

Three Low-Cost Telescopes

Yes, you can buy high-quality scopes for \$100 in today's market.



Authors Joshua Roth (left) and Tony Flanders pose with the test telescopes. The two tabletop units are attached to sturdy photo-tripod legs, their favorite setup for field use.

Orion SpaceProbe 3 Altazimuth Reflector
Orion SkyScanner 100mm TableTop Reflector
Orion GoScope 80mm TableTop Refractor

U.S. price: \$99.95 (for each scope)
Orion Telescopes & Binoculars
OrionTelescopes.com;
800-447-1001

AT PUBLIC STAR PARTIES and astronomy classes, people often ask us how much they need to spend to buy a decent telescope. There are many fine options for less than \$300, and at least one great telescope for less than \$200 — the StarBlast 4.5-inch Astro from Orion Telescopes & Binoculars (reviewed in *S&T*, June 2003, page 46). But in the sub-\$100 price range, low-quality scopes outnumber good ones by a huge margin. Up to now, our highest-rated scope in that price bracket was another unit sold by Orion: the SpaceProbe 3 Altazimuth

Reflector, reviewed together with 10 other telescopes in the December 2005 issue, page 86.

So we were greatly interested when Orion introduced two new telescopes for \$99.95, the same price as the SpaceProbe 3. These are the SkyScanner 100mm TableTop Reflector (a scaled-down and simplified version of the StarBlast) and the GoScope 80mm TableTop Refractor, a

short-tube refractor on a nearly identical mount. Could they match or exceed the performance of the venerable SpaceProbe? To find out, late last year we purchased current versions of the three scopes and set up a shootout.

Out of the Box

Assembling the SpaceProbe for the first time might be a little daunting for some people. The instructions are very clear, and all necessary tools are included, but there are lots of individual pieces and screws. Still, anybody with normal mechanical aptitude should be able to put the scope together in a half hour or less.

The two tabletop units, by contrast, come almost fully assembled. We were observing with both scopes within five minutes of opening the boxes.

The Mounts

It's impossible to overstate how important it is for a telescope to have a steady mount that lets you point the scope smoothly and surely in all directions. Wobbly tripods and mounts that jerk or slip have long been the Achilles' heel of low-cost telescopes. Old-fashioned long-tube 60-mm refractors often had (and still have) excellent optics, but they're traditionally mated with grossly inadequate mounts that make them a misery to use, especially for beginners.

The SpaceProbe's mount looks exactly like the mounts



S&T: TONY FLANDERS

Author Flanders's daughter decided to try the SkyScanner hand-held — a surprisingly effective arrangement at 20x.

for some of those low-cost long-tube refractors, but it works vastly better. We suspect that's because the tube is in almost perfect balance. Regardless of the reason, the SpaceProbe moves smoothly and stays where you point it. It's a little wobbly, especially when the legs are fully extended, but we judge it to be well within acceptable limits as long as the air is calm. Unfortunately, it shakes a lot in a stiff breeze — hardly surprising considering that the whole setup weighs only 8 pounds.

As for the tabletop mounts, they're superb. They're shipped with the azimuth motion a little too loose, but that's easily adjusted, as explained in the owner's manual. Once that's done, their motions rival those of alt-azimuth mounts costing hundreds of dollars. The mounts work well on tables, and they also have sockets in the base allowing them to be attached to any tripod with standard 3/8- or 1/4-inch threaded posts.



S&T: DENNIS DI CICCIO (3)

The Orion SpaceProbe 3 Altazimuth Reflector (left) has a time-tested yoke mount with a thumbscrew slow-motion bar (chrome) for vertical motion. The telescope is balanced well enough to work fine without the slow-motion control, but the bar makes it more stable in a breeze. The SkyScanner 100mm TableTop Reflector (center) is a little bigger than the GoScope 80mm TableTop Refractor (right), but both scopes are exceptionally compact.

The optical tubes connect to the mounts with Vixen-style dovetail bars (a de facto industry standard), making it easy to put the scopes on different mounts if desired. You can also attach the optical tubes to standard photo tripods using the 1/4-20 threaded holes tapped in the dovetail bars. And the SkyScanner works surprisingly well hand-held, as shown on page 53.

The only shortcoming of the tabletop mounts is that they're not quite tall enough for the optical tubes. The SkyScanner can clear the base when pointing at the zenith, but only if it's pushed forward in the dovetail holder, making it somewhat front-heavy. And the GoScope's star diagonal bumps into the base even when the scope is all the way forward in its dovetail. This prevents the scope from pointing anywhere within 18° of the zenith, and risks damaging the diagonal if you push the scope too hard. (The SpaceProbe also can't point directly upward, but it can get a lot closer to the zenith.)

Optical Design

The SpaceProbe 3 is a 3-inch (76-mm) f/9.2 Newtonian reflector. (That means that its focal length — approximately equal to the length of the tube — is $76 \times 9.2 = 700$ mm.) This is a classic design that's easy to manufacture, and the relatively long focal ratio works well with inexpensive eyepieces. The manual has clear directions for collimating (aligning) the telescope's optics, a collimation tool



Both tabletop scopes attach to their mounts with standard dovetail bars. Each bar has three detents on the side and two 1/4-20 threaded holes on the bottom, the latter allowing the optical tube to be attached to a photo tripod. With the GoScope, the finder is also held with a dovetail — a great convenience.

Even when the GoScope is advanced to its foremost position in the dovetail, it can only point 72° degrees above horizontal.

is provided, and the mirror is center-spotted to aid the process. But f/9.2 is so forgiving of minor collimation errors that you will probably never need to adjust the mirrors.

The SkyScanner is a 100-mm f/4 Newtonian reflector, a much less forgiving design in terms of collimation. There's no provision for adjusting the tilt of the primary mirror. And while it's possible to adjust the secondary, there's no centering spot on the primary, making collimation a challenge. In any case, our scope arrived in good collimation right out of the box.

The GoScope is an 80-mm f/4.3 achromatic refractor. This design inevitably shows colored halos around all bright objects. But as we shall see, this scope held some pleasant surprises for us.

All three scopes have clear light paths that allow the entire light cylinder entering the objective to reach the eyepiece — at least in the center of the field of view. They're supplied with 3-element eyepieces with apparent fields of view around 50°. These work very well in the f/9.2 SpaceProbe and adequately in the other two scopes. The center of the field of view is quite crisp in all cases, but due to the short focal ratios of the SkyScanner and GoScope, stars begin to grow strange-shaped spikes about halfway to the edge of the field. Nonetheless, the overall quality is good enough to frame objects in the center of the field and locate bright stars or objects even if they just graze the edge.

Finders and Focusers

All three scopes use Orion's standard EZ Finder II, which projects a red dot onto a window. You view your target through the window, move the scope until the target lines up with the red dot, and you're done! It would work better at night if the red dot appeared less bright. Even so, this unit is infinitely preferable to the junky 5× finderscopes often supplied with low-cost scopes.

The SpaceProbe and SkyScanner come with standard rack-and-pinion focusers. These are perfectly acceptable at the highest magnifications we could push these scopes to,



For more information see [SkyandTelescope.com/\\$100scopes](http://SkyandTelescope.com/$100scopes).

but by no means exceptional. The GoScope, by contrast, uses an unconventional design where the focuser moves the front lens instead of the eyepiece — and it's truly a delight to use. The tension and gearing are just right. The focuser is smooth but not sloppy, fast yet extremely accurate.

Under the Night Sky

We tested the telescopes in an urban park, in Roth's suburban backyard, and at some fairly dark sites in Boston's outer suburbs. Targets included the Moon, Jupiter, Saturn, Venus, the Pleiades and several other star clusters, a number of galaxies, and the Orion Nebula.

Not surprisingly, the SpaceProbe 3 is the clear winner on the Moon and planets when used with its supplied eyepieces. Each scope comes with a 10-mm eyepiece, but because of the telescopes' different focal lengths this yields 35× with the GoScope, 40× with the SkyScanner, and 70× with the SpaceProbe. The SpaceProbe's extra magnification allowed us to see much more detail on the Moon and planets.

Moreover, the SpaceProbe continued to deliver the best planetary images even when we used our own eyepieces to boost all three scopes to their maximum usable magnifications. Jupiter was stunning in the SpaceProbe, showing the North Equatorial Belt in crisp detail, a hint of the South Temperate Belt, and subtle shading in the polar regions. This scope would give a 60-mm apo refractor a good run for its money.

The SkyScanner proved the weakest of the three scopes at high power. The image refused to “snap” into focus, a classic sign of spherical aberration. Nonetheless, Jupiter's North Equatorial Belt and Saturn's rings showed quite clearly even at the 40× delivered by the stock 10-mm eyepiece.

The GoScope was the surprise, come-from-behind winner. There are limits to what can be expected of an f/4.3 two-element, achromatic lens. And because it's



S&T DENNIS DI CICCIO

The GoScope's diagonal threads directly onto the optical tube. This unconventional system works well but precludes attaching accessories such as correct-image diagonals to the telescope.

impossible to suspend the laws of physics, the Moon, Venus, and Jupiter appear with garish violet haloes. But if you can ignore that, planetary images are quite good. When we used an auxiliary Barlow lens to boost the GoScope's magnification to 70×, Jupiter showed nearly as much detail as it did in the SpaceProbe. Aside from the color halo, this scope compares favorably with Orion's 80-mm f/5 ShortTube Refractor, at a fraction of the cost.

We judged the GoScope to be the overall winner for viewing star clusters. Like the SpaceProbe, it shows the stars as pinpoints, but its extra aperture makes fainter stars visible, and its low, 17.5× magnification does a much better job of framing the Pleiades than the SpaceProbe's 28×. The SkyScanner also does well in this category. Stars aren't as sharp as in the other two scopes, but SkyScanner's extra aperture makes the stars brighter, and the two effects more or less balance each other.

For galaxies and nebulae, where light-gathering capa-



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Small Package, Big Impact

To an old-timer like me, it's a miracle that one can buy a well-designed, fully equipped telescope for \$100. But Orion Telescopes & Binoculars doesn't stop there. The scopes reviewed here also come with a DVD boasting seven authoritative video segments on the solar system as well as a CD with a starter version of *Starry Night* — an easy-to-use “desktop planetarium” program that simulates naked-eye and telescopic views of the night sky. What's more, the disk includes a PDF of the 192-page book *Starry Night Companion* by planetarium veteran John Mosley — a comprehensive and highly readable introduction to the hobby and science of astronomy. —Joshua Roth

bility is paramount, the telescopes perform in aperture order. The 100-mm SkyScanner is best, the 80-mm GoScope comes second, and the SpaceProbe third. The difference is particularly striking when viewing the Andromeda family: Messier 31, 32, and 110. In the outer suburbs all three scopes showed all three galaxies, but M32's appearance was barely non-stellar in the SpaceProbe, and seeing M110 required careful use of averted vision. All three galaxies were quite obvious in the SkyScanner, thanks to its additional aperture.

Conclusions

If your primary goal is great views of the Moon and planets, and you have only \$100 to spend, the 3-inch SpaceProbe is clearly the scope for you. It delivers 70× right out of the box, which is enough to give gorgeous views of Saturn's rings and show quite a lot of detail on Jupiter.

The other scopes have just enough magnification to show Saturn's rings and Jupiter's main belts with the supplied eyepieces. But you would need an auxiliary high-power eyepiece or Barlow lens to get the best possible planetary views from these scopes, and that would push you well beyond the \$100 limit. At that point, you have to wonder if it isn't worth spending \$199.95 for the 4.5-inch StarBlast, which delivers significantly better views than any of these three scopes.

If you consider simplicity and small size a premium, the tabletop units have a clear advantage over the SpaceProbe — as long as you have some kind of table or tripod



RAJANI FLANDERS

When a tabletop scope points high in the sky, it's sometimes rather awkward to look through the finder.

to support them. We suspect that most people will find the GoScope the more attractive of the two thanks to its fine optics and excellent focuser. But deep-sky enthusiasts may well prefer the SkyScanner because of its greater light grasp and its ability to point directly upward.

Frankly, you can't go wrong with any of these telescopes; they're all outstanding performers for their price. We just wish that scopes like these had been available when we were children! ♦

S&T associate editor **Tony Flanders** owns three scopes with apertures between 60 and 100 mm, and former S&T senior editor **Joshua Roth** owns four.



SHELDON FAWORSKY / SEAN WALKER

A Scope for Experts?

Novices aren't the only ones who like simple, compact telescopes. I had some free time on a clear weeknight while writing this review, so I took the GoScope and SkyScanner out for a tour of the sky in my local park. My high-quality eyepieces — similar to the ones that any experienced stargazer would likely own — bring out the best in these short-focal-length scopes. And in winter, there's an endless supply of targets for even the smallest instrument. From the Orion Nebula to the glorious Double Cluster in Perseus (pictured here), I've rarely had such an enjoyable couple of hours.

— Tony Flanders