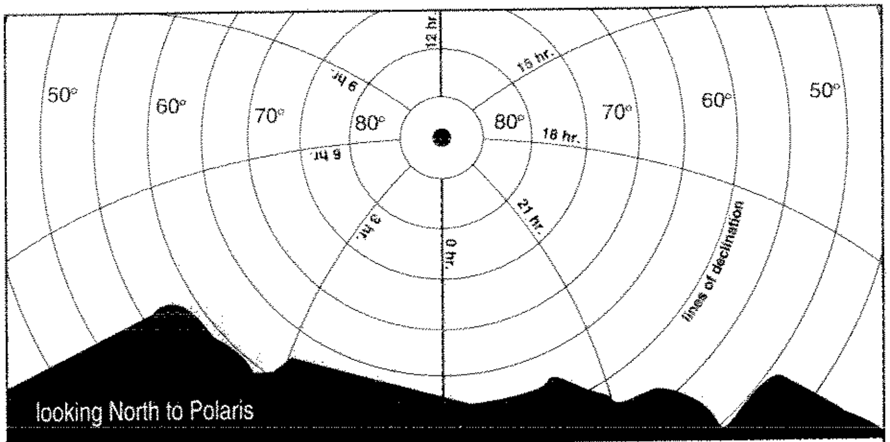

Figure 10

## DETERMINING YOUR LOCATION AND CALCULATING LOCAL MEAN TIME

1) From a map, atlas or other source determine the longitude of your location. Note: Your longitude must be decided before beginning the following steps.

2) For each degree your location is east of the time zone meridian, add 4 minutes to standard time (see figure 12). If west of the time zone meridian, deduct 4 minutes per degree. Time zone meridians in the United States are:

| | |
|---|---|
| Eastern | 75 degrees |
| Central | 90 degrees |
| Mountain | 105 degrees |
| Pacific | 120 degrees |
| Alaska | 135 degrees |
| Hawaii | 150 degrees |

The following examples are based upon Standard Time. For Daylight Savings Time, deduct one hour from clock time.

**EXAMPLE:** Columbus, Ohio

**Step 1-**
83 degrees (longitude)
- 75 (Eastern Time Zone Meridian)
8 (West of time zone meridian)

**Step 2-** 8 degrees X 4 = 32 min. of correction required.

**Step 3-** Deduct 32 min. from standard time.

At 8:00 pm Standard Time in Columbus Ohio, Local Mean Time is:
8:00 pm - 32 min = 7:28 pm.

**EXAMPLE:** Dodge City, Kansas

**Step 1-**
100 degrees 1 min. (longitude)
- 105 degrees (Mtn.Time Zone Meridian)
5 degrees 1 min. (East of time zone meridian)

**Step 2-** 5 degrees X 4 = 20 min. of correction required.

**Step 3-** Add 20 min. to standard time

At 8:00 pm Standard Time in Dodge City Kansas, local mean time is:
8:00 pm + 20 min. = 8:20 pm.

## CORRECTING FOR DATE

On page 9 is a chart showing the sidereal time for each day of the year at 6:00 pm local mean time. To use the chart:

1) Determine the sidereal time for the current date at 6:00 pm Local Mean Time.

2) Add or subtract local mean time as needed to determine sidereal time at your location at the time of observation.

**EXAMPLE:** Date January 1

Chart Time for 6:00 pm local mean time = 0 hours, 45 minutes.

Current Local Mean Time is 7:28 pm.

Difference between chart and current local time = 1 hour, 28 minutes
(7:28 - 6:00 = 1 hour, 28 minutes.)

Sidereal Time at 7:28 pm local time:
0 hours, 45 minutes
+ 1 hour, 28 minutes
2 hours, 13 minutes

**EXAMPLE:** Date June 27

Chart Time = 12 hours, 23 minutes.

Current Local Mean Time is 8:20 pm.

Difference between chart and current local time = 2 hours, 20 minutes
(8:20 - 6:00 = 2:20.)

Sidereal Time at 8:20 pm local time:
12 hours, 23 minutes
+ 2 hours, 20 minutes
14 hours, 43 minutes

**EXAMPLE:** Date September 16

Chart time = 17 hours, 43 minutes.

Current Local Mean Time is 3:00 am.

Difference between chart and current local time = 15 hours, 0 minutes
(6:00 pm - 3:00 am = 15 hours.)

Sidereal Time at 3:00 am local time:
17 hours, 43 minutes
- 15 hours, 0 minutes
2 hours, 43 minutes

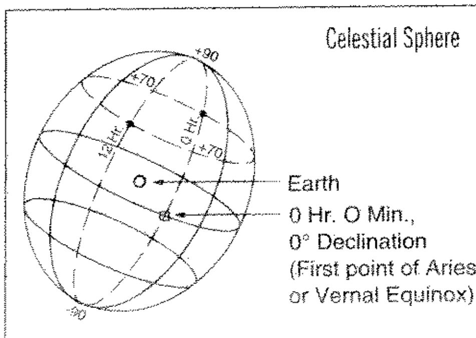

Figure 11

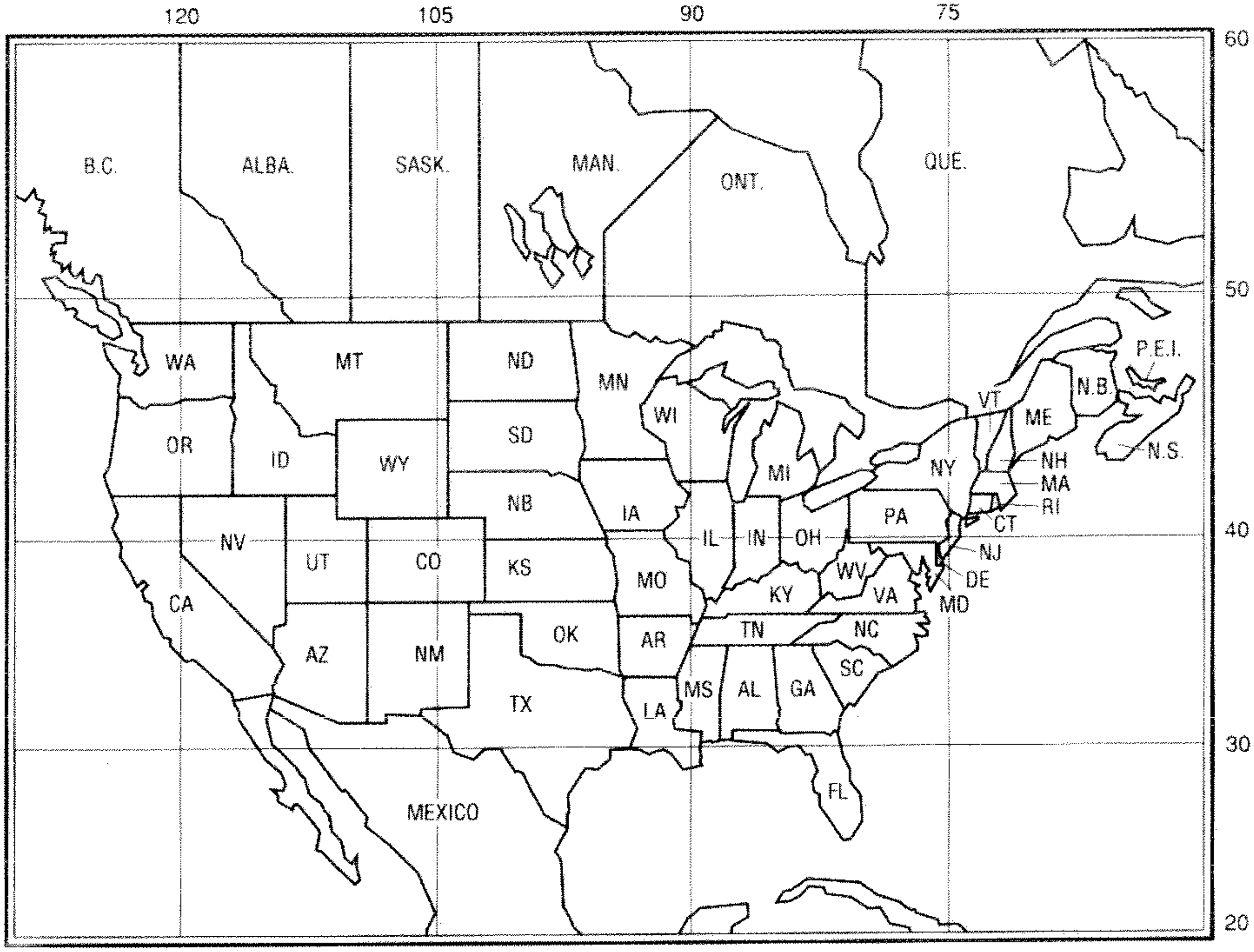


Figure 12

With sidereal time on your meridian for the time of observation established and the sidereal position of the celestial object known, the telescope can be indexed properly.

Exercise: Current sidereal time (on your meridian) = 14 hours, 30 minutes.

Sidereal position of object to be observed is R.A. 18 hours, 36 minutes; Declination plus 38° 46 minutes (this is the "address" for VEGA).

Since we know our position (14 hours, 30 min.) and that R.A. increases to the east, we can deduce that our target is to the east 4 hours, 6 minutes (18:36 - 14:30 = 4:06).

To index VEGA, loosen the hour axis lock, rotate the polar axis body to the horizontal position (Note: Since VEGA is to our east, place the telescope on the west side of the mount) re-lock hour axis.

Manually turn the hour circle so that 14 hours, 30 minutes is in line with the pointer (Note: The upper set of numbers is for use in the northern hemisphere, the lower numbers for the southern hemisphere - figures 13 and 14).

Turn the hour axis control cable to bring 18 hours, 30 minutes in line with the pointer (figure 15 and 16). The six minute error can be ignored as the field of view of the telescope is considerably larger and VEGA will still appear within the field of view.

Loosen the declination lock and turn the telescope to bring 38°45minutes in line with the declination pointer. Use the cable to refine adjustment. The telescope should now be pointing to the northeast and upward (figure 17 and 18).

Look into the low power eyepiece, you should see VEGA. Once you see it, center it in the eyepiece using the control cables and switch to a higher magnification.

Use the hour axis cable to advance the telescope in right ascension. This should keep VEGA centered. If adjustments in declination are required, the polar axis is not in polar alignment.

If adjustments are to the north, the polar axis is pointing to far westward. If advancements are to the south, the polar axis is pointing eastward. To correct, loosen the azimuth lock screw and turn the polar axis as needed.

## SUDDEN TEMPERATURE CHANGES

If possible avoid taking the telescope from cold outside air into warm room temperatures. This will cause the lenses to become coated with condensed moisture, a condition which must be corrected at once. To do this place the telescope at a safe distance from a heat source and let it warm slowly until the moisture disappears. Any stain left on the lenses must be carefully wiped off after it is thoroughly dry. Set up the telescope outdoors in cold weather at least one half hour before use.

# SIDEREAL CHART for 6 P.M. Local Mean Time

| DAY | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | DAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | $0^h 45^m$ | $2^h 48^m$ | $4^h 38^m$ | $6^h 40^m$ | $8^h 39^m$ | $10^h 41^m$ | $12^h 39^m$ | $14^h 41^m$ | $16^h 44^m$ | $18^h 42^m$ | $20^h 44^m$ | $22^h 42^m$ | 1 |
| 2 | 0 49 | 2 52 | 4 42 | 6 44 | 8 43 | 10 45 | 12 43 | 14 45 | 16 48 | 18 46 | 20 48 | 22 46 | 2 |
| 3 | 0 53 | 2 56 | 4 46 | 6 48 | 8 46 | 10 49 | 12 47 | 14 49 | 16 51 | 18 50 | 20 52 | 22 50 | 3 |
| 4 | 0 57 | 3 00 | 4 50 | 6 52 | 8 50 | 10 53 | 12 51 | 14 53 | 16 55 | 18 54 | 20 56 | 22 54 | 4 |
| 5 | 1 01 | 3 04 | 4 54 | 6 56 | 8 54 | 10 57 | 12 55 | 14 57 | 16 59 | 18 58 | 21 00 | 22 58 | 5 |
| 6 | 1 05 | 3 07 | 4 58 | 7 00 | 8 58 | 11 01 | 12 59 | 15 01 | 17 03 | 19 02 | 21 04 | 23 02 | 6 |
| 7 | 1 09 | 3 11 | 5 02 | 7 04 | 9 02 | 11 05 | 13 03 | 15 05 | 17 07 | 19 06 | 21 08 | 23 06 | 7 |
| 8 | 1 13 | 3 15 | 5 06 | 7 08 | 9 06 | 11 08 | 13 07 | 15 09 | 17 11 | 19 09 | 21 12 | 23 10 | 8 |
| 9 | 1 17 | 3 19 | 5 10 | 7 12 | 9 10 | 11 12 | 13 11 | 15 13 | 17 15 | 19 13 | 21 16 | 23 14 | 9 |
| 10 | 1 21 | 3 23 | 5 14 | 7 16 | 9 14 | 11 16 | 13 15 | 15 17 | 17 19 | 19 17 | 21 20 | 23 18 | 10 |
| 11 | 1 25 | 3 27 | 5 18 | 7 20 | 9 18 | 11 20 | 13 19 | 15 21 | 17 23 | 19 21 | 21 24 | 23 22 | 11 |
| 12 | 1 29 | 3 31 | 5 22 | 7 24 | 9 22 | 11 24 | 13 22 | 15 25 | 17 27 | 19 25 | 21 27 | 23 26 | 12 |
| 13 | 1 33 | 3 35 | 5 25 | 7 28 | 9 26 | 11 28 | 13 26 | 15 29 | 17 31 | 19 29 | 21 31 | 23 30 | 13 |
| 14 | 1 37 | 3 39 | 5 29 | 7 32 | 9 30 | 11 32 | 13 30 | 15 33 | 17 35 | 19 33 | 21 35 | 23 34 | 14 |
| 15 | 1 41 | 3 43 | 5 33 | 7 36 | 9 34 | 11 36 | 13 34 | 15 37 | 17 39 | 19 37 | 21 39 | 23 38 | 15 |
| 16 | 1 45 | 3 47 | 5 37 | 7 40 | 9 38 | 11 40 | 13 38 | 15 40 | 17 43 | 19 41 | 21 43 | 23 41 | 16 |
| 17 | 1 49 | 3 51 | 5 41 | 7 43 | 9 42 | 11 44 | 13 42 | 15 44 | 17 47 | 19 45 | 21 47 | 23 45 | 17 |
| 18 | 1 53 | 3 55 | 5 45 | 7 47 | 9 46 | 11 48 | 13 46 | 15 48 | 17 51 | 19 49 | 21 51 | 23 49 | 18 |
| 19 | 1 56 | 3 59 | 5 49 | 7 51 | 9 50 | 11 52 | 13 50 | 15 52 | 17 55 | 19 53 | 21 55 | 23 53 | 19 |
| 20 | 2 00 | 4 03 | 5 53 | 7 55 | 9 54 | 11 56 | 13 54 | 15 56 | 17 58 | 19 57 | 21 59 | 23 57 | 20 |
| 21 | 2 04 | 4 07 | 5 57 | 7 59 | 9 57 | 12 00 | 13 58 | 16 00 | 18 02 | 20 01 | 22 03 | 0 01 | 21 |
| 22 | 2 08 | 4 11 | 6 01 | 8 03 | 10 01 | 12 04 | 14 02 | 16 04 | 18 06 | 20 05 | 22 07 | 0 05 | 22 |
| 23 | 2 12 | 4 14 | 6 05 | 8 07 | 10 05 | 12 08 | 14 06 | 16 08 | 18 10 | 20 09 | 22 11 | 0 09 | 23 |
| 24 | 2 16 | 4 18 | 6 09 | 8 11 | 10 09 | 12 12 | 14 10 | 16 12 | 18 14 | 20 13 | 22 15 | 0 13 | 24 |
| 25 | 2 20 | 4 22 | 6 13 | 8 15 | 10 13 | 12 15 | 14 14 | 16 16 | 18 18 | 20 16 | 22 19 | 0 17 | 25 |
| 26 | 2 24 | 4 26 | 6 17 | 8 19 | 10 17 | 12 19 | 14 18 | 16 20 | 18 22 | 20 20 | 22 23 | 0 21 | 26 |
| 27 | 2 28 | 4 30 | 6 21 | 8 23 | 10 21 | 12 23 | 14 22 | 16 24 | 18 26 | 20 24 | 22 27 | 0 25 | 27 |
| 28 | 2 32 | 4 34 | 6 25 | 8 27 | 10 25 | 12 27 | 14 26 | 16 28 | 18 30 | 20 28 | 22 31 | 0 29 | 28 |
| 29 | 2 36 | | 6 29 | 8 31 | 10 29 | 12 31 | 14 30 | 16 32 | 18 34 | 20 32 | 22 34 | 0 33 | 29 |
| 30 | 2 40 | | 6 32 | 8 35 | 10 33 | 12 35 | 14 33 | 16 36 | 18 38 | 20 36 | 22 38 | 0 37 | 30 |
| 31 | 2 44 | | 6 36 | | 10 37 | | 14 37 | 16 40 | | 20 40 | | 0 41 | 31 |
| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | |

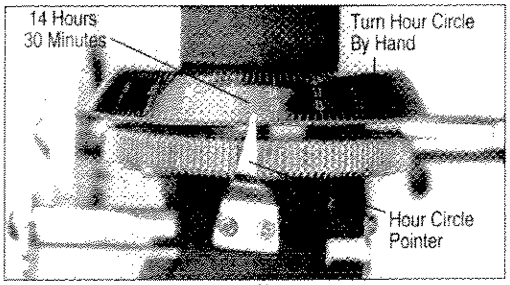

Figure 13

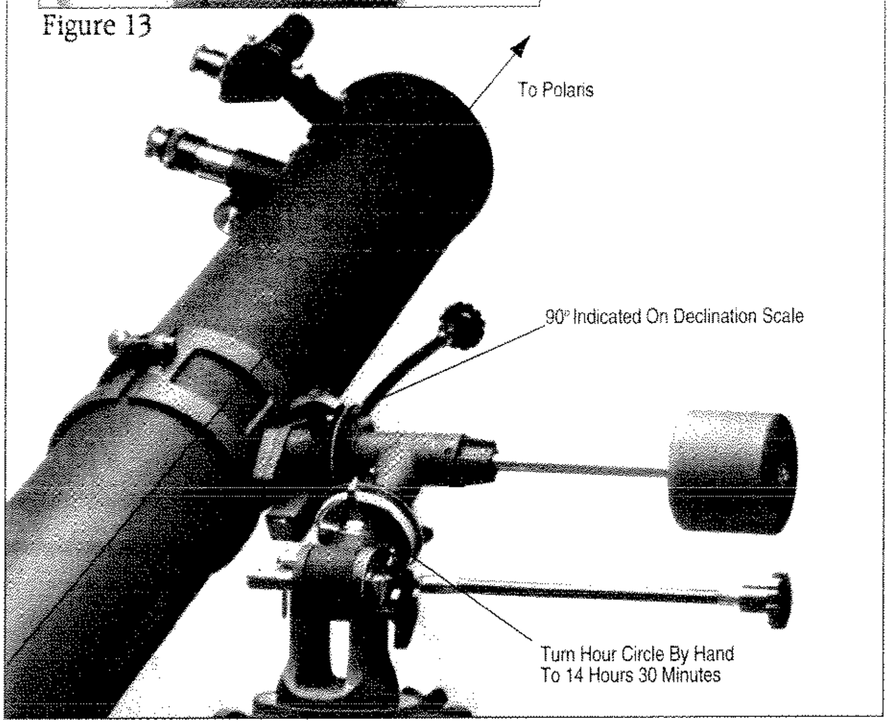

Figure 14

## GETTING THE MOST OUT OF YOUR TELESCOPE

Take the time to become familiar with your new telescope. Learn the names of the various parts, where they are located and how they work. It is best to do this in the day time.

Notice how as magnification is increased, the image becomes darker, the field of view (area seen through the telescope) decreases, and focusing becomes more critical.

When setting up for a viewing session, place the telescope in an area sheltered from the wind if possible. Best night time viewing will be away from city lights and when the atmosphere is steady. With a little practice, you will learn to judge when viewing conditions are good. Look for the nights when the stars shine brightly with little or no twinkling.

Use low power to take advantage of the wider field of view and brighter images. Reserve your high powers for those nights when viewing conditions are really good and there is some detail to be seen. To obtain maximum magnification, place the Barlow Lens in the focusing tube and any eyepiece into the Barlow.

If there is an astronomy club in your area, consider becoming a member. You can learn more in an hour from experienced hobbyists than in a month of uninformed casual observing. The chamber of commerce, library, science museum, nearby schools or planetarium may have information regarding nearby clubs.

## YOUR FIRST VIEWS

Until you become familiar with your telescope, it is best to pick easy targets for your first views of our celestial surroundings. The easiest and most interesting of all is the moon.

The moon is best viewed at low power and when it is less than full. Because of its proximity to Earth, its angular speed is quite fast, 15 arc minutes per minute of time or 1/2 it's diameter per minute. Magnification provided by the telescope not only makes the image larger, it also has the effect of increasing apparent speed, making tracking more difficult.

The brightness of the full moon tends to flatten some surface details and hide others. Best viewing is when it is waxing or waning.

The planets Venus, Mars, Jupiter and Saturn are all easy targets.

Venus is exceeded in brightness only by the sun and moon. It is best viewed at twilight or just before dawn. Look for Venus on the horizon. It may be seen as a disc or as a thin crescent.

Mars appears as a reddish-orange disc. Some surface details may be seen when it is it's closest to earth.

Jupiter, the largest of the known planets in our solar system is an interesting subject. The great red spot is easily seen, although in small telescopes it appears more blue-grey than red. Equally easy to see is the equatorial belt. It also appears blue-grey.

Four of Jupiter's moons, known as the Galilean moons, are seen as tiny specks of light laying on either side of this giant planet.

Saturn, appearing dull yellow in the night sky, reveals its ring systems readily. Depending on it's orbital position relative to earth, the rings may be seen as a streak of light cutting through Saturn, to a broad band surrounding a suspended disc.

Uranus and Neptune are not easy targets for the beginner because they are not bright enough to be seen with the naked eye, making locating them difficult.

Pluto, the furthest of the known planets requires a telescope with a five or six inch diameter objective lens, just to make it barely visible.

Mercury, although a "visible" planet is not an easy telescope target for the novice. It lies so close to the sun that it can only be seen in the early morning or early evening hours, low on the horizon. March, April, August and September are the best months to observe Mercury.

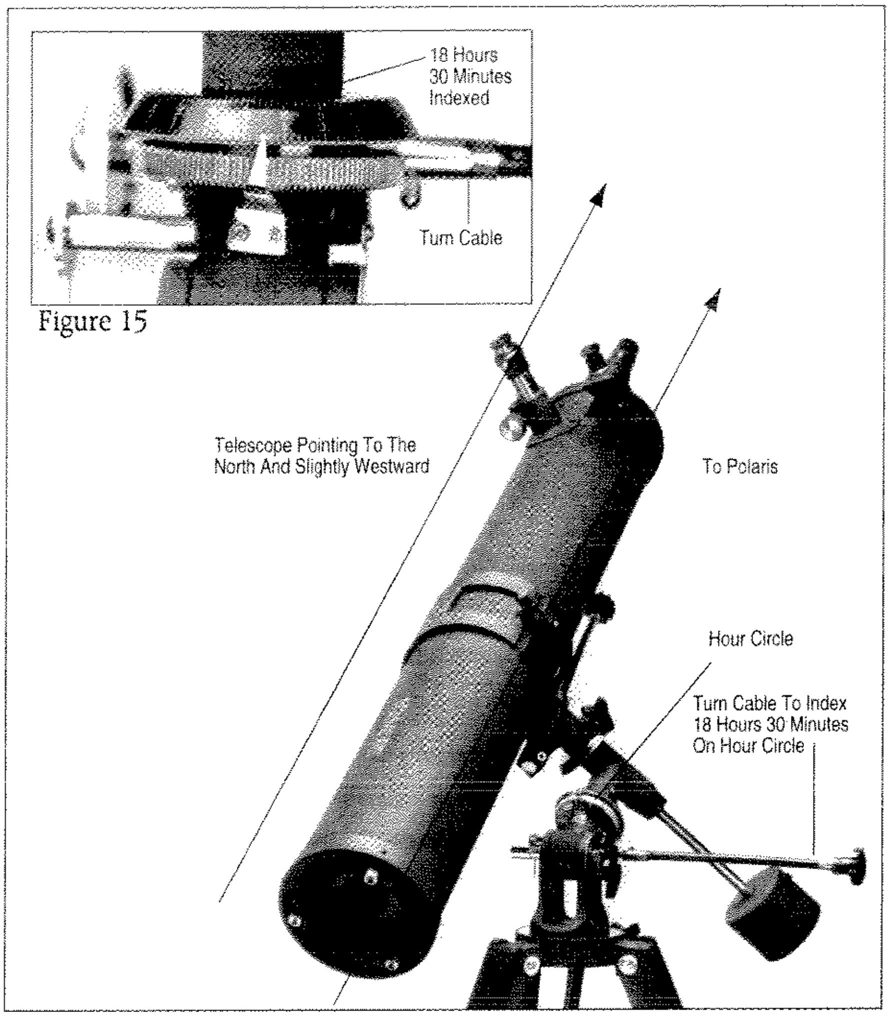

Figure 15

Figure 16

Among the stars, the easiest targets are the Pleiades group in the constellation Taurus and the Great Nebula in Orion.

Turn your telescope onto the seven visible stars of the Pleiades and you will see hundreds of additional stars not visible to the naked eye.

Located about midway down the "sword" of Orion is the Great Nebula. This great gas cloud is in the process of forming a new star, which will have an estimated mass 10,000 times greater than our sun.

Stars in general are not interesting to the casual observer. The magnifying power of telescopes has no apparent effect on them, no detail can be observed, no visual information is revealed. However, to the experienced observer, there are hundreds of interesting stars which provide a lifetime of rewarding study.

An example of one such star is Betelgeuse, the light orange star marking one shoulder of Orion. It is one of the largest known stars, with a diameter 400 times our own sun. Earth's orbit could easily fit inside Betelgeuse. One of the most interesting features of this young star is that it periodically expands and contracts.

Sirius, the brightest star in the night sky is actually 27 times brighter than the sun. In itself, Sirius is of no particular interest. However, because of it's companion star, the Pup, a "binary" system is formed. Sirius and the Pup orbit about a common center of gravity.

About 1/10,000 as bright as Sirius, the Pup is far denser. On Earth, one cubic inch of the Pup's material would weigh one ton. The estimated mass of the Pup is 250,000 times greater than the Earth.

As dense as the Pup is, it does not hold the record. The densest of the known stars is known as AC+20 8247. A tablespoon of it's substance would weigh 720 tons.

On the other hand, the largest known star, Epsilon Auringne B, is 100 million times less dense than water. If it were here on earth, it would have to be tied down to keep it from floating away.

If you wish to learn more about astronomy, there are several sources of information available from libraries and bookstores. *Astronomy Made Simple* (published by Made Simple Books) and *The Stargazer's Bible* (Doubleday) are both inexpensive paperbacks written for the novice. Two monthly periodicals, *Sky and Telescope* and *Astronomy* are available at newsstands or bookstores.

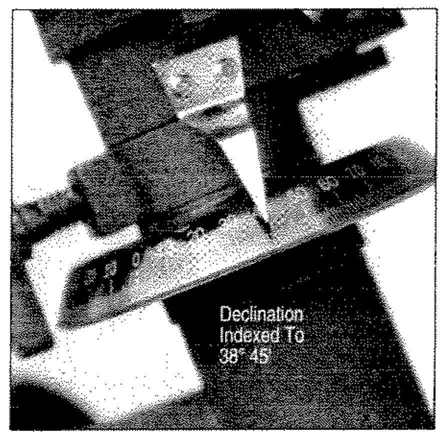

Figure 17

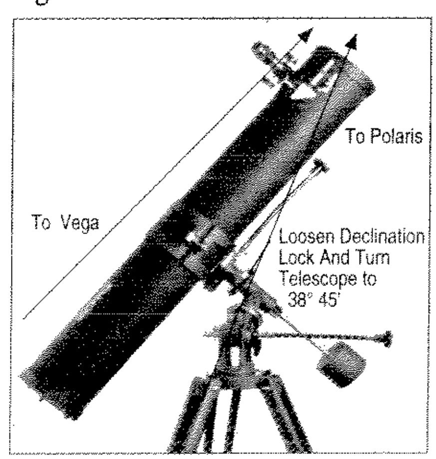

Figure 18

## GLOSSARY OF TERMS

SOLAR DAY-24 hours

SIDEREAL DAY-23 hours 56 minutes and 4 seconds

SOLAR YEAR-365 solar days

SIDEREAL YEAR-365.24 solar days -- 1 full orbit of earth around the sun

RIGHT ASCENSION- (east rising) a term used to mark the position of celestial objects along and east-west line (similar to longitude), expressed in hours

DECLINATION-a term used to mark celestial objects along a nort-south line (similar to latitude), expressed in degrees (+/-) from the celestial equator

VERNAL EQUINOX-the point in time when the sun crosses the equator in spring, on or about March 22, at noon local mean time

FIRST POINT OF ARIES-the intersection of 0 hour right ascension and 0° declination at the time of the sun crossing the equator in spring (vernal equinox)

LOCAL MEAN TIME-solar (clock) time corrected for longitude

MERIDIAN-a line extending from pole to pole

POLAR ANGLE-the angle formed by the North Star, your latitude and your northern horizon

EQUATORIAL MOUNT-a telescope mounting system which compensates for the eastward (counter-clockwise) rotation of the earth

POLAR AXIS-(1) the point(s) about which the earth rotates. These points are at +90° north and at -90° south. (2) a portion of an equatorial mount which adjusts for latitude to compensate for the tilt of the earth

ECLIPTIC-the apparent circle scribed by the sun on the celestial sphere

NEBULA- a vast cloud of gas and dust

MAGNITUDE-a measure of the apparent brightness of stars. The lower the number, the brighter the star. Polaris is a magnitude (2) star. The sun is rated as magnitude (-26.5). On a dark night the unaided eye can discern stars down to magnitude (6).

## SOME INTERESTING OBJECTS TO VIEW

| ITEM | RIGHT ASCENSION | DECLINATION | MAGNITUDE |
|---|---|---|---|
| Andromeda Galaxy | 00 hours, 42 minutes | +41° 15 minutes | 4.8 |
| Ring Nebula | 18 hours, 53 minutes | +33° 02 minutes | 9.3 |
| Orion Nebula | 05 hours, 35 minutres | -5° 27 minutes | — |
| Dumbbell Nebula | 19 hours, 59 minutes | +22° 42 minutes | 7.6 |
| Spiral Galaxy | 09 hours, 55 minutes | +69° 05 minutes | 7.9 |
| Spiral Galaxy | 12 hours, 29 minutes | +8° 01 minute | 8.6 |

## SOME HELPFUL HINTS

1. Set up your telescope in an area sheltered from wind to avoid vibration caused by the wind
2. Make a list of stars or objects you wish to observe in advance of the observing session. By knowing what you are going to observe and their positions (RA-Dec.) in advance, you will save time and trouble trying to read charts at night
3. Cover the lens of a flashlight with red celofane. This will allow you to read your list of objects to be observed, set the setting circles, change eye pieces, ect. without loosing your night vision
4. Allow about 20 to 30 minutes for your eyes to become dark adapted.
5. To see very dim objects appearing in an eyepiece, use averated vision. Center the object in the eye piece then look to one side of it.
6. When you have determined sidereal time on your meridian at the time you start your observation, set a watch to the sidereal time. This will negate the need to recalculate sidereal time each time you change objects.
7. If your observations take place at the same location each time, place markers in the ground to show the location for each tripod leg. Mark each leg to show its extended (height) position. Place a mark on the mount to show the correct azimuth setting. Doing the above, will save time in setting up for an observing session.

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