INSTRUCTION MANUAL

Orion®
Observer™ 70mm Altaz

#9801 Altazimuth Refractor Telescope

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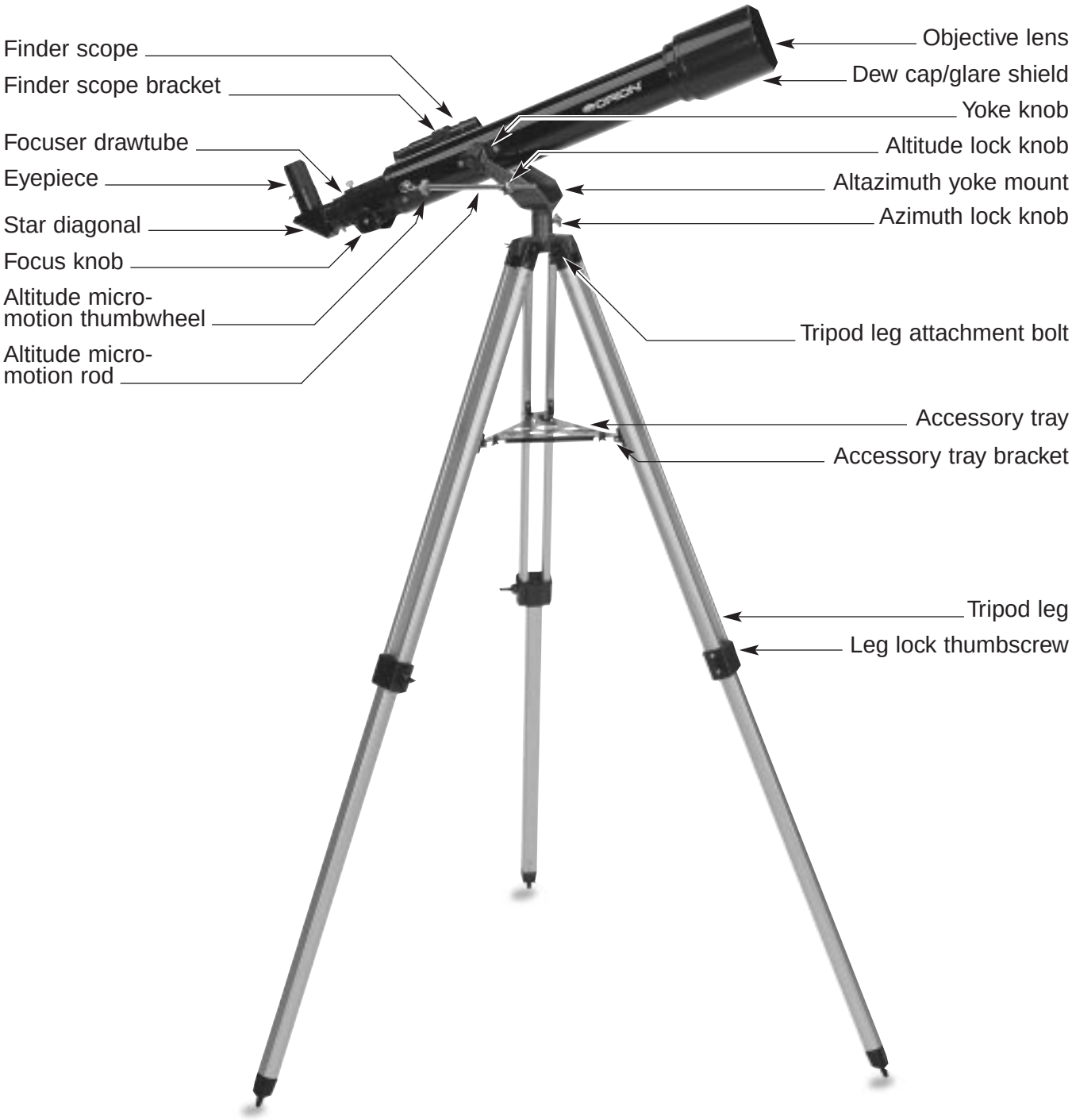

Figure 1. Observer 70mm Altaz Parts Diagram

Congratulations on your purchase of a quality Orion telescope. Your new Observer 70mm Altazimuth Refractor is designed primarily for astronomical viewing, but can also be used for terrestrial observation (with the recommended addition of an image-erecting prism).

If you have never used a telescope before, we would like to welcome you to amateur astronomy. Take some time to familiarize yourself with the night sky. Learn to recognize the patterns of stars in the major constellations; a star wheel, or planisphere, available from Orion or from your local telescope shop, will greatly help. With a little practice, a little patience, and a reasonably dark sky away from city lights, you'll find your telescope to be a never-ending source of wonder, exploration, and relaxation.

These instructions will help you set up and properly use and care for your telescope. Please read them over thoroughly before getting started.

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1. Parts List

Qty.	Description
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1	Altazimuth yoke mount
1	Altitude micro-motion control rod
1	5x crosshair finder scope
1	Finder scope bracket
1	25mm (28x) Kellner eyepiece (1.25" barrel diameter)
1	90° mirror star diagonal (1.25" barrel diameter)
1	Accessory tray
3	Accessory tray attachment screws with wing nuts and washers
2	Yoke knobs
3	Tripod legs
3	Tripod leg lock thumbscrews
3	Tripod leg attachment bolts with washers and wing nuts

2. Assembly

Carefully open all of the boxes in the shipping container. Make sure all the parts listed in Section 1 are present. Save the boxes and packaging material. In the unlikely event that you need to return the telescope during the warranty period, you must use the original packaging.

Assembling the telescope should take only about 10-15 minutes. All bolts should be tightened securely to eliminate flexing and wobbling, but be careful not to overtighten or the threads may strip.

WARNING: ***Never look at the Sun through your telescope (or even with just your eyes) without a professionally made solar filter that fits over the front of the telescope. Permanent eye damage or blindness could result. Be sure also to cover the front of the finder scope with aluminum foil or another opaque material to prevent physical damage to the internal components of the scope itself as well as to your eyes. Young children should use this telescope only with adult supervision.***

During assembly (and anytime, for that matter), DO NOT touch any of the lenses of the telescope, finder scope, or eyepieces, or the mirror of the diagonal, with your fingers. The optical surfaces have delicate coatings on them that can easily be damaged if touched inappropriately. NEVER remove any lens assembly from its housing for any reason, or the product warranty and return policy are voided.

1. Screw a tripod leg lock thumbscrew into the hole in the lower aluminum cuff on each tripod leg. Extend each leg to the same length before tightening the thumbscrews. You can readjust the legs to a more desirable height later, after the scope is completely assembled.
2. Attach the three tripod legs to the base of the yoke mount by lining up the holes in the top of the legs with the holes in the base of the mount, then insert a tripod leg attachment bolt through. The hinged accessory tray bracket on each leg should be facing inward. Tighten the wing nuts on the tripod leg attachment bolts finger-tight.
3. Stand the tripod upright with the yoke mount attached, and spread the legs apart enough to attach the accessory tray to the three hinged brackets on the legs. The brackets should be positioned underneath the tray. Use the accessory tray attachment screws and wing nuts to fasten the accessory tray to the legs. Do not tighten the wing nuts yet.
4. Now, with the accessory tray attached but not tightened, spread the tripod legs apart as far as they will go, until the accessory tray brackets are taut. Then tighten the wing nuts of the accessory tray attachment screws.
5. Next, tighten the wing nuts of the tripod leg attachment bolts at the base of the yoke mount.
6. Attach the altitude micro-motion control rod to the optical tube by first removing the screw from the micro-motion rod attachment post on the side of the optical tube. Slide the screw through the hole at the end of the micro-motion rod and rethread the screw into the attachment post. Make sure the screw is securely tightened.
7. To install the optical tube in the yoke mount, slide the altitude micro-motion rod into its receptacle on the side of the yoke. Make sure the altitude lock knob is sufficiently loose to allow the rod to pass through the receptacle. Then set the optical tube in the yoke, lining up the threaded holes in the sides of the tube with the mounting holes in the yoke. Thread in the yoke knobs until the telescope is held securely. Retighten the altitude lock knob.
8. Insert the star diagonal into the focuser drawtube, securing it with the thumbscrews on the focuser drawtube.
9. Then insert an eyepiece into the star diagonal and secure it in place with the thumbscrews on the diagonal. (Always loosen the thumbscrews before rotating or removing the diagonal or an eyepiece.)
10. Attach the finder scope bracket to the optical tube over the two pre-installed bolts located near the focuser. It doesn't matter whether the bracket stem slants forward or backward; choose whichever orientation you like. Secure the bracket in place with the two round thumbscrews. Do not loosen the two small hex nuts at the base of the bolts, as they keep them from falling into the optical tube.
11. Lastly, install the finder scope in the bracket. To do this, we recommend first loosening the three finder scope alignment screws so that the finder scope can be inserted through the rings—eyepiece end first—without resistance. The larger, objective lens of the finder scope should point in the same direction as the objective lens of the main telescope. Then lightly tighten the three alignment screws until the finder scope is held securely in place and is roughly centered in the ring.

3. Aligning the Finder Scope

Using a low-power finder scope, with its wide field of view, makes it easy to locate objects for observing through the main telescope, which has a much narrower field of view. However, the finder scope and the telescope need to be aligned so that they both point to exactly the same spot in the sky.

1. Alignment is easiest to do in daylight hours. First, loosen the azimuth and altitude lock knobs and the two yoke knobs so the telescope can be moved freely. Then insert the lowest-power eyepiece (longest focal length) into the star diagonal.
2. Point the main telescope at a discrete object such as the top of a telephone pole or street sign that is at least quarter-mile away. Move the telescope so the target object appears in the very center of the field of view, when you look into the eyepiece. Now tighten the altitude lock knob (remember, just "finger tight" so you don't strip the threads), and lightly tighten the azimuth and yoke knobs (so slight movement is still possible with light pressure on the telescope tube). Use the altitude micro-motion control thumbwheel and slight sideways pressure on the main telescope tube to re-center the object in the field of view, if it moved off center when you tightened the lock knobs.
3. Now look through the finder scope. Is the object centered in the finder scope's field of view, i.e., on the crosshairs? If not, hopefully it will be visible somewhere in the field of view, so that only fine adjustment of the three alignment screws will be needed to center it on the crosshairs. If the object isn't in the field of view at all, you'll have to make coarser adjustments to the alignment screws to redirect the aim of the finder scope.
4. By loosening one alignment screw and tightening another, you change the line of sight of the finder scope. Once the target object is centered on the crosshairs of the finder scope, look again in the main telescope's eyepiece and see if it is still centered there as well. If it isn't, repeat the entire process, making sure not to move the main telescope while adjusting the alignment of the finder scope.
5. Check the alignment by pointing the main telescope at another object and centering it in the finder scope. Then look through the main telescope eyepiece and see if the object is centered. If it is, your job is done. If it isn't, make the necessary adjustments to the finder scope's alignment screws until the object is centered in both instruments.
6. Finder scopes often come out of alignment during transport of the telescope, so check it before each observing session.

One way to minimize any misalignment is to keep the finder scope bracket tightly fastened to the main telescope.

7. The finder scope can be focused by rotating the knurled ring of its eyepiece. Note that the image seen through the finder scope appears upside-down. This is normal for astronomical finder scopes.

4. Using Your Telescope

Choosing an Observing Site

When selecting a location for observing, get as far away as possible from direct artificial light such as street lights, porch lights, and automobile headlights. The glare from these lights will greatly impair your dark-adapted night vision. Set up on a grass or dirt surface, not asphalt, because asphalt radiates more heat. Heat disturbs the surrounding air and degrades the images seen through the telescope. Avoid viewing over rooftops and chimneys, as they often have warm air currents rising from them. Similarly, avoid observing from indoors through an open (or closed) window because the temperature difference between the indoor and outdoor air will cause image blurring and distortion.

It's best, although perhaps less convenient, to escape the light-polluted city sky in favor of darker country skies. You'll be amazed at how many more stars and deep-sky objects are visible in a dark sky!

Cooling the Telescope

All optical instruments need time to reach "thermal equilibrium." The bigger the instrument and the larger the temperature change, the more time is needed. Allow at least a half-hour for your telescope to cool to the temperature outdoors. In very cold climates (below freezing), it is essential to store the telescope as cold as possible. If it has to adjust to more than a 40° temperature change, allow at least one hour. Make sure you are not looking over buildings, pavement, or any other source of heat, which will radiate away at night, causing "heat wave" disturbances that will distort the image you see through the telescope.

Aiming the Telescope

To aim the telescope, first loosen both the azimuth and altitude lock knobs, and slightly loosen one of the yoke knobs. Aim the telescope at the object you wish to observe by first "eyeballing" along the length of the telescope tube. Then look through the (aligned) finder scope and move the telescope tube until the object is visible in the finder scope. Center it on the finder's crosshairs. Then tighten the lock knobs. You should now be able to see the object in the main telescope using a low-power eyepiece. (Always use the lowest-power eyepiece available for locating an object, then you can switch up to higher powers if desired.)

1. Fine adjustments in the telescope's vertical position can be made by rotating the altitude micro-motion thumbwheel. Fine adjustments in the azimuth position can be made by applying slight sideways pressure to the back end of the telescope (make sure the azimuth lock knob is slightly loosened).
2. Note that the altitude micro-motion thumbwheel has a limited range of movement. If you reach the end of the travel range, loosen the altitude lock bolt and rotate the thumbwheel back a few turns, then tighten the lock bolt again.

Focusing the Telescope

Practice focusing the telescope in the daytime before using it for the first time at night. Start by positioning the focuser near the center of its adjustment range. Make sure the knurled focus lock knob on the top of the focuser housing is loosened, to allow the drawtube to move freely. Insert an eyepiece into the focuser and secure with the thumbscrew. Point the telescope at a distant subject and get it in the field of view. Now, slowly rotate one of the focusing knobs until the object comes into sharp focus. Go a little bit beyond sharp focus until the image just starts to blur again, then reverse the rotation of the knob, just to make sure you hit the exact focus point. The telescope can only focus on objects at least 50 to 100 feet away. It will not focus without the star diagonal in place.

As with all refractor telescopes used with a standard 90° star diagonal, the image you see will be right-side up, but reversed left-to-right. (A correct-image diagonal may be purchased separately, though the image quality is slightly reduced.)

Do You Wear Eyeglasses?

If you wear eyeglasses, you may be able to keep them on while you observe, if your eyepieces have enough "eye relief" to allow you to see the whole field of view. You can try this by looking through the eyepiece first with your glasses on and then with them off, and see if the glasses restrict the view to only a portion of the full field. If they do, you can easily observe with your glasses off by just refocusing the telescope the needed amount.

Eyepiece Selection

Always start viewing with your lowest-power, widest-field eyepiece. After you've located and looked at the object with a low-power eyepiece, switch to a higher-power eyepiece and see if the object looks better or worse. Keep in mind that at higher power, an image will always be fainter and less sharp (this is a fundamental law of optics). Many viewers use the lowest-power eyepiece practically all the time! Naturally, higher magnifications are desirable for viewing some celestial objects, but stay with low powers when searching for an object and for extended viewing.

To calculate the power, or magnification of a telescope, divide the focal length of the telescope by the focal length of the eyepiece:

Telescope focal length ÷ Eyepiece focal length = Magnification

For example, if you're using this telescope, which has a focal length of 700mm, and a 25mm eyepiece, the power would be

700 ÷ 25 = 28x.

We recommend having a selection of several eyepieces of different focal lengths, so that you can choose the optimal magnification, brightness level, and contrast for each object and for different observing conditions.

Useful Limit of Magnification

Every telescope has a useful limit of power of about 45x-60x per inch of aperture (diameter of objective lens). Claims of higher power by some telescope manufacturers are a mislead-

ing advertising gimmick and should be dismissed. The Observer 70mm Altazimuth Refractor, with its 70mm-diameter (2.8") objective lens, is capable of a maximum useful magnification of about 160x. Any higher and the images will virtually always appear very faint and fuzzy. As a general rule, if the image you see is not crisp and steady, reduce the magnification by switching to a longer-focal-length (lower-power) eyepiece. A small but well-resolved image will show more detail and be more rewarding than a dim, fuzzy, over-magnified one.

Camera Attachment

A 35mm single-lens reflex (SLR) camera body can easily be attached to the Observer 70mm enabling you to take pictures through the telescope. All that is needed is one additional part, called a T-ring, which is specific to your model of camera (see the Orion catalog for selection).

Remove the eyepiece and diagonal from the telescope optical tube. Also remove any lenses that may already be attached to your camera body. Now, connect the T-ring to your camera. The T-ring, with your camera attached, threads directly onto the end of the telescope. When used in this configuration, the Observer 70 acts as a 700mm telephoto lens (the focal length of the telescope).

5. Astronomical Viewing

Let Your Eyes Dark-Adapt

Don't expect to go from a lighted house into the darkness of the outdoors at night and immediately see faint nebulas, galaxies, and star clusters—or even very many stars, for that matter. Your eyes take about 30 minutes to reach perhaps 80% of their full dark-adapted sensitivity. Many observers notice improvements after several hours of total darkness. As your eyes become dark-adapted, more stars will glimmer into view and you'll be able to see fainter details in objects you view in your telescope. Exposing your eyes to very bright daylight for extended periods of time can adversely affect your night vision for days. So give yourself at least a little while to get used to the dark before you begin observing.

To see what you're doing in the darkness, use a red-filtered flashlight rather than a white light. Red light does not spoil your eyes' dark adaptation like white light does. A flashlight with a red LED light is ideal, or you can cover the front of a regular incandescent flashlight with red cellophane or paper. Beware, too, that nearby porch and street lights and car headlights will ruin your night vision.

"Seeing" and Transparency

Atmospheric conditions vary significantly from night to night. "Seeing" refers to the steadiness of the Earth's atmosphere at a given time. In conditions of poor seeing, atmospheric turbulence causes objects viewed through the telescope to "boil." If, when you look up at the sky with just your eyes, the stars are twinkling noticeably, the seeing is bad and you will be limited to viewing with low powers (bad seeing affects images at high powers more severely). Planetary observing may also be poor. Make sure you are not looking over buildings or any other source of heat: that will also cause image degradation.

In conditions of good seeing, star twinkling is minimal and images appear steady in the eyepiece. Seeing is best overhead, worst at the horizon. Also, seeing generally gets better after midnight, when much of the heat absorbed by the Earth during the day has radiated off into space.

Especially important for observing faint objects is good "transparency"—air free of moisture, smoke, and dust. All tend to scatter light, which reduces an object's brightness. Transparency is judged by the magnitude of the faintest stars you can see with the unaided eye (6th magnitude or fainter is desirable).

Tracking Celestial Objects

Celestial objects appear to move slowly across the sky because of the rotation of the Earth on its polar axis. When you observe an object through the telescope, you'll see it drift gradually across the field of view. To keep the object centered in the field, give the tube a light tug or push in altitude and azimuth as needed (make sure the altitude and azimuth lock knobs are slightly loosened). Objects will appear to move faster at higher magnifications, when the field of view is narrower.

How to Find Interesting Celestial Objects

To locate celestial objects with your telescope, you first need to become reasonably familiar with the night sky. Unless you know how to recognize the constellation Orion, for instance, you won't have much luck locating the Orion Nebula. A simple planisphere, or star wheel, can be a valuable tool for learning the constellations and seeing which ones are visible in the sky on a given night.

A good star chart or atlas can come in very handy for helping find objects among the dizzying multitude of stars overhead. Except for the Moon and the brighter planets, it's pretty time-consuming and frustrating to hunt for objects randomly, without knowing where to look. You should have specific targets in mind before you begin looking through the eyepiece.

Start with a basic star atlas, one that shows stars no fainter than 5th or 6th magnitude. In addition to stars, the atlas will show the positions of a number of interesting deep-sky objects, with different symbols representing the different types of objects, such as galaxies, open star clusters, globular clusters, diffuse nebulas, and planetary nebulas. So, for example, your atlas might show that there is a globular cluster sitting just above the lid of the "Teapot" pattern of stars in Sagittarius. You then know to point your telescope in that direction to home in on the cluster, which happens to be 6.9-magnitude Messier 28 (M28).

You can see a great number and variety of astronomical objects with your Observer 70mm Altaz, including:

The Moon

With its rocky, cratered surface, the Moon is one of the easiest and most interesting targets to view with your telescope. The best time to observe our one and only natural satellite is during a partial phase, that is, when the Moon is NOT full. During partial phases, shadows on the surface reveal more detail, especially right along the border between the dark and light portions of the disk (called the "terminator"). A full Moon is too bright and devoid of surface shadows to yield a pleasing view.

The Planets

The planets don't stay put like the stars, so you'll have to refer to charts published monthly in *Astronomy, Sky & Telescope*, or other astronomy magazines to locate them. Venus, Mars, Jupiter, and Saturn are the brightest objects in the sky after the Sun and the Moon. Not all four of these planets are normally visible at any one time.

JUPITER The largest planet, Jupiter, is a great subject to observe. You can see the disk of the giant planet and watch the ever-changing positions of its four largest moons, Io, Callisto, Europa, and Ganymede. If atmospheric conditions are good, you may be able to resolve thin cloud bands on the planet's disk.

SATURN The ringed planet is a breathtaking sight when it is well positioned. The tilt angle of the rings varies over a period of many years; sometimes they are seen edge-on, while at other times they are broadside and look like giant "ears" on each side of Saturn's disk. A steady atmosphere (good seeing) is necessary for a good view. You may see a tiny, bright "star" close by; that's Saturn's brightest moon, Titan.

VENUS At its brightest, Venus is the most luminous object in the sky, excluding the Sun and the Moon. It is so bright that sometimes it is visible to the naked eye during full daylight! Ironically, Venus appears as a thin crescent, not a full disk, when at its peak brightness. Because it is so close to the Sun, it never wanders too far from the morning or evening horizon. No surface markings can be seen on Venus, which is always shrouded in dense clouds.

MARS You probably won't be able to see much surface detail on the Red Planet, but if conditions are particularly good you may notice some light and dark areas, and possibly even a white polar ice cap.

Stars

Stars will appear like twinkling points of light in the telescope. Even powerful telescopes cannot magnify stars to appear as more than points of light! You can, however, enjoy the different colors of the stars and locate many pretty double and multiple stars. The famous "Double-Double" in the constellation Lyra and the gorgeous two-color double star Albireo in Cygnus are favorites. Defocusing the image of a star slightly can help bring out its color.

Deep-Sky Objects

Under dark skies, you can observe a wealth of fascinating deep-sky objects, including gaseous nebulas, open and globular star clusters, and some of the brighter galaxies. Most deep-sky objects are very faint, so it is important that you find an observing site well away from light pollution. Take plenty of time to let your eyes adjust to the darkness. Don't expect these subjects to appear like the photographs you see in books and magazines; most will look like dim gray smudges. (Our eyes are not sensitive enough to see color in such faint objects.) But as you become more experienced and your observing skills get sharper, you will be able to ferret out more and more subtle details.

Note: Remember that the higher the magnification you use, the dimmer the image will appear. So stick with low power when observing deep-sky objects because they're already very faint.

Consult a star atlas or observing guide for information on finding and identifying deep-sky objects. Some good sources to start with are the *Edmund Mag 6 Star Atlas*, *Turn Left at Orion*, and *The Universe From Your Backyard*.

6. Terrestrial Viewing

Your Observer 70mm may also be used for long-distance viewing over land. For this application we recommend substitution of an Orion 45° Correct-Image Diagonal (#8790) for the 90° star diagonal that comes standard with the telescope. The correct-image diagonal will yield an upright, non-reversed image and also provides a more comfortable viewing angle, since the telescope will be aimed more horizontally for terrestrial subjects.

For terrestrial viewing, it's best to stick with low powers of 50x or less. At higher power the image loses sharpness and clarity because of unsteady air. That's because when the scope is pointed near the horizon it's peering through the thickest and most turbulent part of the Earth's atmosphere.

Note: Remember to aim well clear of the Sun, unless the front of the telescope is fitted with a professionally made solar filter and the finder scope is covered with foil or some other completely opaque material.

7. Care and Maintenance

If you give your telescope reasonable care, it will last a lifetime. Store it in a clean, dry, dust-free place, safe from rapid changes in temperature and humidity. Do not store the telescope outdoors, although storage in a garage or shed is OK. Small components like eyepieces and other accessories should be kept in a protective box or storage case. Keep the objective lens cap on the front of the telescope when it is not in use.

Your Observer 70 requires very little mechanical maintenance. The optical tube is aluminum and has a smooth painted finish that is fairly scratch-resistant. If a scratch does appear on the tube, it will not harm the telescope. If you wish, you may apply some auto touch-up paint to the scratch. Smudges on the tube can be wiped off with a soft cloth and a household cleaner such as Windex or Formula 409.

Cleaning the Optics

A small amount of dust or a few specks on the glass objective (main) lens will not affect the performance of the telescope. If dust builds up, however, simply blow it off with a blower bulb, or lightly brush it off with a soft camel-hair brush. Avoid touching optical surfaces with your fingers, as skin oil may etch optical coatings.

To remove fingerprints or smudges from a lens, use photographic-type lens cleaning fluid and lint-free optical lens cleaning tissue. Don't use household cleaners or eyeglass-type cleaning cloth or wipes, as they often contain undesirable additives like silicone, which don't work well on precision

optics. Place a few drops of fluid on the tissue (not directly on the lens), wipe gently, then remove the fluid with a dry tissue or two. Do not “polish” or rub hard when cleaning the lens, as this will scratch it. The tissue may leave fibers on the lens, but this is not a problem; they can be blown off with a blower bulb.

Note: Never disassemble the telescope or eyepieces to clean optical surfaces!

If you follow these simple instructions, your Orion Observer 70mm Altazimuth Refractor will provide you with years of enjoyable exploration.

8. Specifications

Objective lens: 70mm-diameter (2.8") achromat

Objective lens coatings: multi-coated

Focal length: 700mm

Focal ratio: f/10

Magnification: 28x with 25mm eyepiece

Finder scope: 5x magnification, 24mm aperture

Diagonal: 90° star diagonal, mirror type, 1.25" barrel diameter

Eyepiece type: Kellner (three-element), fully coated, 1.25" barrel diameter

Mount type: altazimuth

Tripod: aluminum, adjustable

9. Suggested Accessories

Soft Carrying & Storage Bag (#15157)

Made of rugged nylon, this case holds everything: the tube assembly, the mount, and the tripod. Zipper access. Strap handles.

Explorer™ II Eyepieces

Every observer should have several eyepieces of different focal lengths to allow viewing of astronomical subjects at different magnifications. These eyepieces feature 3- or 4-element lens designs, with a 50° apparent field of view. Fully antireflection coated. Threaded for filters. 1.25" barrels.

6mm (#8153), 10mm (#8152), 13mm (#8151), 17mm (#8154)

Moon Filter (#5662)

Cuts lunar glare 87%, revealing much more surface detail. Threads into barrel of 1.25" eyepieces.

Solar Filter (#7706)

Allows safe viewing of the Sun. See the march of sunspots across the Sun’s surface. This full-aperture glass filter provides a pleasing yellow-orange image of our nearest star, unlike Mylar filters, which produce a blue image.

One-Year Limited Warranty

This Orion Observer 70mm Altazimuth Refractor is warranted against defects in materials or workmanship for a period of one year from the date of purchase. This warranty is for the benefit of the original retail purchaser only. During this warranty period Orion Telescopes & Binoculars will repair or replace, at Orion’s option, any warranted instrument that proves to be defective, provided it is returned postage paid to: Orion Warranty Repair, 89 Hangar Way, Watsonville, CA 95076. If the product is not registered, proof of purchase (such as a copy of the original invoice) is required.

This warranty does not apply if, in Orion’s judgment, the instrument has been abused, mishandled, or modified, nor does it apply to normal wear and tear. This warranty gives you specific legal rights, and you may also have other rights, which vary from state to state. For further
warranty service information, contact: Customer Service Department, Orion Telescopes & Binoculars, P. O. Box 1815, Santa Cruz, CA 95061; (800) 676-1343.

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