

The Little Dob That Could

Orion takes a shot at producing an entry-level telescope well suited to just about everyone. The result? A good starter scope with quality features. | **By J. Kelly Beatty and Joshua Roth**

Like Ponce de León's quest for the Fountain of Youth, amateur astronomers are constantly searching for the perfect beginner's telescope. The requirements haven't really changed over the years: we want a well-built instrument with respectable optics and a steady mount costing something like \$200. But finding such a solid performer among inexpensive commercial offerings has proved difficult.

Taking up that challenge, Orion Telescopes & Binoculars has introduced a 4½-inch reflector on a Dobsonian mount. As the newest member of the company's SkyQuest XT series, this little Dob shares many of the features of its larger siblings. Made in China, the XTs offer metal tubes and the signature "CorrecTension" springs that hold the altitude bearings securely in their cradles. Eyebrows were raised around the office late last year when the 4½-inch was introduced for \$199, so we purchased two of them anonymously to test. Coauthor Roth applied his extensive experience with small-aperture instruments, while Beatty enlisted some relatives to serve as the prototypical family looking to buy its first telescope.

The SkyQuest XT arrives in two boxes, one containing the telescope tube and the other the parts for its base. A 16-page manual steps the user straightforwardly

S&T TEST REPORT



Orion's SkyQuest XT4.5 combines a sleek steel tube with a wooden Dobsonian base in a versatile, 17-pound package. *S&T* photograph by J. Kelly Beatty.

SkyQuest XT4.5 Telescope

4.5-inch f/8 Newtonian reflector on a Dobsonian mount, shipped with two eyepieces.

Price: \$229

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S&T: J. KELLY BEATTY

Left: Assembly of the telescope's base was not difficult, though a power screwdriver made the job easier.

Right: The 6×30 finderscope's achromatic objective is not stopped down like those found on most budget telescopes. Likewise, the $1\frac{1}{4}$ -inch focuser offers smooth operation and plenty of tube extension. The SkyQuest XT4.5 comes with two Plössl eyepieces. Unless otherwise noted, all photography is by Craig Michael Utter.

through the assembly, which takes about 45 minutes using simple hand tools and posed little difficulty for our telescope-unsavvy "test family" of two adults and two children. Most of the work is in putting together the particleboard mount, which has a black laminate finish. The finderscope's holder attaches quickly with two screws. (Incidentally, the entire manual can be downloaded for free from the support area of Orion's Web site, www.telescope.com.)

The mount's ground board is a round-cornered triangle, 18 inches on a side, with inch-high plastic feet that provide good stability and rapidly damp vibrations. Three small pads of Teflon support the 14-inch-diameter azimuth turntable, which spins around a single $\frac{3}{8}$ -inch bolt secured with a locknut; four pads of ultrahigh-molecular-weight polyethylene support the 4-inch altitude bearings. The placement of the altitude bearings allows the tube to swing a few degrees past the zenith before hitting a rubber stop.

Orion uses heavy-gauge steel tubes for this and other models in its SkyQuest se-

ries that should stand up well to everyday wear and tear. The rack-and-pinion focuser, plastic with metal gearing, provides large, easy-to-grip knurled knobs and smooth travel for $1\frac{1}{4}$ -inch eyepieces.



Although many low-end Chinese scopes have tons of goop on the gear teeth of their focusers, ours had just a trace of lubricant and worked very well.

The SkyQuest comes with a nice 6×30 finder in a two-ring, six-screw holder. Its threaded-cell objective can be screwed back and forth for optimal focus, and there was enough play to get good, sharp images when we viewed without eyeglasses. However, on both finderscopes the cross hairs were out of focus, an annoyance that can be corrected only with



difficulty if you take the finder apart. The 9- and 25-mm Plössl eyepieces, whose 1¼-inch all-metal barrels are threaded for filters, give very respectable images (though with limited eye relief). Also included is Orion's *Where the Stars Are* sky-charting software on a CD-ROM. Curiously, each of our telescopes came with a neutral-density Moon filter, an accessory listed as a \$12.95 option in the company's product catalog.

Once set in its cradle, the 34-inch-long tube is very top-heavy, a compromise necessitated by the low mount. Because the tube is so unbalanced, care must be taken to avoid having it crash to the ground during setup. This ceases to be a problem once the two springs are installed, but that's easier said than done. The springs are so stiff that you may need to pull on them with both hands (using the attached cloth loops) to latch each spring's end to its mounting peg. Even though the written instructions are clear, Internet chatter and our own experience suggest one might mistakenly place the cloth loops, not the spring ends, over the pro-

Facing page, bottom: Thanks to their offset positioning, the two heavy-duty springs provide extra tension when the tube is swung toward targets near the horizon.

Below: Orion's instruction manual gives the impression that looping the springs onto their mounting pegs is a fingertip operation.

Right: But in reality the springs are so stiff and taut that children will have difficulty stretching them into position.

truding pegs on the base. You'll need an extra grunt or two — and more muscle than most young children can muster — to stretch the springs into place.

We found that gusts of wind didn't affect the scope's pointing, and the setup will keep targets in line even if someone gently bumps the telescope a bit — a common sidewalk or star-party occurrence. You can adjust the azimuth (side-to-side) motion to taste by tweaking the turntable's locknut. With use, however, we found that the surfaces of the altitude bearings on one of the scopes became slightly scored and rough, which increased the friction and made up-and-down motion stiff and jerky.

Our fix involved drilling new holes to raise the base's attachment pegs by an inch. This eased the springs' installation and smoothed out the motion nicely, yet it retained enough tension to hold the tube in place, even with heavy eyepieces, and kept the base firmly attached when the telescope was carried around.

Optical Performance

The SkyQuest XT4.5 employs the identical optical system used with Orion's small SkyView Deluxe equatorial reflector. The plate-glass primary mirror has a spherical figure, but the modest aperture and long (f/8) focal length mean that it satisfies the ¼-wavelength criterion for



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Fully adjustable mounts cradle the plate-glass primary mirror and elliptical secondary mirror. Our tests showed that the rubber clips (lower left) that held the primary in place were too tight, pinching it and introducing noticeable — but partially correctable — astigmatism.

acceptable optical performance. The secondary mirror, just large enough to receive the primary's entire light cone, is mounted in a plastic sleeve that's held in place by a three-stalk support. Both of our units came out of the box adequately collimated, though even first-time scope owners will be able to fine-tune the alignment if they so choose using the simple collimation instructions in the manual.

We let the scopes acclimate to the outside temperature for at least a half hour before observing, as the instructions suggested, and began with a star test on Capella. An out-of-focus image showed a triangular shape, betraying some astigmatism. Might the mounting cell's trio of mirror clips be stressing the mirror somehow? We would check that possibility later. Meanwhile, even with strong moonlight, the Orion Nebula (M42) showed lots of texture, and the Trapezium was resolved very cleanly with the 25-mm eyepiece (which yields 36 \times). Lots of star groupings showed up crisply in the Double Cluster in Perseus. Seen through the supplied Moon filter, the lunar views were satisfying — as detailed and contrasty as you'd expect from any small, budget-priced telescope.

Make no mistake, however: the

SkyQuest XT4.5 is in a completely different league from department-store trash, and it outperforms the short-focal-length reflectors we tested last year (*S&T*: March 2000, page 63) for all uses except low-power, wide-field views. Using the 9-mm eyepiece (101 \times) on Jupiter, we could see the Great Red Spot and the rift in the South Equatorial Belt during moments of steady seeing. Saturn showed four moons, the Cassini Division (even in mediocre seeing conditions), and subtle zones on the globe. There was a hint of

Right: To avoid hunching over while observing, the authors attached a trio of short table legs to the telescope's ground board. **Below:** The legs attach to metal flanges that have been angled outward by thin wooden wedges cut with a miter saw.



lateral color at 36 \times — one limb of Jupiter bloomed red, the other blue — but it went away at 101 \times and thus had been introduced by the low-power eyepiece. (That being said, the supplied Plössl's are definitely a cut above most standard-issue oculars.) After swapping in higher-grade eyepieces to increase the magnification to 200 \times , the views became noticeably softer due to the combined effects of astigmatism and the diffraction introduced by the primary-mirror clips and the secondary's support stalks.

Our telescopes were later disassembled for a closer look at the optics. Both the primary and secondary mirrors have fully adjustable mounts, though the lock-down screws for the primary require an Allen wrench that was not supplied. These were overly tight, which compromised the collimation a bit and possibly caused some mirror flexure. Since the Phillips-head collimating screws are spring loaded, you could safely back off the lock screws — or even remove them entirely.

Bench tests with an artificial star confirmed our initial suspicions: screws for the rubber clips holding both primary mirrors had been overtightened, enough so to pinch and distort the glass. Backing
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Making a Good Scope Better

As impressive as Orion's budget 4½-inch Dobsonian is, small modifications can tweak its performance for the better. When testing the telescopes described in this review I was impressed with how good the views were. However, being a telescope maker, I naturally believed that the scope could probably be improved with a minimum of effort.

Two areas in particular deserve attention: the amount of diffraction "noise" in the images and some last traces of astigmatism. Astigmatism can be ground into the mirrors themselves, but more often it is the result of the optics being stressed in their cells. Since we had already loosened the clips holding the primary mirror, it seemed likely that the source of the remaining astigmatism was the secondary mirror's holder.

The secondary mirror on our review scopes is held in place by a plastic sleeve that slips over the body of the holder and captures the mirror's rim. This sleeve covers about ¼ inch of the diagonal's outer edge. Removing a single screw from the sleeve allows it to be slid

By Gary Seronik

off and the mirror removed. (Obviously, this is best done with the whole spider assembly removed from the tube.) After peeling the thin layer of felt from the holder, I stuck three evenly spaced ¼-inch strips of double-sided foam tape to the rim of the holder and then carefully aligned and affixed the secondary mirror. A word of caution regarding this type of tape: some adhesives will fail when subjected to high temperatures. If you use double-sided foam tape, make sure your telescope isn't stored in a closed garage on a hot summer day. Alternatively, you can use three blobs of silicone adhesive (aquarium sealant) instead — just be sure to leave about a ⅛-inch gap between the back of the secondary and the plastic of the diagonal mount.

Having taken care of the secondary mirror, I tackled the diffraction issue. Most of this "noise" comes from the spider vanes that support the secondary holder, but a fair amount also comes from the three clips that hold the primary mirror in its cell. As can be seen in the picture on the facing page, the mirror rests on six ribs that connect an inner ring with an outer lip. I remounted the primary by attaching six squares of the double-sided foam tape to three of the ribs (about halfway from center) and along the circumference. I then placed the mirror face down on a clean sheet of paper on a flat surface and firmly pushed down on the back of the cell to make sure the tape made good contact with the mirror. (Again, use silicone adhesive if you are concerned that your telescope might face extreme heat.)

After reassembling the scope and collimating the optics, I took it out for another look at Jupiter and Saturn. The result was first-rate views. No astigmatism was visible, and the diffraction noise was noticeably reduced. I was impressed with how much cleaner the planets looked. The shadow of Io stood out boldly from the dull gray of Jupiter's South Equatorial Belt. Saturn's Equatorial Belt and the Cassini Division in the rings were easily seen. The improvement was easily worth the half hour I spent making the modifications.



Top: The stock diagonal holder not only covers some of the secondary mirror's surface but also introduced some astigmatism into the image.

Middle: The outer sleeve can be eliminated by attaching the secondary mirror to its base with small squares of double-sided foam tape or silicone adhesive.

Bottom: Six pieces of double-sided foam tape (or three pads of silicon adhesive) will securely hold the primary mirror in its cell and eliminate the need for diffraction-inducing mirror clips.

Advertisement

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off the clips' screws removed some of the astigmatism, but not all of it, in each scope. Full-up (Foucault and Ronchi) tests of the primary mirrors showed reasonably smooth, zone-free surfaces. Surprisingly, one of the mirrors had been overcorrected to yield a paraboloid — an unexpected bonus!

A second round of field testing showed that a little loss of sharpness was still present, caused by the rubber clips protruding onto the primary and from the secondary mirror's mount and stalks. But overall the views were definitely better with mirror stresses reduced.

Getting Down and Dirty-Kneed

Orion markets the SkyQuest XT4.5 as a kid's scope, and we agree that it would make a dandy one.

With a total weight of just 17 pounds, this little bundle can be carried whole by just about anyone (or quickly separated into equal-weight halves). Admittedly, this scope does not have the take-along portability of a short-focal-length refractor or Edmund Scientific's Astroscan, though Orion does offer an optional padded carrying case. But its simple, tough-as-nails design will appeal to those of you who worry about the damage that youngsters can inflict on more elaborate optics and electronics.


That being said, we found this scope *too* short for convenient use, even for a standing child or seated adult. When pointed straight up the eyepiece height is just 34½ inches, and using the finder took some unnatural gyrations of the head and neck. Viewing something near the horizon requires you to assume a prayerful posture on your knees. Of course, you can always place the base on a table or some blocks, but who wants to lug those out into the field?

We solved the problem with \$15 worth of easily obtained hardware, by attaching metal flanges underneath the ground board and screwing a trio of 14-inch table



No matter what their age, budding amateur astronomers will appreciate the SkyQuest XT4.5's modest weight (17 pounds) and ease of use. S&T photograph by J. Kelly Beatty.

legs into them (see page 62). This puts the eyepiece 48 inches off the ground when the scope is pointed at the zenith. When the legs are removed, the ground board's plastic feet are tall enough to keep the flanges off the ground — even with the 15° wooden shims we added to splay the legs slightly.

This little scope was introduced in late 2000 for \$199 plus shipping, but since then Orion has raised the price to \$229. Even so, we feel the well-designed optical system and quality accessories make the SkyQuest XT4.5 worth considering even for more experienced observers who want a quick fix of starlight on a moment's notice. And for those seeking that mythical ideal first telescope, your search may be over. Even though there is room for improvement, in our view this SkyQuest XT has set a new standard for the beginner's telescope. 

Executive editor J. Kelly Beatty recently joined the ranks of three-telescope owners, and senior editor Joshua Roth can be found most clear nights exploring the 4th-magnitude skies near his suburban home.