A Compact 8-inch Travelscope

This Dobsonian gives great views and fits into an airplane's overhead storage compartment. | **By Gary Seronik**

One of the best reasons for learning to build telescopes is that you can make instruments that perfectly match a particular observing need or circumstance. As an editor at *Sky & Telescope*, my "circumstance" happily involves a lot of travel, and as a result I found myself dreaming of a telescope that I could take with me as I zigzag across North America from one star party to the next. It seemed a shame to arrive under the dark skies of the Texas Star Party or Mount Kobau without a telescope of my own.

For a while, I made do with my Questar — an icon of portability but offering only 3½ inches of aperture. But for my eyes, the dark skies I was lucky enough to enjoy deserved the light grasp of at least a 6-inch scope. Initially I found a solution in simply cutting the tube of my 6-inch f/6 Newtonian in half. This way I could fit both tube halves (stuffed with my cold-weather gear and other clothing) and my lightweight German equatorial mount into one large suitcase. This configuration survived a few trips, but eventually my luck ran out, and some rough treatment by baggage handlers resulted in a crushed telescope and a return to the drawing board. I resolved that my next travelscope would have to be compact enough to go as carryon luggage.

As I scanned back issues of this magazine and prowled the Internet I was surprised by how few appealing travelscope designs I saw. Many solutions either forced you to relegate some major portion of the instrument as checked baggage or involved a design that was literally a pain in the neck to use. Truth be told, I didn't search too carefully since I really was only looking for an excuse to do what I wanted anyway: build a scope that precisely suited my needs.

Making Choices

In addition to carryon-luggage portability, my travelscope would ideally have these features:

- at least 6 inches of aperture, although 8 would be better
- a focuser that doesn't come straight

While a compact telescope might be suitable for travel, it could also be an ergonomic nightmare. However, the elevated ground board and convenient eyepiece location of this scope make it easy to use from a seated position, regardless of where it is aimed. Unless otherwise noted, all photographs are by *Sky & Telescope*'s Craig Michael Utter.

out the side of the tube
- maximum and minimum eyepiece heights that allow seated viewing
- effective baffling against stray light
- no-tools setup.

When I sat down with a clean sheet of paper to make some preliminary sketches, all roads seemed to point to some kind of nested, truss-tube Dobsonian. I converted my 6-inch f/6 reflector to this configuration and found that the design worked better than I expected. Also, the finished scope was considerably smaller than the typical airline carryon allowance of 22 by 9 by 14 inches.* This suggested the possibility of an even larger instrument utilizing the same design.

When it comes to compact truss-type Dobsonians, there are two truths that are virtually inescapable. First, the secondary cage will not be light enough, and second, the balance point will likely be farther up the tube than optimal for a low-profile rocker box. Since in my case the height of the rocker box is fixed by the dimensions of the carryon requirement, there is a limit to how far up the tube the side bearings can be positioned before the back of the tube strikes the bottom of the rocker box. My philosophy was to do the best I could to keep the secondary cage lightweight and to move the side bearings as far up the mirror box as possible and hope for the best. If the scope turned out front-heavy, then I simply would have to add counterweights to the rear.

The first step in the process was to obtain a suitable primary mirror. Since the telescope would have to be compact, a short-focal-length mirror seemed in order. As it happened, I already had a ground and polished plate-glass 8-inch f/4.1 spherical mirror from another project that didn't pan out. Although I had heard many times that figuring a fast plate-glass mirror would be a challenge, this one progressed inexplicably smoothly, and soon I had a good parabola. The majority of the figuring was accomplished with a subdiameter (4-inch) tool. As soon as the mirror was off being aluminized I began constructing the telescope itself.

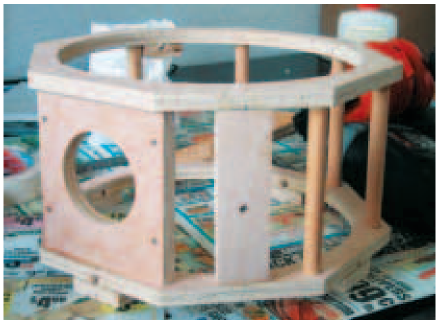
For the 8-inch travelscope, I decided to stick with the nested design that had worked so well with the 6-inch version. In this configuration the secondary cage fits inside the mirror box, which goes inside the rocker box, and the whole works is stored inside the case (really just another box) that also serves as an elevated ground board. Since the maximum dimensions of the package were set by the airlines, I would have to work from the outside in. I made lots of rough sketches and calculations before I began cutting wood — a measure that saved me from certain frustration and a load of mistakes. In a nested design, where the dimensions of every piece are interrelated, the importance of careful planning cannot be overstated.

Building the Components

I should mention that the telescope shown here was made by someone with very limited carpentry skills. I could not make a perfectly square box if my life depended on it. Luckily, the Dobsonian design is very forgiving. I used a drill press for most of the holes and a table saw for the straight cuts. However, my most-used tool was an inexpensive saber saw. The curved surfaces on the rocker box and the side bearings were cut with the saber saw and a circle-cutting jig, although these could have been done freehand. I discovered that, contrary to my expectations, the best blade for cutting circles was not the narrowest one. The skinny blades tended to splay out when the saw was cutting curves. The result was a top surface that had a slightly different radius than the bottom. The solution was to use a ½-inch-wide blade, which tended to bend far less.

Most of the parts for my travelscope were cut from a half sheet of good-quality

As this issue goes to press, airlines are reassessing their carryon policies. Before departing for the airport, check with your carrier to confirm its current regulations.



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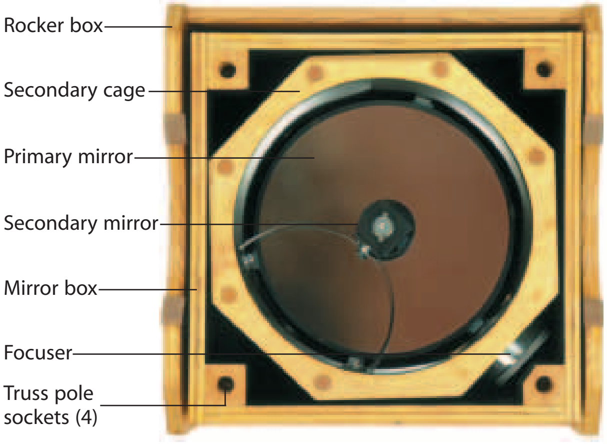
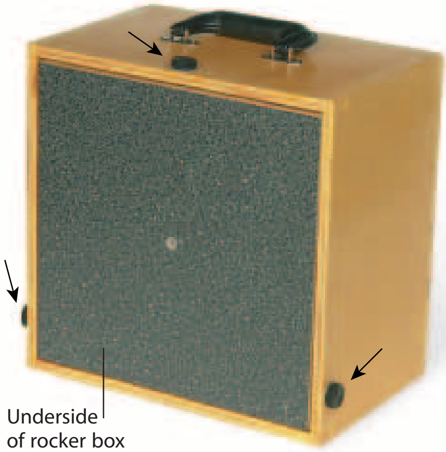
Left: **The various wooden components of the travelscope are seen here before final sanding and varnishing. At left is the mirror box, at right is the rocker box, and in back is the case, which also serves as the ground board.** ***Right:*** **The secondary cage.**

½-inch plywood. All wooden pieces were finished with three coats of satin marine spar varnish. Wherever possible I used stainless-steel hardware for durability, and plastic knobs for ease of assembly and adjustment. There are numerous sources for these parts — mine were purchased from Reid Tool Supply Co. (www.reidtool.com).

My calculations showed that for the telescope to meet carryon dimensions, the secondary cage would have to be no larger than 10⅜ by 10⅜ by 5 inches. The diameter of the primary mirror and cell set the minimum inside diameter at 8¾ inches. The secondary cage consists of two identical hexagonal pieces joined at each corner with lengths of ½-inch wood doweling. The hexagon shape offers two important advantages: it provides a means of mounting the focuser at a comfortable angle (45° from horizontal), and it also ensures that the secondary cage will clear the truss-pole mounting blocks located at the in-





Left: **The travelscope is almost ready for travel — all that remains is to slip the cover over the nested pieces. The four truss poles are too long to fit inside and are stored along with cloths and other essentials in another suitcase.** ***Right:*** **Three bolts (arrowed) pass through the exterior of the carry case and into mating holes in the rocker box to hold the entire nested assembly together during transport.**

side corners of the mirror box when the scope is packed for travel.

On two sides of the hexagon cage I used strips of plywood to provide a mounting location for a 2-inch low-profile helical focuser and for the finderscope. I also added four blocks around the perimeter of the lower part of the secondary cage to provide a double thickness of wood for the T-nuts that accept the truss-pole bolts. In the front, two additional blocks were added so that the curved secondary holder could be securely attached. I used black plastic presentation folders (available at most large office-supply stores) cut to size to line the inside of the secondary cage. Once this assembly was completed I had accurate numbers to use in sizing the mirror box.

The travelscope's mirror box is 11 9⁄16 inches square by 7 inches deep. This is big enough for the secondary cage to nest inside with about 1⁄16-inch clearance on all sides. Two sets of three holes are cut in the bottom to accommodate the mirror cell's collimation bolts and for ventilation. In addition, two more holes were added on one side for a pair of small fans that cool the primary mirror. These run off eight AA batteries and blow across the face of the mirror, ensuring that the optics cool quickly to the ambient air temperature.

Residing in the corners at the top of the mirror box are four 2½-inch lengths of 1¼-by-1¼-inch hardwood stock, each with a ½-inch-diameter, 2-inch-deep hole drilled lengthwise in the center. These serve as sockets for the four ½-inch diameter truss poles. There is no complex clamping system. What keeps the poles from slipping out is the fact that they are under tension — the poles have to bend inward about 1 inch to attach to the secondary cage. This scheme works remarkably well and satisfies my desire for quick and easy assembly.

The rocker box is pure Dobsonian, the dimensions of which are dictated by the size of the mirror box. The hole for the central pivot has a nylon bushing glued into place to prevent the center bolt from wearing into the wood. The top of the carry case serves as the ground board. Three legs attach to the bottom to ensure that it clears the ground and also to provide a few more inches of eyepiece height.

The four truss poles are simply ½-inch-diameter 1⁄16-inch wall-thickness aluminum stock purchased at Home Depot. (Telescopes of greater focal length, which require longer poles, would benefit from using either wider poles or more of them to ensure the necessary degree of rigidity and freedom from vibration.) I gave them a chromelike finish with hardware-store aluminum polish.

Calculating how long the poles should be was perhaps the most difficult step in planning the scope — I did it twice to make sure that I had the length right. It might be worth making up a set from inexpensive ½-inch wood doweling first, just to make sure you haven't miscalculated. At ⅝ inch from the top end of each pole is a ¼-inch hole for the bolt that joins the pole to the secondary cage. To ensure that these holes would be accurately (and uniformly) placed, I made a jig out of a scrap piece of 1¼-by-1¼-inch hardwood stock.

In the Field

I was pleased to find that the 8-inch travelscope goes together in about five minutes. The first step is to remove the

Left: **Despite the lack of a traditional shroud covering the truss poles or a light shield on the secondary cage, the scope is effectively baffled against stray light by the single annular baffle (arrowed) in the focuser draw tube. In the focuser one sees only the diagonal mirror and a portion of the secondary cage behind it.**

Right: **Lightweight Dobsonians are especially sensitive to changes in balance that occur, for example, when a lightweight eyepiece is exchanged for a heavy one. One way around this problem is to add some virtual weight with a spring. Adjusting the turnbuckle allows changes to the amount of tension exerted.**

nested pieces from the case and attach the three legs. The handknobs used for this operation are the same ones that hold the packed scope together. Next, I place the three Teflon pads on top of the case. The pads have brads hammered through them and recessed, which fit loosely into holes drilled in the top of the case. The rocker box is bolted on by means of another handknob that threads into a T-nut in the ground board. Next the two side bearings (made from half circles of ¾-inch plywood faced with Ebony Star Formica) are attached to the mirror box with T-knobs, and the mirror box is set into the rocker. The four poles slide into their respective sockets in the mirror box, and the secondary cage is attached. Since each pole and socket is identical, it is not necessary to number the poles or arrange them in any particular order — another time-saving measure. The last step in assembly is to attach the finder and the battery pack for the fans. As quick as that, the scope is ready for a night of observing.

The maiden voyage for this telescope was to the annual Mount Kobau Star Party, held at a remote location near Osoyoos, British Columbia. Getting there involved a cab rid to the airport, clearing customs and security (which resulted in more than a few curious inquiries), a 5½-hour flight across North America, and a 6-hour drive in a rental car — the last 45 minutes of which was up the bumpy unpaved road that leads to the mountaintop where the star party takes place. The scope

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After a journey of 2,700 miles by plane, taxi, and rental car, the author's portable 8-inch f/4.1 travelscope is set up and ready for a night under the dark skies of the Mount Kobau Star Party.

arrived in fine shape and even after all the jostling required only a minor tweak to perfect the collimation. That night I enjoyed many wonderful views of the rich starfields that adorn the Cygnus and Sagittarius Milky Way — all with a 22½-pound package that fits into the overhead luggage compartment of a commercial airplane.

As satisfying as the views are, I have to confess that half the fun of having a scope like this is simply carrying it around from airport to airport and in and out of taxis. There's something sublimely cool about carting about an 8-inch telescope as a piece of carryon luggage. I'm confident that this telescope will be my companion whenever work (or pleasure) finds me on a plane headed to dark skies.

Gary Seronik *is an avid telescope builder and serves as this department's editor. He likens telescopes to golf clubs — for any given situation, there is only one that will be just right.*