Library Edition TableTop Telescope Instruction Manual

Orion StarMax 90 TableTop Maksutov-Cassigrain Telescope

Based on the Orion TableTop Telescopes Instruction Manual

Donated by:

and

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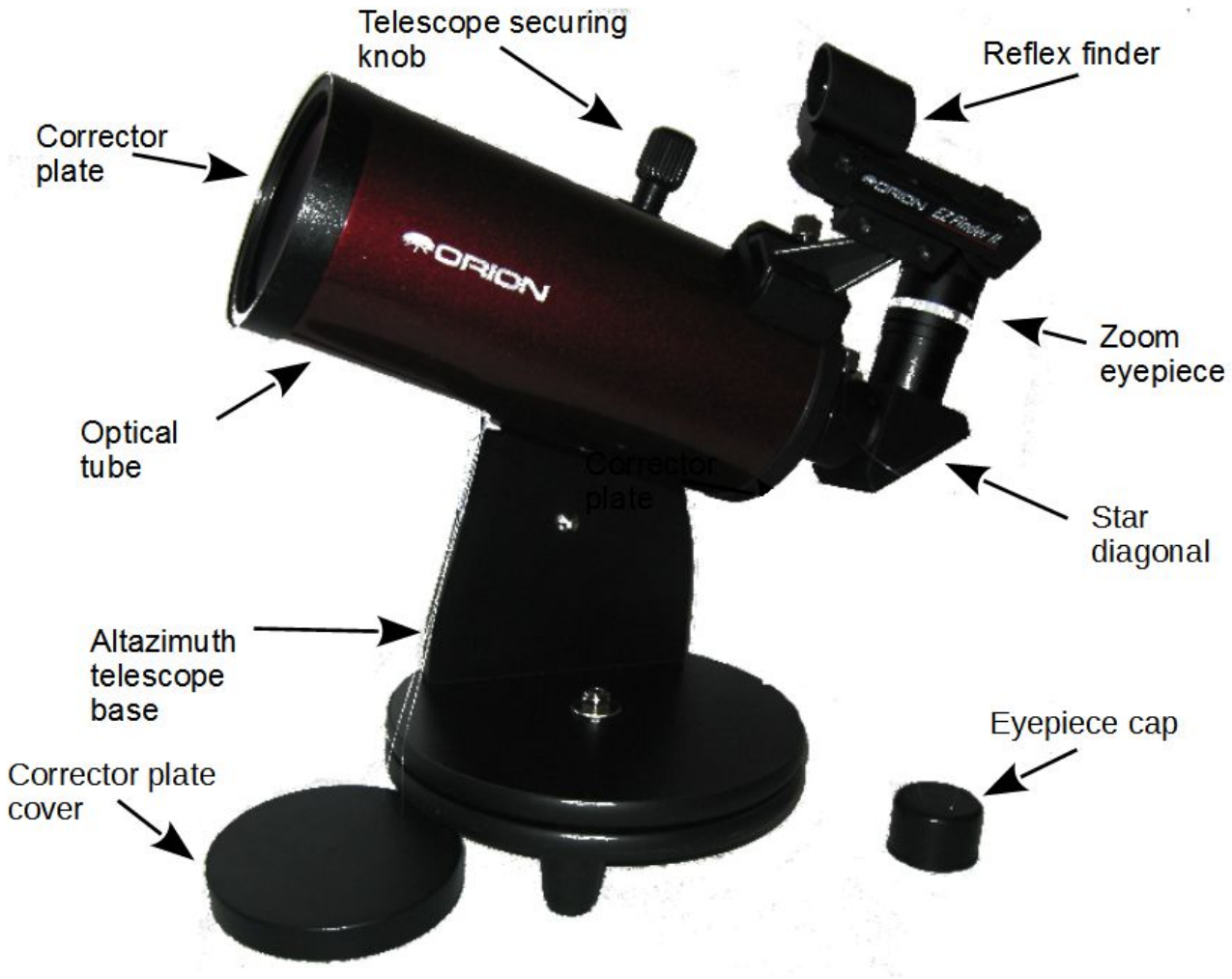


Illustration 1: Telescope Parts - side view

Cautions

Do not point the telescope at the sun. Looking at the Sun with this telescope can cause eye damage and blindness.

Do not touch or attempt to clean the optics (corrector plate and eyepiece). Some dust or dirt will not affect the view. The optics can be damaged by improper cleaning. Return the telescope to the library for cleaning.

The Telescope

The tabletop telescope will provide stunning views of the Moon, planets, and the brighter star clusters and nebulae. The telescope will produce right side up terrestrial images, however they will be mirror images, as will the celestial images.

Telescope parts (see illustrations 1 & 2)

Zoom eyepiece: Focal length is adjustable from from 21 mm (60X) to 7 mm (180X). The eyepiece has a rubber eye cup than can be folded down for eyeglass wearers.

Optical tube: Contains the primary optical components: A corrector plate, a thick meniscus lens that corrects the light entering the telescope for the spherical mirrors. 90 mm primary mirror at the bottom of the tube, and a secondary mirror which is an aluminized spot on the back of the

Illustration 2: Telescope - rear view

corrector. Which reflects the licgh back through a hole in the center of the primary mirror to the eyepiece. The optical train produces a 1,250 mm focal length and a focal ratio of f/13.9.

Altitude tension adjustment knob: By tightening and loosening this knob, you can

change the amount of tension in the altitude (up/down) motion of the telescope.

Altazimuth base: The wooden base provides a stable base for the telescope when placed on a sturdy table, like a picnic table. Celestial objects viewed through the telescope will appear to slowly move due to the Earth's rotation. The higher the power that faster this apparent motion.

EZ Finder II reflex sight: This finder does not magnify. When properly aligned it puts a virtual red dot on the object you're aiming at. The use of the finder is discussed in the **Getting Started** section.

Telescope securing knob: This allows the telescope to be positioned fore and aft in the mount for balance and stowage. Three indentations on the Dovetail bar are used for this purpose. The telescope tube must be supported by your hand when moving from one indentation position to another.

90º Star diagonal: Contains a right angle prism to allow a convenient viewing angle when looking up into the sky. It also maked the image right-side-up, and produces a mirror image.

Focus knob: Alters the spacing of the internal optical components to focus the telescope. This provides an extreme range of focus, so it is possible to become 'lost' and have difficulty in changing focus from near to far objects. Rotate the knob clockwise to focus on near objects, and counterclockwise to focus on more distant ones.

Illustration 3: Vertical Storage Position

Unstowing the telescope from the vertical storage position

The telescope is packaged in a cardboard box with a built-in handle.

1. Open the box.
2. Loosen the Altitude adjustment knob (Illustration 2) enough so the telescope can be rotated into a horizontal position with the Telescope securing knob pointing up, and tighten.

Illustration 4: Telescope securing knob in the forward storage indentation in the Dovetail bar

3. **Supporting the telescope with one hand** unscrew the Telescope securing knob a couple of turns and slide the telescope forward to engage the center indentation and re-tighten the Telescope securing knob.

Getting Started

It's best to get a feel for the basic functions of the TableTop telescope during the day, before observing astronomical objects at night. This way you won't have to orient yourself in the dark! Find a spot outdoors where you'll have plenty of room to move the telescope, and where you'll have a clear view of some object or vista that is at least 1/4 mile away. It is not critical that the telescope be exactly level, but it should be placed on flat ground or pavement to ensure smooth

movement. The telescope was designed specifically for visual observation of astronomical objects in the night sky.

4. Pull the Telescope up and out by grasping the 90º Diagonal and place the telescope on a sturdy table. It should look like Illustration 3.

Placing the TableTop

One of the great assets of the TableTop Telescope is its extremely portable size. Due to its overall short length, you will find that viewing while sitting down on the ground next to the telescope is the most comfortable. If you wish to raise the telescope off the ground so that it can be used while standing or sitting in a chair, then a platform, such as a milk crate or table can be used.

Altitude and Azimuth (Aiming the Telescope)

The TableTop altazimuth base permits motion along two axes: altitude (up/down) and azimuth (left/right). Moving the telescope up/down and right/left is the "natural" way people search for objects; which makes pointing the telescope intuitive and easy.

Simply take hold of the 90º Diagonal and move it left or right so that the base rotates. Move it up or down in the same manner. Both motions can be made simultaneously and in a continuous manner for easy aiming. This way you can point to any position in the night sky,from horizon to horizon.

Altitude Tension Adjustment

When aiming the telescope in altitude, you may find that the optical tube is either too hard to move or does not stay in place. Use the altitude adjustment tension knob to change the amount of tension between the optical tube and the altazimuth base to find the right level of tension to properly move and balance the telescope. (Refer to Illustration 2 to identify the Altitude Tension Knob).

Focusing the Telescope

Using Zoom eyepiece dialed to 21mm aim the optical tube so the front end is pointing in the general direction of an object at least 1/4-mile away. With your fingers, slowly rotate the focus knob until the object comes into sharp focus. A good method to ensure you've hit the exact focus point is go a little bit beyond sharp focus until the image starts to blur again, then reverse the rotation of the knob and stop when sharp focus has been achieved again. Note that it is possible to become 'lost' and have difficulty in changing focus from near to far objects. Rotate the knob clockwise to focus on near objects, and counterclockwise to focus on more distant ones.

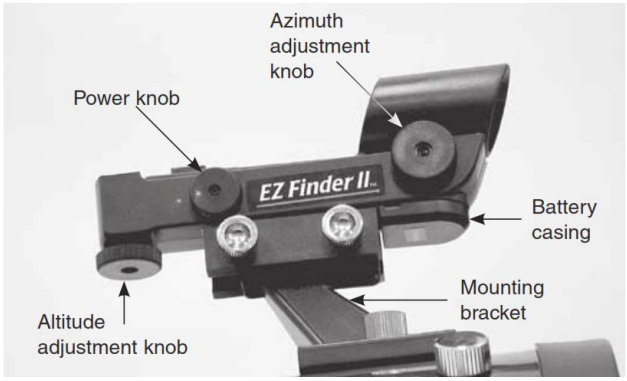


Illustration 5: The EZ Finder II Reflex Sight

Operating the EZ Finder II Reflex Sight

The EZ Finder II reflex sight makes pointing your telescope almost as easy as pointing your finger! It's a non-magnifying aiming device that

superimposes a dot on the sky, showing exactly where the telescope is pointed. The EZ Finder II works by projecting a tiny red dot produced by a light emitting diode(LED), not a laser beam, onto a lens mounted in the front of the unit. When you look through the reflex sight, the red dot will appear to float in space.

Illustration 6: The EZ Finder II superimposes a tiny red dot onthe sky, showing right where the telescope in pointing.

The first time you use the EZ Finder II you may have to remove the clear plastic tab near the battery cover; this tab prevents the batteries from accidentally being drained during storage. Turn the power knob clockwise until you hear the "click" indicating that power has been turned on. Look through the back of the reflex sight with both eyes open to see the red dot.

Position your eye at a comfortable distance from the back of the sight. The intensity of the dot is adjusted by turning the power knob. For best results when stargazing use the dimmest possible setting that allows you to see the dot without difficulty. Typically a dimmer setting is used under dark skies and a bright setting is used under light-polluted skies or daylight. (See Illustration 5.)

Aligning the EZ Finder II Reflex Sight

When the EZ Finder II is properly aligned with the telescope an object that is centered on reflex sight's red dot should also appear in or near the field of view of the telescope's eyepiece at lowest power. Alignment of the sight is easiest during daylight before observing at night.

1. Without moving the main telescope, use the EZ Finder II's azimuth (left/right) and altitude (up/down) adjustment knobs to center the red dot on the object in the eyepiece.

2. When the red dot is centered on the distant object, check to make sure that the object is still centered in the telescope's field of view. If not, re-center it and adjust the EZ Finder II's alignment again. When the object is centered in the eyepiece and on the reflex sight's red dot, the EZ Finder II is properly aligned with the telescope and is ready to be used.

The EZ Finder II alignment should be checked before every observing session. Choose any distant target (during the day) or bright star (at night), center the object in the telescope's eyepiece, and then adjust the knobs until the object is centered on the red dot of the reflex sight. (See Illustration 5.)

3. Aim the telescope at a distant object such as a telephone pole or roof chimney and center it in the telescope's eye-piece. The object should be at least 1/4 mile away. Now, with the EZ Finder II turned on, look though it. The object will appear in the field of view near the red dot

At the end of your observing session, be sure to turn the power knob counterclockwise until it clicks off. When the two white dots on the EZ Finder II's body and power knob are lined up, the EZ Finder II is turned off.

Replacing the Battery

Replacement 3-volt lithium (CR-2032) batteries are available from many retail outlets. Remove the old battery by inserting a small flat-head screwdriver into the slot on the battery cover and gently prying open the cover. Then carefully pull back on the retaining clip and remove the old battery. Do not over bend the retaining clip. Then slide the new battery under the battery lead with the positive (+) side facing down and replace the battery cover.

Turn off the finder power after use. The user is responsible for purchasing and replacing the battery if due to leaving the finder power on.

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 streetlights, porch lights, and automobile headlights. The glare from these lights will greatly impair your dark-adapted night vision. Avoid viewing over rooftops and chimneys, as they often have warm air currents rising from them. Similarly, avoid observing indoors through a window, either open or closed, because the temperature difference between the indoor and outdoor air will cause image blurring and distortion. Window glass may also introduce glare, internal reflections, or double-images into your view.

If at all possible, escape the light-polluted city sky and head for darker country skies. You will be amazed at how many more 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, when you look up at the sky with your naked 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.

In conditions of good seeing, star twinkling is minimal and images appear steady in the eyepiece. Seeing is best over- head, 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).

If you cannot see stars of magnitude 3.5 or dimmer then conditions are poor. Magnitude is a measure of how bright a star is – the brighter a star is, the lower its magnitude will be. A good star to remember for this is Megrez (mag. 3.4), which is the star in the "Big Dipper" connecting the handle to the "dipper". If you cannot see Megrez, then you have fog, haze, clouds, smog,

or other conditions that are hindering your viewing.

Tracking Celestial Objects

The Earth is constantly rotating about its polar axis, completing one full rotation every 24 hours; this is what defines a “day”. We do not feel the Earth rotating, but we see it at night from the apparent movement of stars from east to west.

When you observe any astronomical object, you are watching a moving target. This means the telescope’s position must be continuously adjusted over time to keep an object in the field of view. This is easy to do with the TableTop Telescope because of its smooth motions on both axes. As the object moves off towards the edge of the field of view, just lightly nudge the telescope to re-center it.

Objects appear to move across the field of view faster at higher magnifications. This is because the field of view becomes narrower. Objects seen through the eyepiece will be right side up but will be reversed left-right.

Magnification Limits

Every telescope has a useful magnification limit of about 2X per millimeter of aperture. This comes to 180X for the 90mm TableTop Telescope which is the magnification produced by the zoom eyepiece when set to 7mm.

Moderate magnifications are what give the best views. It is better to view a small, but bright and detailed image than a dim, unclear, oversized image.

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 binary stars. Deep-sky objects are generally too faint at the magnifications employed by this Maksutov-Cassigrain telescope, but a few are bright enough.

Remember that you are seeing these objects using your own telescope with your own eyes! The object you see in your eyepiece is in real-time, and not some conveniently provided image from an expensive space probe. Each session with your telescope will be a learning experience. Each time you work with your telescope it will get easier to use, and planetary and stellar objects will become easier to find. Take it from us, there is big difference between looking at a well-made full-color NASA image in a lit room during the daytime, and seeing that same object in your telescope at night. One can merely be a pretty image someone gave to you. The other is an experience you will never forget!

Objects to Observe

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

A. The Moon

With its rocky surface, the Moon is one of the easiest and most interesting targets to view with your telescope. Lunar craters, marias (dry lava “seas”), 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. However it is the best time to trace out crater rays. Make sure to observe the Moon when it is well above the horizon to get the sharpest images.

B. The Planets

The planets don't stay put like the stars, so to find them you should refer to Sky Calendar at our website (OrionTelescopes.com), or to charts published monthly in Astronomy, Sky & Telescope, or other astronomy magazines. See also the web site list at the back of these instructions. Venus, Jupiter, Saturn and Mars are the brightest objects in the sky after the Sun and the Moon. The TableTop Telescope is capable of showing you these planets in some detail. Other planets may be visible but will likely appear star-like. Because planets are quite small in apparent size, using higher magnification is justified in viewing these. Not all the planets are generally visible at any one time.

JUPITER: The largest planet, Jupiter, is a great subject for observation. 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. Also these moons pass in front of Jupiter (transit), casting their shadows on the planet, duck behind Jupiter (occultation), or are eclipsed in Jupiter's shadow. These events occur almost daily. See the Appendix for a website where these times may be found.

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 (next time 2025), 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 will probably see a bright "star" close by, which is 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: At it's closest some detail on the surface of Mars can be seen. One of the polar caps can usually be seen. These are mostly carbon dioxide. Other surface features will have to wait until Mars is closest to the Earth which occurs on average of every 26 months. The next two closest Mars dates are May 20, 2016, and July 31, 2018. The 2018 date is the closest Mars will get to the Earth since it's closest of recorded history August 27, 2003. Mars during about 4 months centered on the indicated dates will be the best for viewing.

C. 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 gorgeous two-color double star Albireo in Cygnus is a favorite. Defocusing a star slightly can help bring out hints of color. See the Appendix for a list.

D. Brighter Deep-Sky Objects

Under dark skies, you can observe some of the brighter deep-sky objects, including gaseous nebulae, open and globular star clusters, and a few galaxies. Even the brighter 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. Do not expect these objects 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 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. See the Appendix for a list.

Viewing Hints

Amateur astronomy can be an entertaining and educational activity for the entire family. Astronomy is also a serious scientific pursuit. As with any science you will achieve the best results by following some basic guidelines. These recommendations will assist you in getting the most out of the telescope. This is just a sample of suggested techniques; for more helpful tips please visit the Learning Center at OrionTelescopes.com.

Light Pollution

Most of us live where city lights interfere with our view of the heavens. As our metropolitan areas have become more developed, the scourge of light pollution has spread, washing out many stars and nonstellar celestial objects from our sight. Faint deep sky objects become difficult or impossible to see through the murk of light pollution. Even bright nebulas like the Orion and Lagoon Nebulas lose much of their delicate detail. The Moon and planets are not affected; they require steady air more than dark skies, so they remain good targets for city-dwelling observers.

The International Dark-Sky Association is waging the fight against light pollution. The IDSA was founded in 1988 with the mission of educating the public about the adverse impact that light pollution has on the night sky and astronomy. Through educational and scientific means, the nonprofit IDA works to raise awareness about the problem and about measures that can be taken to solve it.

Do you need help dealing with local officials to control street or building lighting in your area? The IDA's extensive support materials can show you how. Help preserve dark skies, join the IDA today! For information, write to IDA, 3225 N. First Ave., Tucson, AZ 85719-2103 or visit their website: www.darksky.org. The best way to avoid immediate problems with light pollution, however, is to take your telescope to where there are dark skies. You will be amazed at how many stars you can see when you get away from the city lights.

Do You Wear Eyeglasses?

If you wear eyeglasses, you may be able to keep them on while you observe. In order to do this, your eyepiece must have enough "eye relief" to allow you to see the entire field of view with glasses on. You can try looking through the eyepiece first with your glasses on and then with them off, to see if the glasses restrict the view to only a portion of the full field.

If the glasses do restrict the field of view, you may be able to observe with your glasses off by just refocusing the telescope to your unaided vision. If your eyes are astigmatic, images will

probably appear best with glasses on. This is because a telescope's focuser can accommodate for nearsightedness or farsightedness, but not astigmatism. Astigmatism, however, is less a problem at higher magnification.

Appendix

Jovian (Jupiter's) Satellite Positions

https://in-the-sky.org/jupiter.php

The satellite positions are represented graphically for a month at a time as wavy lines. Io 's line is orange; Europa's, yellow; Ganymede's Red; Callisto's Blue.

Mutual Jovian Satellite Events

http://www.projectpluto.com/jevent.htm

Times are in Universal Time (UT). For EST subtract 5 hours from UT. For EDT subtract 4 hours from UT. Note that the evening hours in Michigan are actually early the next day in UT. After 2015 it will be 5 ½ years before these types of events occur again.

Finding your way around the sky

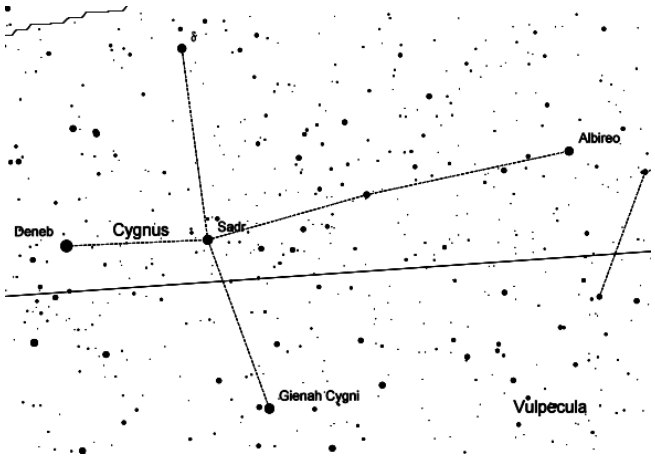
Books on constellations, star charts or star atlases may be consulted or borrowed from the library. With these you can learn the constellations and find your way around the sky.

A monthly star chart for the Grand Traverse Area can be found at http://epemeris.bjmoler.org along with a list of planetary events for the month. There are also commercial and free star chart programs on the Internet. Here are some free ones listed in order of ease of use.

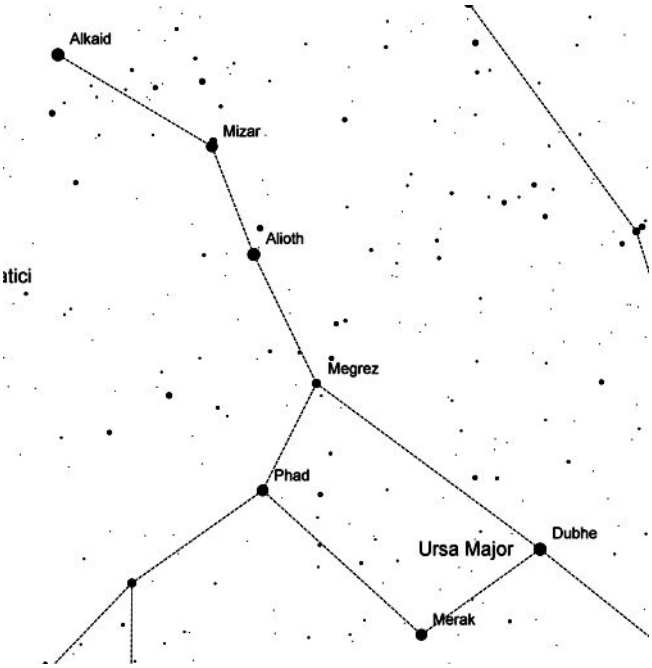
- Stellarium: http://www.stellarium.org. For older computers use version 0.12… For newer ones you can use version 0.13… This shows a very realistic sky.
- Sky Charts: http://astrosurf.com/astropc/. This is a good program for use out with the telescope.
- Hallo northern sky: http://www.hnsky.org/software.htm. This one looks bare bones but there are a lot of hidden features. It is the hardest to use.

Some Interesting Stars

Alberio (β Cygni) The star in the beak of Cygnus the swan or the foot of the Northern Cross is a blue and Gold binary star. Visible in the evening from late spring to late autumn.

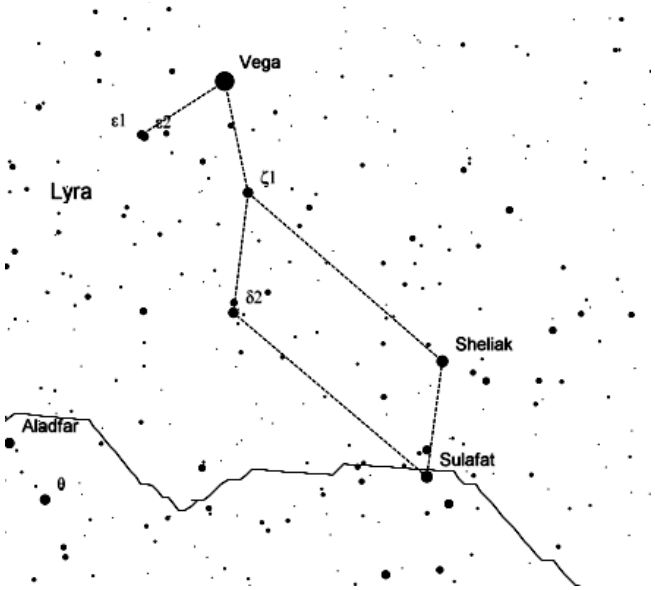


Mizar (ζ Ursa Majoris) and Alcor. Mizar, at the bend in the handle of the Big Dipper has a dim and challenging naked eye companion Alcor. The ability to see the pair was an ancient eye test. In a



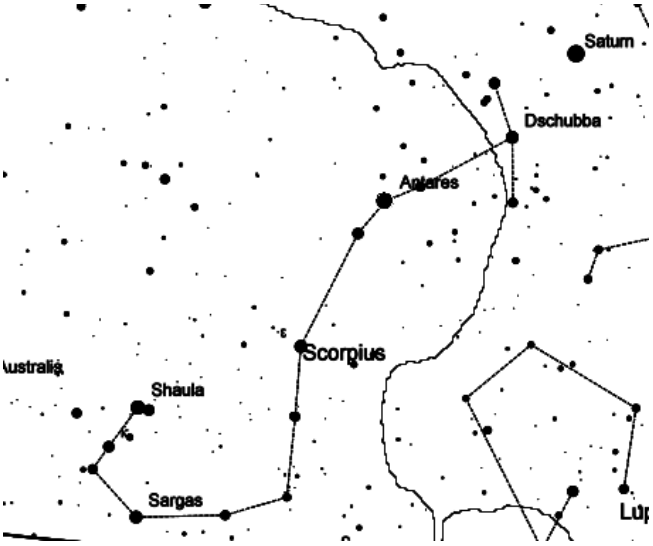
telescope Mizar as a close companion. These stars are up all year, except are low in the north in the autumn.

Epsilon Lyrae (ε^1, ε^2 Lyrae) This is a wide double star next to Vega in Lyra the harp. Inspection at high power can reveal that each is again a close binary star, which gives the star the nickname "The Double-Double Star". Visible in the evening from late spring to late autumn.



Antares (α Scorpii) is the bright red giant star in Scorpius. It shows a yellow-orange in telescopes. However because it appears close to the horizon a lot the Earth's atmosphere can cause it to sputter all the colors of the rainbow. The worse the seeing the sparklier it gets. Visible from late spring to late summer.

Note that Saturn is plotted on the chart. This illustration is a print from Sky Charts, a computer program for July 4, 2015 which will display the position of planets for that date. On any other date Saturn will not be in that exact position. This is why printed star charts do not have planets plotted on them except, maybe, in a special section.

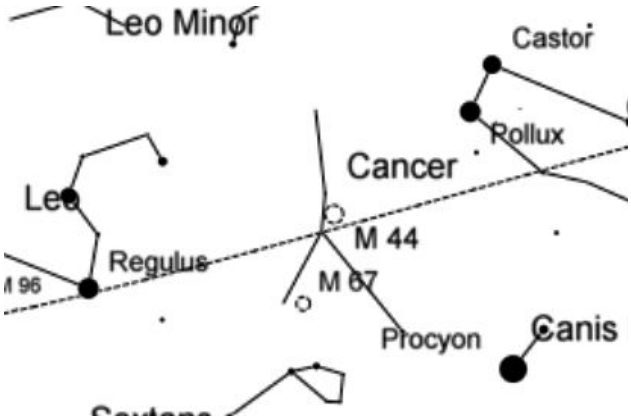


Some Bright Deep-Sky Objects

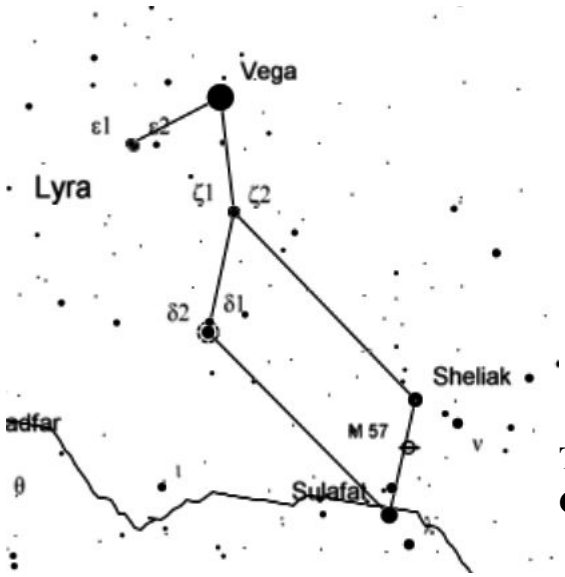
Even the brightest deep-sky objects may not be visible in the EZ View finder, so the telescope is pointed to the object using nearby stars as guides.

Most of the brighter deep-sky objects are mostly known by their Messier Catalog number. Charles Messier was a French astronomer around the time of the American Revolution, and hasd a telescope with a smaller diameter than the TableTop Telescope. He was searching for comets, which when they first appear look like tiny fuzzy blobs. But comets move. When he found a fuzzy blob that didn't move against the background of the sky, he marked it down with a number and location, so he wouldn't bother with it if he ran across it again. Many of these objects also have nicknames.

The Beehive Cluster, M44 is a nearby star cluster easily visible as a star cluster in binoculars. It is a springtime object. It's a faint fuzzy spot to the naked eye. It's rather large, so it will fill the field of the lowest power eyepiece setting. The Beehive is an open or galactic star cluster that are generally found in the band of the Milky Way, unless they are close to us, or very old. For 2015, the planet Jupiter will be between Cancer and Leo. It was removed from the chart. Also distant star cluster M67 in on the chart. It is small and faint with a lot more stars than the Beehive and will be a challenge to spot.



The Ring Nebula, M57 is small and cannot be seen with the naked eye or with binoculars, but it is still reasonably easy to find. A nebula is a cloud of gas and/or dust. M57 is in the constellation of Lyra the harp, a constellation visible in summer and early autumn. Point the telescope's finder about half way between the two southern stars of the parallelogram of stars that's the harp's body, Sulafat and Sheliak. Move the telescope in a small spiral enlarging the search pattern by half the field of view at a time. The Ring Nebula will appear a ghostly small circular glow. Once centered, more magnification may be used. The center will be darker than the edge. Inside is a very faint invisible star that blew out its outer layers of gas into a smoke ring near the end of it's life.



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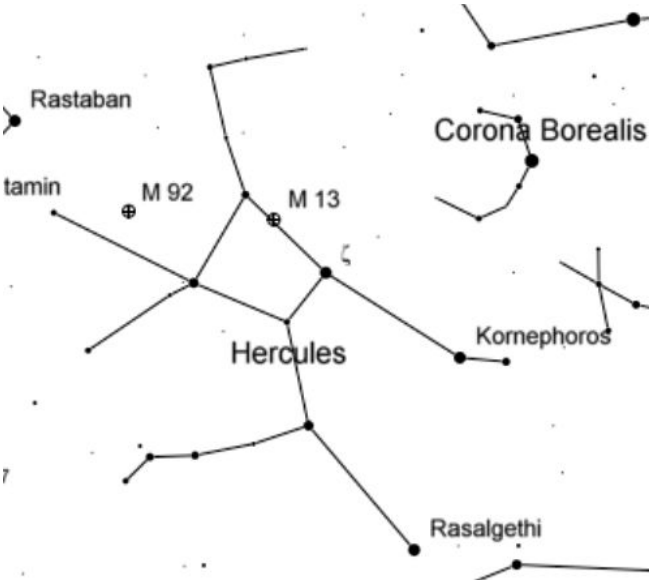
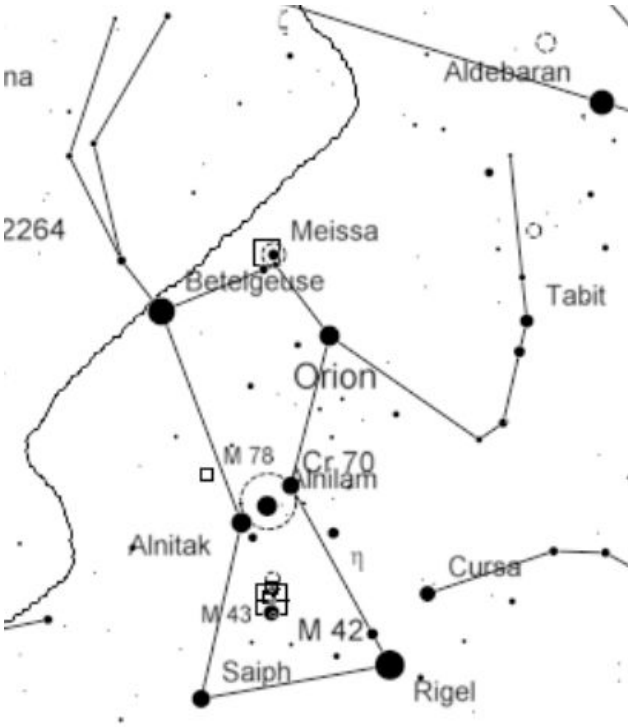
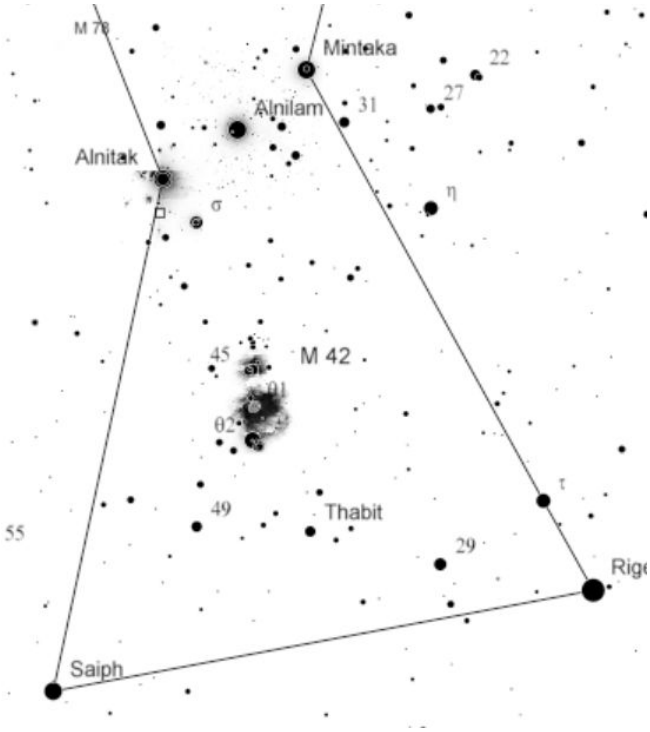


Hercules Globular Cluster, M13 is the finest globular star cluster in the northern hemisphere of the sky. It is visible from late spring to early autumn. Globular star clusters have populations of hundreds of thousands of stars. They date back to the origin of the Milky Way of ten or a bit more billion of years old. There are only about 150 of these that belong to the Milky Way. M13 is visible in binoculars on the western side of the Keystone pattern of stars, about one third the distance from the north star on that side to the south side. It takes a much larger telescope to see individual stars. The star cluster will be a large circular glow. M92 is another star cluster which is dimmer and will be quite a challenge to find

The Great Orion Nebula, M42 is the brightest nebula or cloud of gas in the sky. It is a place where stars are forming. It looks like a glow around a tiny clutch of four stars called the Trapezium, which appears as one of the stars in the center of a line of three stars that is the sword, hanging down from Orion's belt.





The first chart is one of the constellation of Orion. The second image is the southern part of Orion showing the nebula better. Orion is a winter constellation.