

Orion® Observer™ II 70mm Altazimuth Refractor

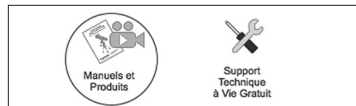
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Congratulations on your purchase of an Orion telescope. Your new Observer II 70mm Altazimuth Refractor is a terrific starter instrument for exploring the exotic wonders of the night sky. Designed to be compact and easy to use, it will provide many hours of enjoyment for the whole family.

If you have never owned 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. 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, properly use, and care for your telescope. Please read them over thoroughly before getting started.

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1. Parts List

Part	Qty
A – Tripod leg	3
B – Yoke mount	1
C – Hex head tripod mounting bolt (3"), with 5/8" washer and wing nut	3
D – Leg lock thumbscrews	3
E – Accessory tray	1
F – Screw with 3/8" washer and wingnut	3
G – Optical tube	1
H – Yoke knob	2
I – Altitude micro-motion rod	1
J – Micro-motion rod anchor screw	1
K – Red dot finder scope	1
L – Mirror star diagonal	1
M – 25mm Kellner eyepiece	1
N – 10mm Kellner eyepiece	1
O – Screwdriver tool	1
P – Dust cover	1

WARNING: *Never look directly at the Sun through your telescope—even for an instant—without a professionally made solar filter that completely covers the front of the instrument, or permanent eye damage could result. Young children should use this telescope only with adult supervision.*

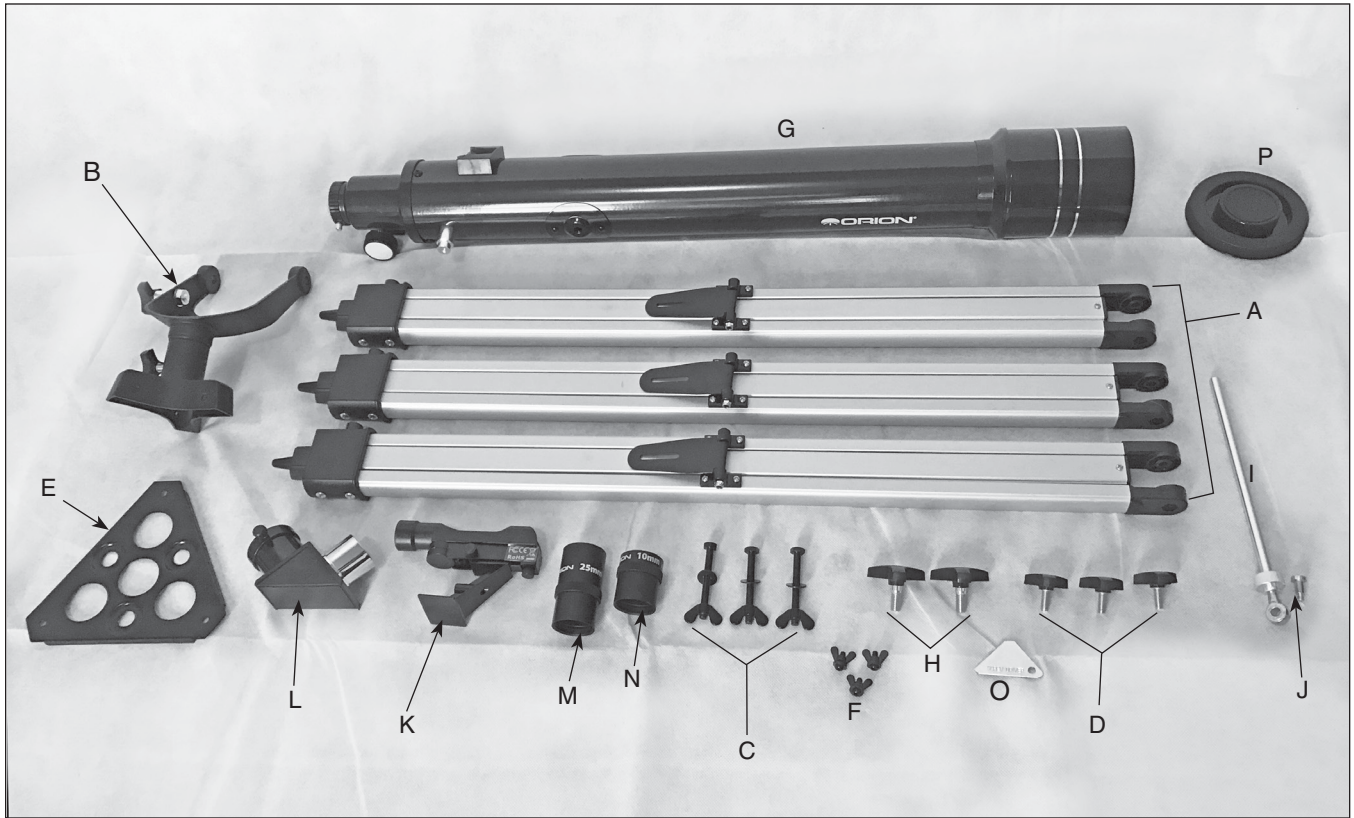


Figure 1. The parts of the Observer II 70 Altaz telescope.

2. Assembly

1. Attach the three aluminum tripod legs (A) to the yoke mount (B) with the three hinged leg braces facing inward. Three hex-head bolts (C) each about 3" long, with 5/8" washers (C) and wing nuts (shown in **Figure 1** attached to the bolts), are provided for this purpose. Note that the bolts should be inserted from the side of the leg that has the hex-shaped hole, so that the bolt head seats in the hex-shaped hole. The washer then the wing nut are placed on the opposite side on the exposed end of the bolt.
2. Attach a leg lock thumbscrew (D) to each leg as shown (**Figure 2**). Extend the sliding inner portion of the adjustable-height tripod leg to the desired length for all three legs. Lock in place by tightening the leg lock thumbscrews. **Do not over-tighten the leg lock thumbscrews or you may damage the collar they are attached to.**
3. Now stand the tripod upright, spreading the legs evenly apart so the accessory tray can be positioned to attach to the three leg braces.
4. Attach the accessory tray (E) to the leg brace supports (**Figure 3**) with the three short screws (F), small (3/8") washers, and small wing nuts provided (washers and wing nuts shown attached to the screws in **figure 1**). Place a washer on the screw. Then place the accessory tray on top of one of the leg braces so that the mounting screw passes through the hole at one of the corners of the accessory tray, and through the slot in the leg brace. Then place another small washer on the screw and thread on and tighten the wing nut. You may find it helpful to use the supplied screwdriver tool (O) to hold the screw heads while tightening the wingnuts. Repeat this procedure until the tray is attached to all three leg braces.

The tripod and yoke mount are now fully assembled (**Figure 4**). Next you will install the telescope tube on the altazimuth yoke mount.

5. With the optical tube (G) oriented relative to the yoke mount (B) as shown in **Figure 5**, line up the holes in the attachment plates on the side of the optical tube with the holes in the ends of the yoke mount (**5a**). Then secure the optical tube to the mount by inserting a yoke knob (H) through the hole on each side of the yoke and thread them into the attachment plates on the optical tube (**5b**). They should be reasonably tight but still allow movement of the telescope up and down with gentle force.
6. Insert the altitude micro-motion rod (I) through the hole in the metal receptacle on the yoke mount (**Figure 6a**). You may have to unthread the altitude lock knob a few turns to provide clearance for the rod). Then attach the other end of the rod to the metal anchor cylinder using the anchor screw (J) provided (**Figure 6b**). Use the supplied screwdriver tool (O) to tighten the screw.

Finally, you will install a few accessories, then you'll be ready to observe!

7. To attach the red dot finder scope (K) to the optical tube, orient the finder scope as shown in **Figure 7** and slide

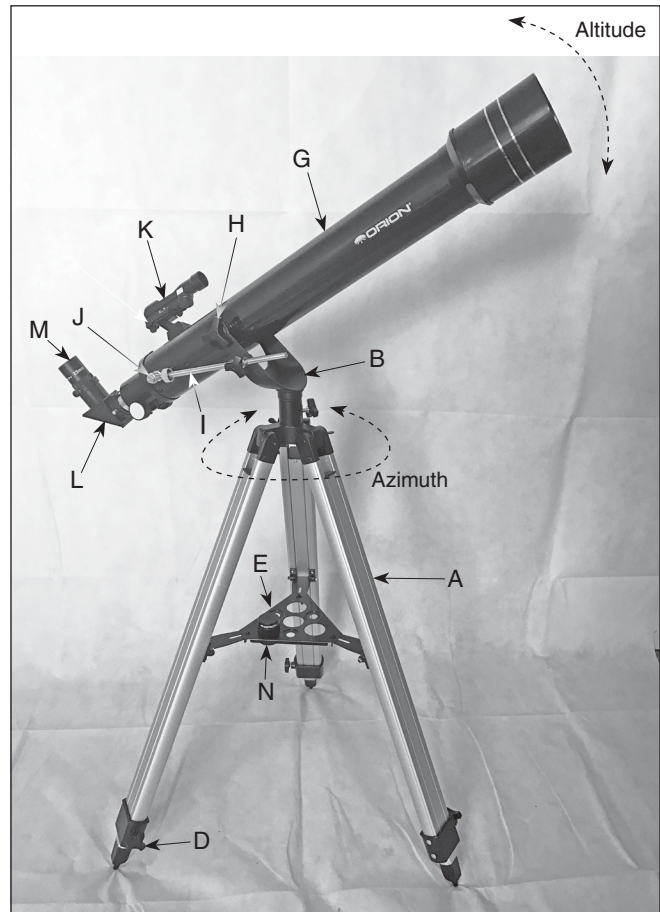


Figure 2. The Observer II 70 Altazimuth Refractor telescope fully assembled, with key parts identified.

the bracket foot into the finder scope base until it clicks. (To remove the finder scope, press the small tab at the back of the base and slide the bracket out.)

8. Insert the star diagonal (L) into the focuser drawtube and tighten the thumbscrew on the drawtube collar (**Figure 18**). Then insert the 25mm eyepiece (M) into the diagonal and secure it by lightly tightening the thumbscrew on the diagonal.

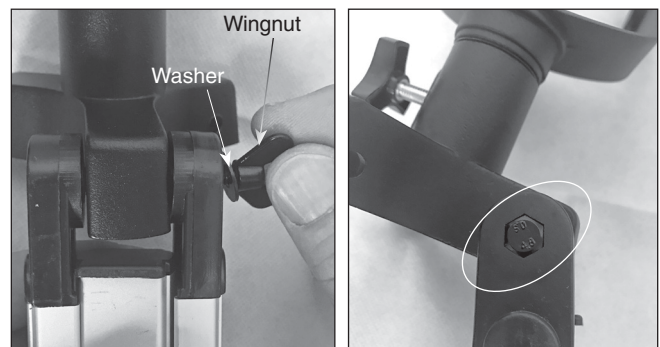


Figure 3. a) Attach the three tripod legs to the mount platform, **b)** making sure the bolt's hex-shaped head seats in the hex-shaped recess of the tripod leg.

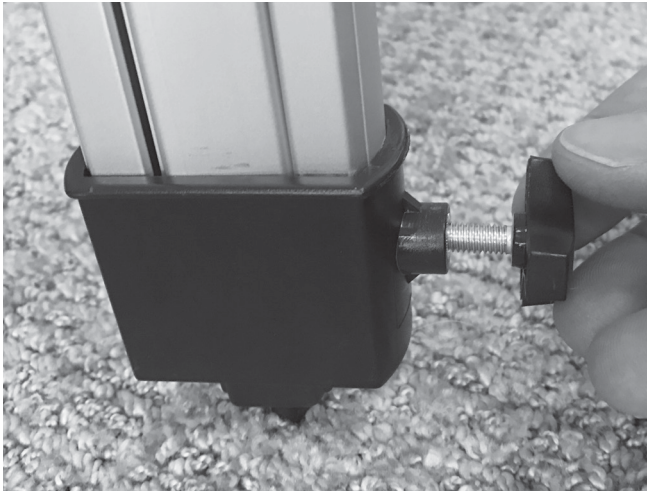


Figure 4. Thread a leg lock thumbscrew onto each tripod leg as shown, being careful not to overtighten.

The telescope is now completely assembled! Before it can be effectively used, however, there are a couple of things to do to prepare the telescope for operation.

3. Preparing the Telescope for Operation

Aligning and Using the Red Dot Finder Scope

The included red dot finder scope (**Figure 9**) makes pointing your telescope almost as easy as pointing your finger! It's a non-magnifying aiming device that superimposes a tiny LED red dot on the sky, showing exactly where the telescope is pointed. It permits easy object targeting prior to observation in the higher-power main telescope.

Before you can use the red dot finder scope, you must remove the small plastic tab sticking out from the battery compartment (**Figure 10**). Doing so will allow the pre-installed 3V CR-2032 button cell battery to make contact with the finder scope's electronic circuitry to power the finder's red LED illuminator. The tab can then be discarded.

To use the red dot finder scope properly, it must be aligned with the main telescope. This is easiest to do during daylight hours, before observing at night. Follow this procedure:

1. First, remove the dust cap (P) from the front of the telescope.
2. Then, with the 25mm eyepiece already in the focuser from step 8 above, point the telescope at a well-defined land target (e.g., the top of a telephone pole) that's at least a quarter mile away. When pointing the telescope, be sure to loosen the azimuth lock knob and micro-motion lock knob (for coarse movement in altitude) to allow the telescope to rotate freely about both axes.
3. Center the target in the eyepiece

Note: The image in the telescope will appear mirror reversed, i.e., reversed left to right. This is normal for refractor tele-

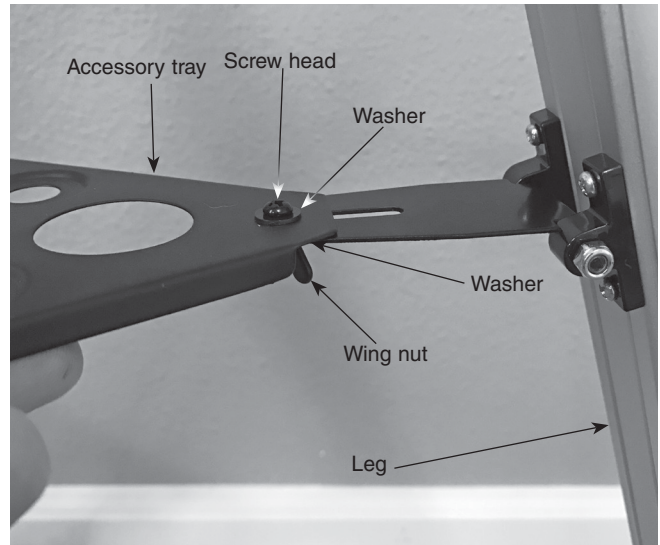


Figure 5. Attach the accessory tray to each of the tripod three leg brace supports using the provided hardware.

scopes used for astronomical observing with a standard star diagonal. (For terrestrial observing we recommend using an optional "correct image" diagonal, which will serve up a correctly oriented view.)

4. Now that a distant target is centered in the main telescope's eyepiece, turn on the red dot finder scope by sliding the power switch to ON (refer to **Figure 10**). The "1"



Figure 6. The assembled altazimuth mount and tripod.

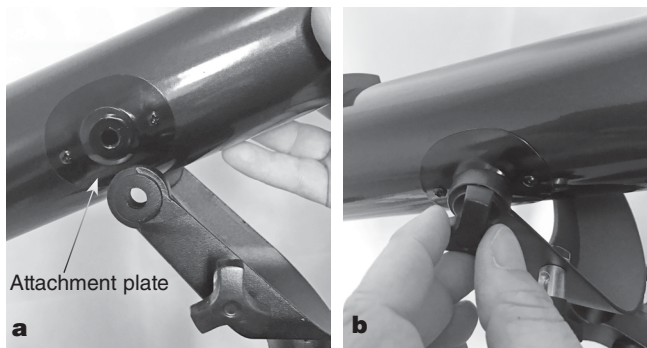


Figure 7. a) Place the optical tube in the yoke mount, lining up the holes in the tube's attachment plates with those in the yoke mount. **b)** Thread the yoke knob into the threaded hole in the attachment plates.

position provides dim illumination while the "2" position provides brighter illumination. Typically the dimmer setting is used under dark skies and the brighter setting is used under light-polluted skies or in daylight. Position your eye at a comfortable distance from the rear of the unit. Look through the rear of the finder scope with both eyes open to see the illuminated red dot. The target object should appear in the field of view somewhere near the red dot.

5. You'll want to center the target object on the red dot. To do so, *without moving the telescope*, use the finder scope's vertical and horizontal adjustment knobs (shown in **Figure 10**) to position the red dot on the object.
6. When the red dot is centered on the distant object, check to make sure the object is still centered in the telescope's eyepiece. If it isn't, re-center it then adjust the finder scope's alignment again. When the object is centered in

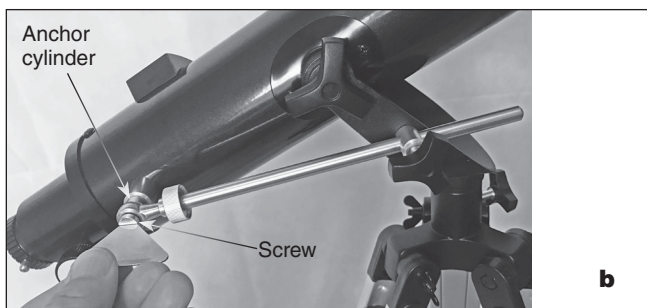
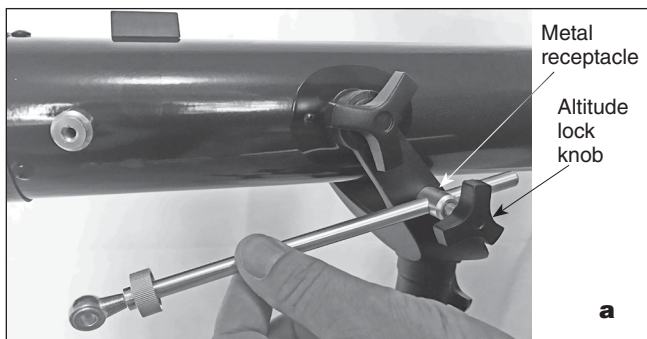


Figure 8. a) Insert the micro-motion rod through the hole in the metal receptacle on the yoke mount. **b)** Attach the other end of the rod to the anchor cylinder on the optical tube.

the telescope eyepiece and on the finder scope's red dot, the finder scope is properly aligned with the telescope. The red dot finder scope's alignment should be checked before every observing session.

At the end of your observing session, be sure to slide the power switch on the red dot finder scope to OFF to preserve battery life.

Understanding the "Altazimuth" Mount

The Observer II 70mm Altazimuth refractor features an "altazimuth" mount, which permits motion along two perpendicular axes: altitude (up/down) and azimuth (left/right) (see **Figure 2**). This makes pointing the telescope easy and intuitive. To move the telescope in the azimuth direction, loosen the azimuth lock knob, take hold of the telescope and gently rotate it to the desired position. Then re-tighten the azimuth lock knob. To move the telescope in the altitude direction, loosen the altitude lock knob then move the tube up or down to the desired position. Then retighten the altitude lock knob. If the telescope moves too freely in the altitude direction, then tighten up the yoke knobs a bit. Of course, you can move the telescope in altitude and azimuth simultaneously by loosening both of the lock knobs.

Because making fine-adjustments in the altitude of the telescope can be difficult, the Observer II 70mm Altazimuth refractor comes equipped with an altitude micro-motion rod and thumbwheel (**Figure 12**). After making coarse altitude adjustments by moving the tube by hand, you can then move the telescope incrementally by turning the micro-motion rod's thumbwheel (the altitude lock knob must be tightened for this). The telescope will move a very small amount either up or down, depending on which direction you turn the thumbwheel. Fine motion can be helpful when centering an object in the eyepiece.

4. Astronomical Observing

For many, this will be your first foray into the exciting world of amateur astronomy. The following information and observing tips will help get you started.

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,

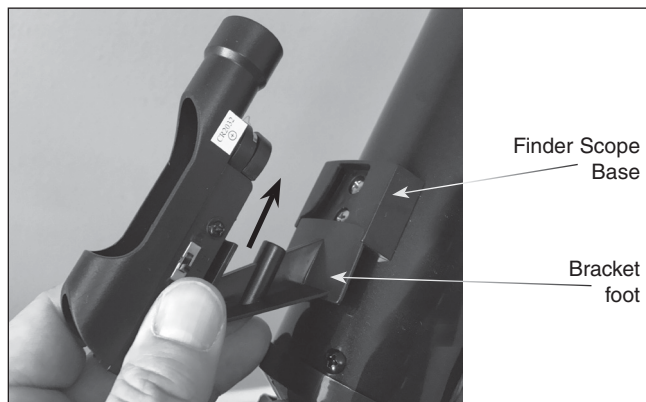


Figure 9. Insert the red dot finder scope's bracket into the base near the focuser as shown.

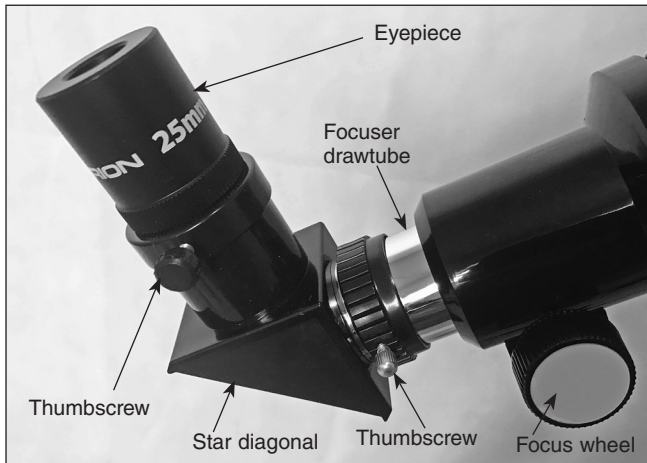


Figure 10. Secure the star diagonal in the focuser drawtube with the thumbscrew on the drawtube collar, then install the eyepiece in the diagonal.

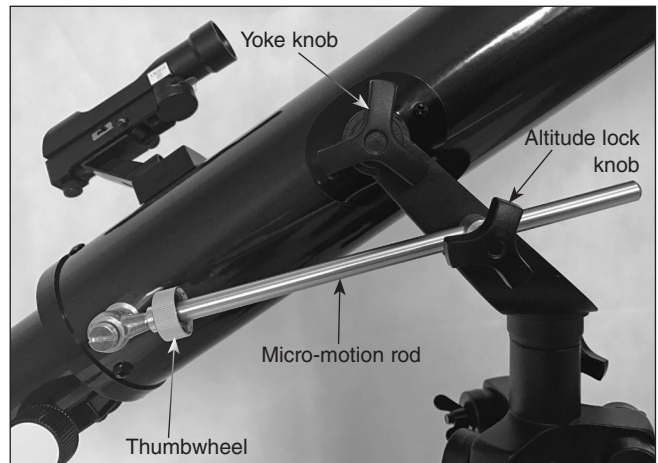


Figure 12. The micro-motion rod and thumbwheel allow fine altitude pointing control.

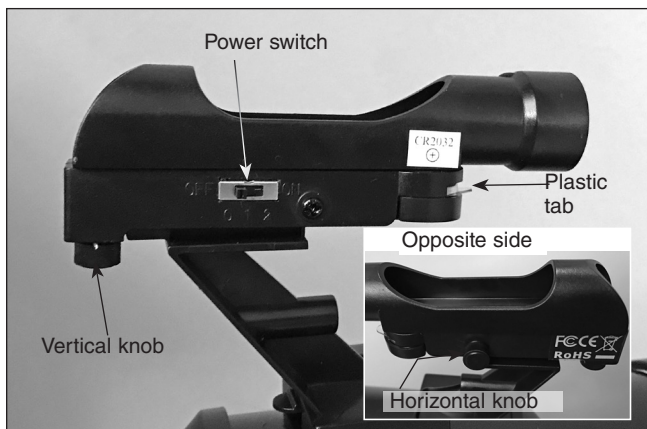


Figure 11. The red dot finder scope has vertical and (inset) horizontal adjustment knobs for aligning it with the telescope.

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.

If at all possible, escape the light-polluted city sky and head for darker country skies. You'll be amazed at how many more stars and deep-sky objects are visible in a dark sky!

“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 you look up at the sky and stars are twinkling noticeably, the seeing is poor and you will be limited to viewing at lower magnifications. At higher magnifications, images will not focus clearly. Fine details on the planets and Moon will likely not be visible.

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 (5th or 6th magnitude is desirable).

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 30 minutes for your telescope to acclimate to the temperature outdoors before you start observing with it.

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. 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.

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. Beware, too, that nearby porch, streetlights, and car headlights will ruin your night vision.

Eyepiece Selection

Magnification, or power, is determined by the focal length of the telescope and the focal length of the eyepiece being used. Therefore, by using eyepieces of different focal lengths, the resultant magnification can be varied. It is quite common for an observer to own five or more eyepieces to access a wide range of magnifications. This allows the observer to choose the best eyepiece to use depending on the object being viewed and viewing conditions. Your Observer II 70mm Altazimuth refractor comes with 25mm and 10mm Kellner eyepieces, which will suffice nicely to begin with. You can purchase additional eyepieces later if you wish to have more magnification options.

Magnification is calculated as follows:

$$\frac{\text{Telescope Focal Length (mm)}}{\text{Eyepiece Focal Length (mm)}} = \text{Magnification}$$

For example, the Observer II 70mm Altazimuth has a focal length of 700mm, which when used with the supplied 25mm eyepiece yields:

$$\frac{700 \text{ mm}}{25 \text{ mm}} = 28x$$

The magnification provided by the 10mm eyepiece is:

$$\frac{700 \text{ mm}}{10 \text{ mm}} = 70x$$

The maximum attainable magnification for a telescope is directly related to how much light it can gather. The larger the aperture, the more magnification is possible. In general, a figure of 50x per inch of aperture is the maximum attainable for



Figure 13. The Kellner eyepieces have barrels threaded to accept optional Orion 1.25" filters. A Moon filter is useful for cutting glare and revealing more detail on the lunar surface.

most telescopes. Going beyond that will yield simply blurry, unsatisfactory views. Your Observer II 70mm Altazimuth has an aperture of 70mm, or 2.8 inches, so the maximum magnification would be about 140x (2.8 x 50). This level of magnification assumes you have ideal atmospheric conditions for observing (which is seldom the case).

Keep in mind that as you increase magnification, the brightness of the object viewed will decrease; this is an inherent principle of the laws of physics and cannot be avoided. If magnification is doubled, an image appears four times dimmer. If magnification is tripled, image brightness is reduced by a factor of nine!

So start by using the 25mm eyepiece, then try switching to the 10mm eyepiece later if you want to boost the magnification.

Focusing the Telescope

To focus the telescope, turn the focus wheels (**Figure 10**) forward or back until you see your target object (e.g., stars, the Moon, etc.) in the eyepiece. Then make finer adjustments until the image is sharp. If you're having trouble achieving initial focus, rack the focuser drawtube all the way in using the focus wheels, then while looking into the eyepiece slowly turn the focus wheels so that the drawtube extends outward. Keep going until you see your target object come into focus. Note that when you change eyepieces you may have to adjust the focus a bit to get a sharp image with the newly inserted eyepiece.

What to Expect

So what will you see with your telescope? You should be able to see bands on Jupiter, the rings of Saturn, craters on the Moon, the waxing and waning of Venus, and many bright deep-sky objects. Do not expect to see color as you do in NASA photos, since those are taken with long-exposure cameras and have "false color" added. Our eyes are not sensitive enough to see color in deep-sky objects except in a few of the brightest ones.

Objects to Observe

Now that you are all set up and ready to go, one critical decision must be made: what to look at?

A. The Moon

With its rocky surface, the Moon is one of the easiest and most interesting objects to view with your telescope. Lunar craters, maria, and even mountain ranges can all be clearly seen from a distance of 238,000 miles away! With its ever-changing phases, you'll get a new view of the Moon every night. 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 are cast on the surface, which 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. Make sure to observe the Moon when it is well above the horizon to get the sharpest images.

Use an optional Moon filter to dim the Moon when it is very bright. It simply threads onto the bottom of the eyepieces (you must first remove the eyepiece from the focuser to attach a filter). You'll find that the Moon filter improves viewing comfort, and helps to bring out subtle features on the lunar surface.

B. The Planets

The planets don't stay put like the stars, so to find them you should refer to the monthly star charts at OrionTelescopes.com, or to charts published monthly in *Astronomy*, *Sky & Telescope*, or other astronomy magazines. Venus, Mars, Jupiter, and Saturn are the brightest objects in the sky after the Sun and the Moon. Other planets may be visible but will likely appear star-like. Because planets are quite small in apparent size, optional higher-power eyepieces or a Barlow lens are recommended and often needed for detailed observations.

B. The Sun

You can change your nighttime telescope into a daytime Sun viewer by installing an optional full-aperture solar filter over the front opening of the telescope. The primary attraction is sunspots, which change shape, appearance, and location daily. Sunspots are directly related to magnetic activity in the Sun. Many observers like to make drawings of sunspots to monitor how the Sun is changing from day to day.

Important Note: Do not look at the Sun with any optical instrument without a professionally made solar filter, or permanent eye damage could result.

D. The Stars

Stars will appear like twinkling points of light. Even powerful telescopes cannot magnify stars to appear as more than a point 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 a star slightly can help bring out its color.

E. 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 different types of galaxies. Most deep-sky objects are very faint, so it is important you find an observing site well away from light pollution.

To find deep-sky 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. Once you have identified a few constellations, a good star chart, atlas, or astronomy app will come in handy for helping locate interesting deep-sky objects to view within the constellations.

Do not expect these objects to appear like the photographs you see in books and on the internet; most will look like dim gray smudges. Our eyes are not sensitive enough to see color in deep-sky objects except in a few of the brightest ones. But as you become more experienced and your observing skills get sharper, you will be able to ferret out more and more subtle details and structure.

5. Worthwhile Optional Accessories

- **Moon Filter** – A 1.25" Moon filter will cut down the strong glare of sunlight reflected from the Moon, making Moon viewing more comfortable and revealing more surface detail. The filter threads into the bottom of the Kellner eyepieces that came with your telescope (**Figure 13**).
- **Barlow Lens** – A 2x Barlow lens doubles the magnifying power of any eyepiece it's used with, giving you a big power boost to get in closer to your target object. You just insert it between the diagonal and the eyepiece.
- **Correct-Image Diagonal** – Also called an "erect-image" diagonal, this accessory will provide a correctly oriented view through the telescope, which is recommended for daytime terrestrial viewing.
- **Planisphere** – A nifty "star wheel" that shows what stars and constellations are visible in the sky at any time of any night. Just set the date and time see a mini representation of your local night sky. Great for identifying what you see and planning an evening's observing session.
- **Star Map** – More detailed than a planisphere, a star map is essential for locating interesting celestial objects to observe with your telescope. Nowadays many mobile astronomy apps feature customizable star maps that you can access on your smartphone or tablet while you're at the telescope.

6. Telescope 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 dust cover on the front of the telescope when it is not in use.

Your refractor telescope requires very little mechanical maintenance. The optical tube 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 household cleaning fluid.

Cleaning Optics

Any quality optical lens cleaning tissue and optical lens cleaning fluid specifically designed for multi-coated optics can be used to clean the lenses of your telescope and eyepieces. Never use regular glass cleaner or cleaning fluid designed for eyeglasses. Before cleaning, remove any loose particles or dust from the lens with a blower bulb or soft brush. Then apply some cleaning fluid to a tissue, never directly on the optics. Wipe the lens gently in a circular motion, then remove any excess fluid with a fresh lens

tissue. Oily fingerprints and smudges may be removed using this method. Use caution; rubbing too hard may scratch the lens. On larger lenses, clean only a small area at a time, using a fresh lens tissue on each area. Never reuse tissues.

When bringing the telescope inside after an evening's viewing it is normal for moisture to accumulate on the lenses due to the change in temperature. We suggest leaving the telescope and eyepieces uncovered overnight to allow the condensation to evaporate.

Eyepieces: 25mm and 10mm Kellner, antireflection coated, 1.25" barrel diameter, threaded for Orion filters

Eyepiece magnification: 28x (with 25mm eyepiece) and 70x (with 10mm eyepiece)

Finder scope: Red dot finder scope

Mount: Altazimuth yoke

Tripod: Aluminum

Total instrument weight: 5 lbs. 8oz.

7. Specifications

Objective lens: 70mm (2.8") diameter, achromatic

Effective focal length: 700mm

Focal ratio: f/10

Lens coatings: Antireflection coated

Focuser: Rack-and-pinion, accepts 1.25" accessories

One-Year Limited Warranty

This Orion product 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. Proof of purchase (such as a copy of the original receipt) is required. This warranty is only valid in the country of purchase.

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. It is not intended to remove or restrict your other legal rights under applicable local consumer law; your state or national statutory consumer rights governing the sale of consumer goods remain fully applicable.

For further warranty information, please visit www.OrionTelescopes.com/warranty.



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