# ASTRONOMY TECHNOLOGY TODAY

Your Complete Guide to Astronomical Equipment

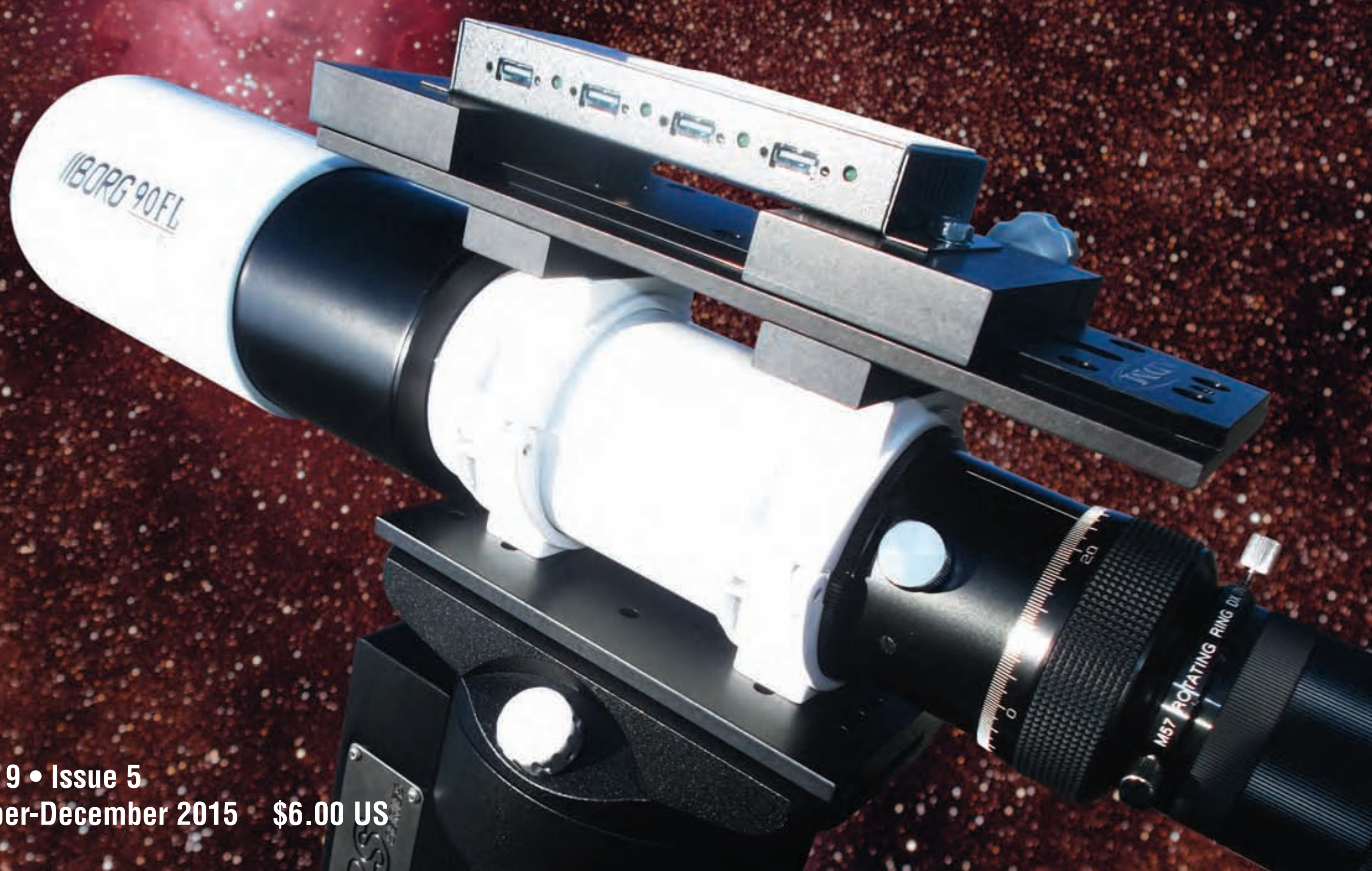
LUNATICO ASTRONOMIA'S SELETEK PLATYPUS AND FIREFLY • AURORA CLOUD SENSOR III

DISCOVERY TELESCOPES PREMIUM DHQ NEWTONIAN REFLECTORS

STARLIGHT INSTRUMENT'S NEW POSI-DRIVE MOTOR SYSTEM

# The Borg 90FL

## Light, Fast, and Fantastic!





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## Cover Story: Pages 37-43

Our cover features a Borg 90FL apochromatic refractor set up for astrophotography. Because it is a Borg, the specific telescope pictured is an assembly of highly-configurable modular components. The heart of this Borg system is a native 90-mm, f/5.6, 500-mm focal length fluorite-lensed objective assembly with lenses by Canon Optron of Japan. Frequent contributor Mark Zaslove used a configuration of the Borg 90FL set up at f/4 to capture the background image of the M8-M20 (Lagoon and Trifid nebulae) region of Sagittarius, spanning 151 by 225 arcminutes, with a QHY10 CCD camera with an APS-sized sensor.


## In This Issue



## Industry News/New Products



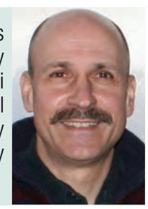




# ATT Contributing Writers

**David Ellison** is a retired anesthesiologist who lives with his patient wife of 27 years, and an old gassy dog. He's an amateur machinist, an advanced woodworker, and he runs the "Astronomy Hacks" user group on Yahoo. David has a small home observatory in Chattanooga , TN , and travels to star parties for dark site imaging. He uses his photographs to introduce younger people to astronomy.

**Austin Grant**, a high-school Chemistry and Biology teacher, is a self-described perpetual hobbyist, experienced in such areas as building computers and repairing arcade equipment. Austin stumbled into astronomy several years ago and it soon became his primary interest. Being a child of the digital age, it didn't take long for him to find digital astro-imaging and he sold his last pinball machine to fund his current imaging rig. Austin shares his passion for stargazing with his students.



**Dr. James Dire** has an M.S. degree in physics from the University of Central Florida and M.A.and Ph.D. degrees from The Johns Hopkins University, both in planetary science. He has been a professor of physics astronomy at several colleges and universities. Currently he is the Vice Chancellor for Academic Affairs at Kauai Community College in Hawaii. He has played a key role in several observatory projects including the Powell Observatory in Louisburg, KS,which houses a 30-inch (0.75-m) Newtonian; the Naval Academy observatory with an 8-inch (0.20-m) Alvin Clark refractor; and he built the Coast Guard Academy Astronomical Observatory in Stonington, CT, which houses a 20 inch (0.51-m) Ritchey–Chrétien Cassegrain telescope.

**John O'Neill** is a retired advertising and marketing consultant living in Seminole, Florida and is a member of the St. Petersburg Astronomy Club. Over seventeen years ago, he started into the world of astro imaging, using film, then upgraded to CCD cameras with color filters. Visit his website at http://www.oneilladvertising.com to view a number of his images.

**Mark Zaslove** is a two-time Emmy Award winner and recipient of the coveted Humanitas Prize. Mark is a born-again astro noobie, who once had an Optical Craftsman scope as a kid, and is now recapturing his youthful enthusiasm(with a digital twist) and having a lovely time doing it.



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## Industry News/New Products











# Discovery Telescopes Premium DHQ Newtonian Reflectors

By Dr. James R. Dire

Fifteen year ago, I bought my first Discovery telescope, an 8-inch f/5 Newtonian. The optics were great. The telescope is still in use on my brother's ranch in the Texas Hill Country. A few year later, I purchased a Discovery 8-inch f/6 Newtonian for my son for his 21st birthday, and the slower focal ratio provided virtually coma-free viewing.

Fast-forward to 2005, when I purchased a Discovery 8-inch f/7 Premium DHQ Newtonian to use as the main imaging instrument in my backyard observatory (**Image 1**). Although configured as a Dobsonian, I removed the optical tube assembly and mounted the scope on a Parallax HD150 German equatorial mount using a set of Parallax tube rings.

The optics were contained inside a solid *Sonotube*-like tube with a flat-black interior finish and a nice glossy-black exterior. This material has very low thermal expansion and less flexure than Newtonians made with thin sheet metal tubes. The four-vane spider, secondary-mirror assembly and primary-mirror cell were much higher quality than similar components in then imported 8-inch Newtonians. The only thing that could have been improved was the focuser. Back then, the standard focuser was single-speed 1.25-inch rack-and-pinion version. Still, I had little difficulty achieving focus for CCD or DSLR imaging.

Most of my images with this scope were taken with a Canon 30D DSLR camera or a SBIG ST-2000XCM CCD camera – the focuser handled the weight of either without flexing. **Image 2** is a 55-minute prime-focus exposure of the Horsehead Nebula (IC434) taken with the 8-inch 1422-mm focal length Discovery telescope. **Image 3** is the same configuration with a 25-minute exposure of the Pinwheel Galaxy (M33). Both images demonstrate that high-quality images can be obtained with a fairly inexpensive 8-inch Newtonian telescope. At f/7, there is no hint of coma in the images, and stars all round out to the edges of the images.

**Image 1 - The author previously used this Discovery 8-inch f/7 optical tube assemble in a roll-off roof observatory.**

Newtonians are by far much less expensive to manufacture per inch of aperture than any other telescope design. And Newtonians with high-quality optics provide exceptional views and images. I am partial to f/6 to f/8 Newtonians, since the longer focal lengths yield higher magnification and require smaller secondary mirrors, thus less obstruction of light for the primary. These middle-of-the-road focal ratios are also better for imaging than optically much-slower Cassegrain and catadioptric designs.

Discovery still makes the 8-inch f/7 Dobsonian, the smallest aperture in their Premium DHQ line. They now come with a quality 2-inch single-speed focuser. Each scope is also supplied with a 25-mm Plössl eyepiece, a Telrad finder and tube covers. I

Image 2 - IC434, the Horsehead Nebula, taken with a Discovery 8-inch f/7 Newtonian.

Image 3 - M33, the Pinwheel Galaxy, captured in a 35-minute exposure with a Discovery 8-inch f/7 Newtonian.

don't think there is a finer production 8-inch Newtonian sold in America!

Recently, I was searching for a permanent telescope for a small domed observatory located on the island of Kauai. My dome is 10 feet in diameter and has a 24-inch wide shutter. The dome size is ideal for a 10- to 12-inch telescope with a small refractor for guiding.

I contacted Discovery Telescopes to see if they would make me a 10-inch f/6 optical tube assembly with a quality 2-inch focuser. I was happy to find out the standard focuser was a JMI EV-3. I opted to pay a little extra and get the JMI EV-1 focuser, since it was dual-speed, and I could eventually motorize it. I own telescopes with other high-quality name-brand focusers, but this focuser is one of the nicest one I have ever used.

I used another set of Parallax tube rings

**Image 4 - Discovery 10-inch f/6 optical tube assembly mounted in a small domed observatory on Kauai.**

**Image 5 - The JMI EV-1 focuser.**

(thanks Joe) to attach the telescope to a Paramount ME German equatorial drive (**Image 4**). The length of the tube was perfect, giving me six or more inches of clearance away from anything attached to the dome (like the lower shutter motor).

First light was on the nearly full Moon with a 31-mm Tele Vue Nagler eyepiece. My friend, Tom Ellis, and I both agreed it was the finest view of the Moon our eyes have ever seen in a telescope. A week later, we viewed every Messier object along the Milky Way between M6 and M27 with a couple of side trips to M13, M57 and Omega Centauri. The views were outstanding. Even with the huge 82-degree field of view of the 31-mm Nagler, we saw no hint of coma!

**Image 5** shows a close-up view of the focuser with this behemoth eyepiece. The focuser only has one setscrew, barely visible in the image behind the right side of the eyepiece. But with the compression ring, it firmly holds this heavy eyepiece and my SBIG CCD camera!

There is a course-focus knob on the left and a course/fine combination knob on the right. The white graduated ring and brass pointer on the right focus knob make recording focus points easy for quick eyepiece changes. The graduated ring also makes focusing for CCD imaging go much faster. I also observed no focus shift when tightening the lock screw.

I did not realize until the telescope arrived that it would have curved vanes holding the secondary mirror assembly (**Image 6**). These vanes completely eliminate star diffraction spikes like those seen in Image 2.

The primary mirror and mirror cell (**Image 7**) were not installed in the optical-

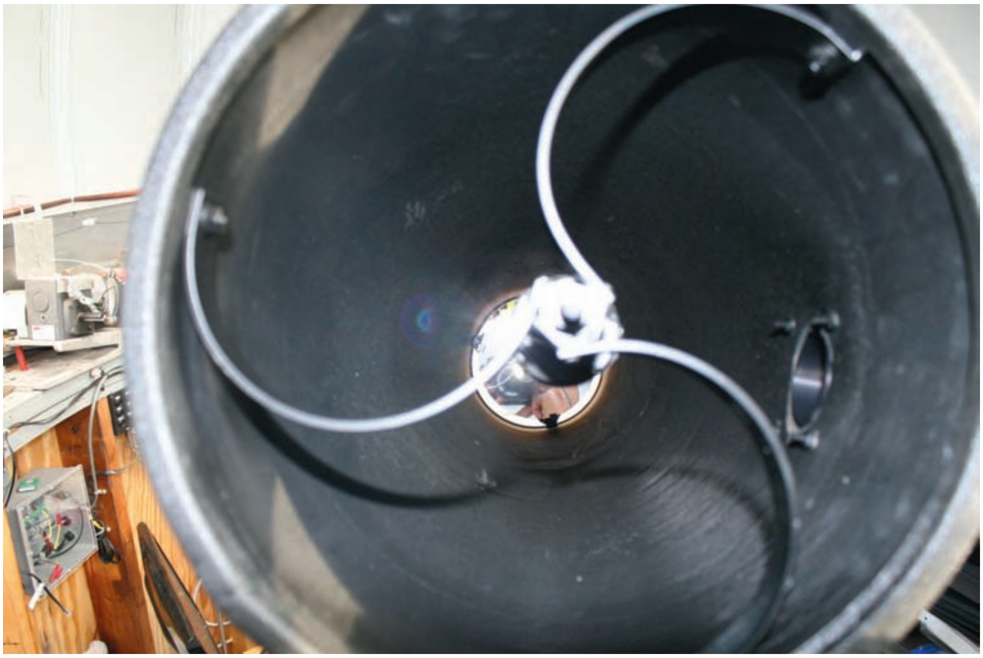

Image 6 - Curved secondary vanes on the Discovery 10-inch f/6 telescope.

tube assembly during shipping. They were packaged separately with lots of foam wrapping in a smaller box inside the box containing the tube. The primary mirror is 1.5 inches thick and center-marked for using a collimation tool.

The primary mirror-secondary mirror separation in the tube was designed so that most eyepieces will focus within the focuser drawtube range. However, as I experienced with my former Discovery 8-inch f/7 telescope, there was not enough back focus for using a camera. This is a common problem with larger focal ratio Newtonians.

After measuring the drawtube extension with the 31-mm eyepiece in focus, I calculated I would have to move the primary mirror 1.5 inches closer to the secondary to have enough back focus for CCD imaging. So, I drilled new holes for

**Image 7 - The 10-inch f/6 mirror and mirror cell. The mirror is center marked for using a laser collimation tool.**

**Image 8 - The primary-mirror collimation wing nuts for the Discovery 10-inch f/6 telescope.**

the mirror cell (with it removed, of course) 1.5 inches closer to the secondary. After reassembling and collimating the optics, I had the perfect amount of focuser drawtube motion to focus either of the previously-mentioned cameras. For visual use, I just install an extender into the focuser before inserting an eyepiece.

The back of the mirror cell appears in **Image 8**. The floatation system is simple but rugged. There are three large collimation wing nuts, and the springs are heavy-duty – locking bolts are not required in the design.

The telescope holds the collimation quite well. The design provides for ample airflow behind and around the primary mirror to facilitate cooling. But since my dome is not air-conditioned and the interior temperature typically reaches 90-100 degrees in the late afternoon, I have added a 12-volt cooling fan behind the mirror cell. If I open the dome at sunset and start cooling the mirror, the mirror reaches ambient temperature by the end of twilight.

After a quick focus check, I am ready for imaging before the background sky is black. With only a 13-degree (Fahrenheit) average diurnal temperature variation on Kauai and a 10-degree summer-to-winter temperature variation (both in average high and low temperature), I am virtually making no adjustments to the focus position for nightly imaging.

One note of importance is that, due to the open design of the rear of the OTA, I have to cover the rear of the tube during imaging. Even the small amount of red light from my power strip switches can ruin an image when incident on the rear of the mirror. After the mirror is cooled, I just replace the thick black vinyl tube cover over the bottom of the tube.

A computer inside the dome controls

**Image 9 - Thirty-minute exposure of globular star cluster Messier 10 with the Discovery 10-inch f/6 telescope.**

**Image 10 - Three-hour exposure of the Owl Nebula, M97, taken with the Discovery 10-inch f/6 telescope.**

the telescope mount, dome shutters, dome rotation, and the cameras. When I start an imaging run, I secure all lights inside the dome and power down the computer monitor. I control the computer in the dome remotely over a LAN from outside the dome, so the inside of the dome remains dark and vibration free during imaging.

Discovery Telescopes have been in business since 1991. All telescopes and components are handcrafted in their California facility – only their eyepieces are imported. They specialize in Newtonian optics, and their Premium DHQ line has 8-inch f/7, 10-inch f/6, 12.5-inch f/5, and 15-inch and 17.5-inch models that can be made f/4.2 or f/5. These models can be ordered with a split-tube design, meaning the tube can be disassembled into two pieces for easier transport. The three largest sizes mentioned above can be ordered as truss-tube Dobs, too!

So how does the Discovery 10-inch f/6 PDHQ telescope perform with CCD imaging? During my first night of imaging, the seeing was 2.5 to 3 arc seconds – poor for our location. So I selected a few targets that would turn out okay under those conditions.

My first object was the globular cluster M10 (**Image 9**). Star clusters in the Messier Catalog are easier to image than other deep-space objects, because they are brighter and require shorter exposures. This image is a 30-minute exposure using an SBIG ST-2000XCM single-shot color CCD camera. The stars are nice and round all the way out to the edge of the image. The colors of the stars are deep, ranging from red to blue, and an uncountable number of stars are resolved. I even picked up a couple of faint galaxies at the 5-o'clock position on the edge of the cluster.

My second object was M97, the Owl Nebula (**Image 10**). The combined exposure was three hours using the same CCD camera. This was the longest exposure I have taken of M97 and the longest focal length telescope (1524 mm) I have used to image it. Besides the normally seen blue disk with the two "owl" eyes, I was able to capture the fainter outer ring of the nebula, which contains more red emissions. In previous imaging of M97 with smaller telescopes, I was able to capture the three 16th-magnitude stars that surround the Owl's southern eye. In this image, I was able to capture two even fainter stars superimposed of the nebula's northern edge.

Discovery Telescopes makes excellent Dobsonian telescopes with the finest production Newtonian optics made in America. They are excellent for any type of celestial viewing, and as I have demonstrated, the Premium DHQ optical tube assemblies make excellent imaging telescopes at a fraction of the cost of a similar-sized refractors, or any other reflector design. ATT