## Telescope technology

# The new Dobsonian revolution

*The simplest telescope undergoes a high-tech redesign.* **by Michael E. Bakich**

We can trace the start of today's hottest trend in amateur astronomy — short telescopes with large apertures — to the 2008 Okie-Tex Star Party held at a dark site near Kenton, Oklahoma. During the 8-day event, Rick Singmaster, owner of Starmaster Portable Telescopes, in Arcadia, Kansas, debuted his company's new 16.5-inch FX Dobsonian reflector (Dob), which boasted a focal ratio of f/3.7. The one characteristic about this scope that had all the participants buzzing was that when aimed at the zenith, the eyepiece height stood a scant 64 inches (1.6 meters) above the ground.

Mike Lockwood, who runs Lockwood Custom Optics, located near Philo, Illinois, also attended this star party. A mirror-maker since the late 1980s, he had ground, polished, and figured all the mirrors for Singmaster's FX scopes. Lockwood brought a 30-inch f/3.77 Dob that he had built with telescope-makers Mike Conron and Bob Nonnemann. Because of its mirror's focal length, this scope was 20 percent shorter than existing instruments of similar aperture.

Together, Singmaster and Lockwood would start down a path that would lead to big changes in large Dobs. In so doing, they, and others like them, may eliminate a major complaint in the hobby: Owners (and prospective owners) of large Dobs hate to climb ladders.

**Since the 1960s, when Dobson introduced his design, amateurs have found this type of scope easy to make.**

**Rick Singmaster,** owner of Starmaster Portable Telescopes, shows off two telescopes that helped launch the new Dobsonian revolution. Starmaster's 20-inch f/3.7 FX model (left) stands just a bit taller than Mike Lockwood's 20-inch f/3 "test" Dob (right). Starmaster Portable Telescopes

### Revolution, part 1

Chinese-born (of American parents) astronomy popularizer John Dobson (born 1915) spent 23 years in a Vedantan monastery trying to understand the universe. Upon leaving in 1967, he helped found the San Francisco Sidewalk Astronomers. This group, as its name indicates, uses telescopes that members set up on city sidewalks to promote astronomy to the public and to schools. Dobson's best-known accomplishment, however, is the development of a simple and cheap instrument that combines a Newtonian optical tube assembly with an altitude-azimuth (alt-azimuth) mount. The pairing resulted in the Dobsonian telescope.

Because the tube rides atop the mount's cradle, the two parts separate easily for transport. Since the 1960s, when Dobson introduced his design, amateurs have found this type of scope easy to make. Simple materials make it less costly than other configurations.

Many astronomy clubs continue to conduct telescope-making workshops for members who purchase a kit of materials and build a small Dob. For most, this will be their first scope. On the other end of the scale, some intrepid amateurs have produced truly mammoth instruments.

It didn't take long for telescope manufacturers to see the advantages inherent

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**Star parties** like the 2009 Chiefland Star Party in Florida often feature numerous big Dobs. From left to right in this picture are five Starmaster models: a 30-inch f/3.7 FX, a 20-inch f/3.7 FX, a 28-inch f/3.6 FX, a 30-inch f/3.3 SFX, and a 16.5-inch f/3.7 FX. John VeDepo

in the design. Models with apertures of 6 and 8 inches began to appear in the late 1970s. In 1980, Coulter Optical in California became the first to mass-produce large Dobsonian telescopes. The company turned many amateurs into big-Dob users with its Odyssey 13.1-inch and 17.5-inch models.

Today's advanced Dobs include computerized alt-azimuth drives, which will locate any of the thousands of celestial objects in their databases and keep them centered in the eyepiece. Such drives alone don't work for long-exposure astroimaging, however, because the field of view rotates as the drive tracks the object across the sky. Prospective astrophotographers can remedy this with a device called a field derotator. Otherwise, they must keep their exposures short.

In the current market, big Dobs have become popular enough to excite manufacturers with potential sales. Orion Telescopes and Binoculars, for example, recently announced its line of Monster Dobsonian Telescopes. Customers can choose among apertures of 36, 40, and even a colossal 50 inches.

**Lockwood Custom Optics,** located near Philo, Illinois, currently has four mirror-grinding machines with mirror-figuring capacities of 14, 22, 34, and 60 inches. Lockwood Custom Optics

**Al Nagler,** CEO of Tele Vue Optics, mans the Tele Vue booth with his wife, Judi, at the 2005 Photo Marketing Association convention in Orlando, Florida. Michael E. Bakich

## Further development

While at the Okie-Tex Star Party, Singmaster and Lockwood discussed the feasibility of creating telescopes having mirrors of even shorter focal ratios. At the time, Lockwood owned a 20-inch mirror blank, which he figured to f/3 in late 2008. By year's end, the mirror had received its aluminum coating, and Singmaster installed it in a newly completed telescope built just for it.

Side-by-side tests with a Starmaster 20-inch FX f/3.7 scope showed that the images the f/3 mirror produced were nearly indistinguishable from the longer-focal-length instrument. And Lockwood discovered unexpected benefits. The new mirror was only 1¼" thick, so it cooled more quickly than the 1.6"-thick glass in the FX model. It weighed less, too, so the scope was easier to transport. "Also," he says, "the telescope was a more rigid assembly because the struts were shorter." Struts are the poles that connect the boxes holding the primary and secondary mirror assemblies in Dobs.

Lockwood then addressed the main thing driving the demand for the new Dobs: "People are tired of ladders," he says. "Shorter scopes give you more opportunities to observe seated, and you see more detail when you're comfortable."


Tele Vue Optics

**The 13mm Tele Vue Ethos** eyepiece was the first to feature a 100° apparent field of view. Such a design provides spectacular vistas of celestial objects through short-focal-ratio Dobs, but it also will reveal any optical defects.


Tele Vue Optics

**The Paracorr Type 2** is a coma corrector developed by Tele Vue Optics. Its dual function lets a user position all Tele Vue eyepieces for optimum performance. The optical assembly is removable for use in an imaging system.

## Achieving top performance

The reason most manufacturers waited 4 decades after Dobson introduced his telescope to incorporate fast mirrors involves the optical properties of the primary mirror used in a Newtonian telescope.

"For all Newtonian mirrors faster than f/12, opticians must alter the curve slightly from the shape of a sphere to that of a parabola," says Al Nagler, founder and CEO of Tele Vue Optics, located in Chester, New York. "However, this introduces an off-axis aberration called coma, so named because stars outside the center of the field of view increasingly look like comets." Coma gets worse as the true field gets larger and as the mirror's focal ratio gets faster.

Until the development of Nagler eyepieces, another aberration — eyepiece astigmatism — generally masked coma. So in 1989, Al Nagler developed the Paracorr coma corrector. "We weren't the first to create a coma corrector. Professional observatories had used them for years," Nagler says. Tele Vue's model was, however, the first and most popular such device available to amateur astronomers. Nagler explains that coma becomes bothersome to most people when the mirror has a focal ratio of f/5 or faster.

A general way of looking at how the Paracorr performs is to compare the size of a star image as it approaches the edge of the field of view with and without the device in a scope with an f/4.5 mirror. "With the Paracorr, the star becomes 6 times smaller, which means the image intensity increases by 36 times," Nagler says. "So, for example, coma may cause the faintest stars of a globular cluster to become invisible, but if those faint stars are 6 times sharper, or have 36 times the image intensity, they become visible."

With a coma corrector, you also have the potential of the same performance at

> "People are tired of ladders. Shorter scopes give you more opportunities to observe seated, and you see more detail when you're comfortable."
> — Mike Lockwood

**Mike Lockwood gets ready to observe through his 20-inch f/3 test Dobsonian reflector at the 2009 Winter Star Party held on West Summerland Key in Florida. He ground and polished the mirror, and Starmaster Portable Telescopes built everything else. Note how compact the telescope is, even sporting a 20-inch aperture. No ladder required here!** Lockwood Custom Optics

the edge of the field of view as at the center. "For most people, that's great aesthetically," Nagler says, "but there's another benefit: If you don't have a drive, you can start an object at one edge of the field of view and let it drift across. As it does, you'll have the same performance across the whole field of view. This means less adjusting of non-driven Dobs while you observe."

## Enter the Paracorr 2

According to Nagler, two things led to the development of the Paracorr Type 2: "First, we realized that astroimaging requires a virtually diffraction-limited performance across the entire field of view, not just part of it.

"The second thing was that it was clear mirror-makers were capable of — and interested in — making faster optics," he continues. "Specifically, when we saw a 20-inch f/3 mirror that Mike Lockwood produced, I called every mirror-maker I knew to get their reaction. The response was positive, and at that point I realized somebody had to move the ball forward yet again. I said to myself, 'If you build it, they will come.'"

Nagler then called upon optical designer Paul Dellechiaie, who has worked at Tele Vue for some 25 years. Together, they set some parameters for the new Paracorr. It would be for 2" focusers only, and it must have both imaging and visual capability.

Nagler encapsulated what Dellechiaie designed by giving a reference benchmark: "The original Paracorr took an f/4.5 mirror and made it act like an f/12 without the Paracorr [with respect to coma]. The new Paracorr will take an f/3 mirror and make it act like an f/12! And not just f/3 — every focal ratio benefits."

In essence, at f/3, the Paracorr Type 2 makes star images at the edge of the field of view 25 times smaller than they will appear without any coma correction. "That's an intensity increase of 625 times!" says Nagler.

Singmaster has a high regard for Tele Vue's Paracorr. "After looking through the original Paracorr using an Ethos eyepiece with a 100° field of view, I was astonished to find that the image quality was outrageously good — almost to the edge of the field," he says.

"Then Mike [Lockwood] and I worked with Al [Nagler] in developing and testing the new advanced model of the Paracorr. The images through the Ethos eyepieces are sharp to the edge of the field with only the slightest falloff at the extreme edge when observing bright stars. When I saw that, [Lockwood] and I looked at each other and said, 'Well, Al Nagler just gave us permission to bring f/3.3 telescopes to market.'"

## The revolution is upon us

Amateur astronomers who want big Dobs but aren't keen on climbing ladders have responded well to the new developments. According to Singmaster, "I'm now selling 90 percent fast scopes and only about 10 percent slow ones."

Lockwood agrees. "We're seeing orders coming in for large, fast mirrors," he says, "I'm quite busy."

Nagler sums up what's happening to Dobs like this: "Everything is adding up. Mirror-makers have gone to the fastest speed, which allows much more true field for a given aperture. We've got better eyepieces, and we can eliminate the ladders. To me, it could be another renaissance in Dobsonian technology."

That statement is music to the ears of today's amateur astronomers who desire the light-gathering power of a big Dob in a small package.

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