Tony Flanders

Three Bargains for Beginners

We put three entry-level scopes through their paces.

ALL PHOTOGRAPHS TAKEN BY *S&T*: SEAN WALKER

Choosing the right telescope for beginners can be difficult, particularly on a limited budget. Tony Flanders compares three telescopes that give excellent value for their prices.

How much does a decent beginner scope cost? There are plenty of good choices for $400, and the options are almost limitless if you're willing to spend more. At the opposite extreme, it's possible to buy a good telescope for as little as $100 (*S&T:* March 2011, p. 52). But $100 scopes have very small apertures and limited capabilities.

Things change when you move up a notch in price. If you shop carefully, a $200 telescope can provide very good views of planets and deep-sky objects. Two of these have been reviewed in prior issues: the Orion StarBlast 4.5 Astro Reflector (*S&T,* June 2003, p. 46), and the Astronomers Without Borders OneSky Reflector (*S&T,* Feb. 2014, p. 60). But how do they compare to each other? And are there other worthy candidates in the same price range?

While searching for good telescopes in the $200 price range, we evaluated many other scopes, and one of them stood out. The Meade Infinity 90 Refractor offers a fair amount of aperture with a rich package of accessories. Its 90-mm f/6.7 achromatic objective lens has just 62% the light-gathering area of the StarBlast's mirror, but that's partially offset by the refractor's unobstructed aperture.

StarBlast Versus OneSky

The StarBlast and OneSky are strikingly similar. Both are small Newtonian reflectors, though the OneSky's 130-mm f/5 mirror gathers 30% more light and has a 44% longer focal length than the StarBlast's 114-mm f/4 mirror. Their mounts are identical, requiring a table or similar support to hold them.

The most obvious difference between the StarBlast

Meade Infinity 90mm Altazimuth Refractor

U.S. price: $219.95
Available at meade.com and various dealers worldwide

Meade's Infinity 90mm Altazimuth Refractor has enough aperture to produce satisfying views of the Sun, Moon, and planets, as well as bright deep-sky objects and double stars.

Orion StarBlast 4.5 Astro Reflector Telescope

U.S. price: $209.99
Available at telescope.com

For more than a decade, Orion's StarBlast has been one of the best "bang-for-the-buck" telescopes, featuring a 4½-inch parabolic mirror in a compact alt-az configuration.

Astronomers Without Borders OneSky Reflector

U.S. price: $199.95
Available in the U.S. (online orders only) at astronomerswithoutborders.org

The Astronomers Without Borders OneSky Reflector packs a moderately large 5.1-inch aperture mirror into a collapsible tube design.

All three telescopes include enough eyepieces to provide satisfying wide-field and close-up views of targets, and the Infinity 90mm includes a 2× Barlow lens (not shown). The StarBlast and OneSky both come with a useful collimating tools.

WHAT WE LIKE:	WHAT WE LIKE:	WHAT WE LIKE:
Good high power with stock eyepiece	Very easy to use	Very easy to use
No collimation or cool down required	Adjustable eyepiece angle	Good high power with supplementary Barlow
Good slow-motion controls	**WHAT WE DON'T LIKE:**	**WHAT WE DON'T LIKE:**
WHAT WE DON'T LIKE:	Requires table or other stand	Requires table or other stand
Awkward when pointed near zenith	Not great at high power	Awkward eyepiece angle
Poor-quality Barlow lens		Slightly crude helical focuser

Although the OneSky has both a larger aperture and longer focal length than the StarBlast, it collapses into a somewhat smaller package for convenient storage and travel.

and OneSky is that users can collapse the OneSky's tube for convenient transportation. This also allows it to incorporate a much longer focal length into a slightly smaller package.

The OneSky's open tube works well under dark skies. But the view is plagued by reflections that dramatically decrease the contrast of deep-sky objects when the scope is used near bright lights. Users can fix this by constructing a simple shroud out of lightweight foam material (see **http://is.gd/GMPMMW**).

The StarBlast has a standard rack-and-pinion focuser. While this would be adequate in many scopes, it's slightly crude with the StarBlast's f/4 focal ratio, in which a tiny change in eyepiece position causes a big change in focus. The OneSky's simple helical focuser is easier to fine-tune with the lightweight eyepieces supplied with the scope.

Both optical tubes slide back and forth to achieve balance. The OneSky uses a Vixen-style dovetail bar that holds the tube at a fixed orientation, placing the focuser about 20° left of vertical. This requires you to stand behind the scope when aiming high in the sky. The StarBlast uses tube rings that allow you to rotate the tube and adjust the eyepiece angle to a comfortable angle.

The OneSky we reviewed in 2014 had a very good mirror, as does the OneSky that I borrowed for this review, suggesting that this is typical for the model. StarBlasts, by contrast, have shown considerable variation in optical quality. My own StarBlast has a good mirror, though not as good as the one in the OneSky. The best StarBlast mirrors are excellent and the worst are merely acceptable — fine for deep-sky observing but less than ideal for viewing the Moon and planets.

The OneSky works best on a standard-height table or similar support. The telescope focuser's fixed position forces users to stand behind the instrument when viewing near the zenith.

The Orion StarBlast is extremely comfortable to use when seated, though a small table or other support is necessary to perch the scope at a comfortable height.

All three of the telescopes include eyepieces that are variants of the three-element Kellner design. Their optical quality is very similar, as I verified by using each of the eyepieces in all of the scopes. The design works significantly better in the OneSky than in the StarBlast. The eyepieces are quite sharp in the center in both scopes, but stars are severely distorted near the edge of the field in the StarBlast due to its very fast f/4 focal ratio. The fraction of the field that's truly sharp is much larger in the f/5 OneSky.

To achieve high magnifications, the StarBlast needs short-focal-length eyepieces, which tend to have less eye relief. I found my eyeball uncomfortably close to the glass when using the stock 6-mm eyepiece. On the flip side, the StarBlast's short focal length gives it an expansive field of view when used with premium eyepieces: a 24-mm wide-field design produces a magnificent 3.4° field, big enough to take in the entire Veil Nebula.

All three scopes have variable-intensity red-dot finders. These work much better than the low-quality finderscopes that used to be included with budget-priced telescopes, but they do have their quirks. The electrical contacts tend to be a little balky, sometimes requiring jiggling the battery case before the finders light up.

Good as they are, the StarBlast and OneSky have a number of limitations. Most obviously, they require a table or similar support. Some users have good results using milk crates, buckets, or other found objects. An ideal solution is to build your own support, like the one shown above or the more robust model described under "DIY Improvements" at **eyesonthesky.com**.

One big consideration for beginners is that all reflecting telescopes require collimation. To their credit, both the StarBlast and OneSky ship with center-spotted mirrors and simple but effective collimation tools — features often omitted with scopes that cost several times as much. Using these, collimation is fairly quick and easy once you've learned to do it, but it's still a major psychological hurdle for most beginners.

Reflectors also take a fair amount of time to cool down to the ambient temperature before they deliver truly sharp images. And they're problematic for viewing terrestrial subjects because they show everything upside down.

Refractors sidestep all of these problems. They require no collimation, cool down in a matter of minutes, and they're typically used with star diagonals that show objects right-side up. A small refractor is more appropriate than a reflector for many beginners despite the fact that you get significantly less aperture for any given amount of money. Let's take a quick look at our refractor before discussing how all three scopes perform under the night sky.

The Infinity 90

The Meade Infinity 90 offers a respectable aperture at an attractive focal ratio. F/6.7 is short enough to give the telescope a wide field of view and a reasonably compact tube. But it's also long enough to avoid the extreme false color that sometimes exists with inexpensive achromatic objectives. An unusual feature of the Infinity 90 is that it includes a 90° image-erecting prism that shows objects in correct orientation rather than mirror-reversed as with most refractors used with a conventional star diagonal — very handy for terrestrial viewing. Unlike some inexpensive image-erecting prisms, this one has very good optical quality.

The Infinity 90's biggest shortcoming is its mount. It's quite stable and vibration-free unless you're using it in a strong wind — far superior to the wobbly mounts supplied with most low-cost 60-mm refractors. But it's awkward to use. The scope isn't counterbalanced, so the altitude bearing needs a lot of friction to prevent the scope

The Equatorial StarBlast

The 4.5-inch StarBlast is available with a lightweight equatorial mount, which I also used during this review. I'm not usually a fan of ultralight equatorial mounts, but this one works quite well with the StarBlast due to the optical tube's extreme shortness and light weight.

Equatorial mounts can be daunting to beginners because of their complexity. But they can also be used in alt-azimuth mode by setting the altitude scale to 90°, and in that configuration they're just as simple as tabletop mounts, with the added benefit of slow-motion controls.

from toppling backward when pointed high in the sky. It's impossible to make fine adjustments with such stiff bearings, though the long handle supplied with the mount helps a lot. In practice, I almost always needed the slow-motion controls to center my target. This two-step process makes it frustrating to browse galaxy fields or the Milky Way with the ease and grace of the other two scopes.

The slow-motion controls are very handy for keeping the planets centered as they drift across the field at high power. But they have a limited range of motion, so they eventually "bottom out." Then you have to reset them, recenter the planet, and start over again.

The refractor's tripod is also fairly short. That keeps it both stable and light; the entire assembled scope is easy to carry in one hand. But even with its legs fully extended, I had to sit on a low footstool to view through the eyepiece when the scope was aimed high in the sky. It's exceedingly awkward to view through the red-dot finder in this position, so I avoided targets within 30° of the zenith.

The Infinity 90 costs a little more than the OneSky and StarBlast, but that's offset by the inclusion of an extra eyepiece offering 95× magnification, making it the only one of the three scopes that can provide detailed views of the planets without a supplementary eyepiece or 2× Barlow lens.

The Infinity 90 does in fact include a 2× Barlow. Unfortunately, it exhibits strong false color everywhere except the center of the field. But even without the Barlow, the Infinity 90 has the most versatile eyepiece collection of all the scopes.

All three scopes have eyepieces with thoughtfully selected focal lengths, as shown on the facing page. Low power is 26× for the StarBlast and OneSky and 23× for the Infinity 90. These are ideal magnifications for viewing large star clusters such as the Pleiades (M45) and Beehive (M44) and also very good for star-hopping. Medium-high is 75× for the StarBlast, 65× for the OneSky, and 67× for the Infinity 90 — excellent for close-up views of deep-sky objects, but a little low for viewing the Moon and planets.

The OneSky's collapsible tube is susceptible to stray light that can compromise its otherwise excellent views. The author made this simple shroud out of a piece of lightweight foam that can be found at most arts and crafts stores.

Under the Stars

When I tested the StarBlast, OneSky, and Infinity 90, I mostly restricted myself to using the stock eyepieces, sometimes with the addition of my own 2× Barlow. I used one or more of the scopes on most clear nights in May 2015, viewing the Moon, Venus, Jupiter, Saturn, and a wide range of deep-sky objects. I compared the scopes side by side on specific targets and also used each scope by itself for an entire evening to get a sense of its overall feel.

Left: The Infinity 90 includes a quality image-erecting prism that makes the scope useful for both terrestrial and astronomical observing. *Middle:* Even when fully-extended, the Infinity 90 tripod is short. While this provides a stable view at high magnification, a low stool or observing chair is required for comfortable viewing in most positions. *Right:* Aiming the refractor at targets anywhere near the zenith is awkward, due to the position of the red-dot pointer. A better placement for the finder would be near the objective lens.

Roughly aiming the Meade Infinity 90 refractor is aided by using the long handle at the back of the tripod. Targets can then be centered with the slow-motion controls.

TELESCOPE SPECIFICATIONS

	Infinity 90	StarBlast	OneSky
Aperture	90 mm	114 mm	130 mm
Focal length	600 mm	450 mm	650 mm
Focal ratio	f/6.7	f/4.0	f/5.0
Weight	11.9 lb. (5.4 kg)	13.0 lb. (5.9 kg)	14.8 lb. (6.7 kg)
Low mag.	23×	26×	26×
Medium mag.	67×	75×	65×
High mag.	95×	—	—

Optical specifications are based on advertised data.
Weights are as measured.

The planets are particularly attractive targets for beginners — and challenging targets for small telescopes. Even at medium-high magnifications (67× to 75×), all three scopes easily displayed the phase of Venus, the two main belts of Jupiter, and gorgeous views of Saturn's rings. My best views of the planets came at 95× with the 6.3-mm eyepiece on the Infinity 90, 112× with my own 4-mm eyepiece on the StarBlast, and 130× using the OneSky with its 10-mm eyepiece plus a 2× Barlow. At these magnifications, I could see the Jupiter's Great Red Spot, shadow transits of its moons, and the Cassini Division in Saturn's rings when atmospheric steadiness allowed. These features were quite obvious in the OneSky, a little harder to pick out in the Infinity 90, and problematic with the StarBlast.

I also tried the StarBlast at 150× with the stock 6-mm eyepiece and a 2× Barlow, but I found the scope very hard to focus at this magnification, and I saw little improvement over the view at 112×. One problem with the StarBlast is that the "sweet spot" where the view is truly sharp is relatively small, requiring you to nudge the scope quite frequently.

At the opposite extreme, the Infinity 90's view is sharp all the way to the field stop; the 3-element eyepieces work very well at f/6.7. Together with the slow-motion controls, this makes it very easy to track the planets. Like all fast achromats, the Infinity 90 shows violet halos around the Moon and planets, but the planetary views are otherwise quite attractive and detailed.

Under the semi-dark skies of my country home, all three scopes performed admirably on deep-sky objects, given their apertures. They showed all of the Messier objects with ease, and provided detailed views of many. The OneSky wins the prize on globular clusters, but all three scopes resolve a half dozen to a dozen stars in M4, M22, M5, and M13. The Infinity 90 is best for large open clusters such as M44, the Beehive, due to the scope's sharp field with the stock low-power eyepiece. But the OneSky is also superb, and the StarBlast isn't far behind. On galaxies and nebulae, the scopes perform in aperture order with the best views in the largest aperture.

Conclusions

The OneSky probably ranks highest among these scopes because it provides the best overall views both of planets and deep-sky objects. But it does require a supplementary 2× Barlow to show the planets in detail, and its focuser works poorly with heavy eyepieces. Moreover, each of the other scopes has advantages that might be compelling in specific circumstances.

The StarBlast has superb ergonomics due to its rotatable tube; it's ideal for viewing from a seated position. Deep-sky enthusiasts will also appreciate its extraordinarily wide maximum field of view when used with an additional 24- or 25-mm eyepiece. It's the weakest of the three on planets, but still comfortably ahead of most telescopes in its price class.

The Infinity 90 is best for people who want quick looks at the Moon and planets because it requires no collimation, cools down in a matter of minutes, and offers views not far behind the OneSky's. And it's completely self-contained, needing no table or stand to support it. But its alt-azimuth mount isn't well suited to browsing the deep sky.

While each of these telescopes has some flaws and limitations, they're all easy to use and a joy to look through. Best of all, they offer outstanding value for their amazingly low prices. ✦

Sky & Telescope *Contributing Editor* ***Tony Flanders*** *loves to use compact, convenient telescopes.*