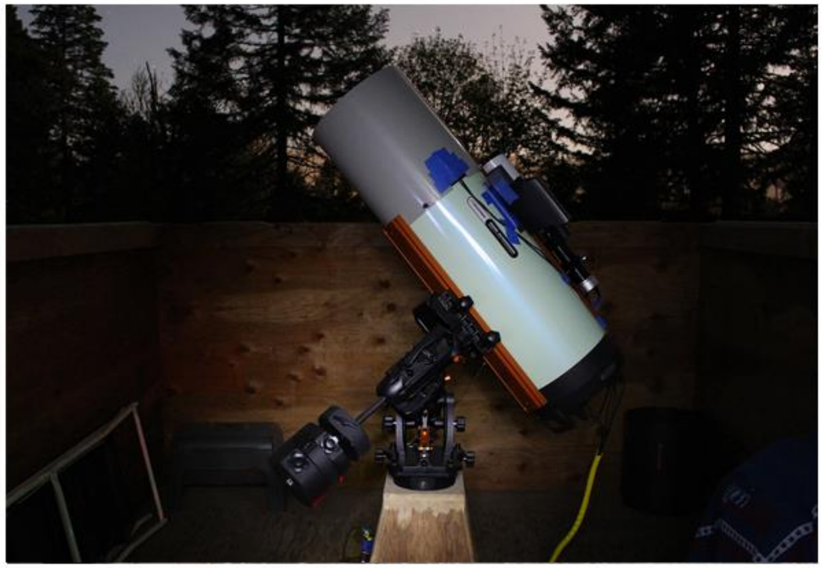
There's a lot to like in Celestron's new CGX Equatorial Mount. It's designed to handle a 55-pound payload, fitting neatly into the Celestron mount lineup midway between the 30-pound-rated AVX and 90-pound-rated CGE-Pro. It's an all-new design, too, which became apparent the moment I opened the shipping box, but I'll get to that in a moment.

For years the CGEM has defined the standard as the mid-range equatorial mount for backyard astronomers and celestial imagers. The CGX is the new CGEM: it's beefier but more compact, and (at long last!), it has a USB 2.0 port for control by a remote PC. The CGX is light enough to take to a dark-sky site yet hunky enough to swing an 11-inch SCT with aplomb as the centerpiece of your backyard observatory. Tap the telescope and vibrations damp out quickly. And it has home switches on both axes and an internal real-time clock so you can turn on and calibrate the mount from any starting position. I really like that one. Plus you find lots of new features you might not appreciate right away.

What you do appreciate the moment you slice open the shipping box and fold back the cardboard flaps are the handles. There are two: one is on the base and the other is on the top of the declination axis. They are big, solid handles. In my notebook, I wrote, "The handles are genius! I could not have lifted the equatorial head right out of the box without them. With the handles, you have a solid, controlled grip. They make it easy to lower the CGX onto the tripod, too. I like the latitude adjuster: very smooth and fast. Azimuth was easy to adjust." And it turns out that the necessary 8mm hex wrench is clipped under the handle on the base ready for use. Those who have struggled with unwieldy equatorial heads will immediately appreciate the thought that has gone into these features of the CGX.

The CGX is a handsome beast. It looks really good: the flanges and design detail suggest strength and stability. I noted, "Good placement of power and hand control connectors. I plugged the hand control into Aux 1 and it worked." Aux 2 supports the optional StarSense or SkyPortal WiFi. The auto-guider plug and a USB 2.0 port are located on the side of the polar axis. The tripod is solid and sports an extra-large tray for eyepieces and accessories.



Richard Berry's Observatory Set-up
TELESCOPE: RASA 11" with CGX

My plan was to test the CGX in two different ways. First, I wanted to evaluate it as a mount for out-of-town imaging at a dark-sky site. The ease of lifting the 45-pound equatorial head and setting it on the 20-pound tripod would be a big plus in that regard. For portable deep-sky observing, I decided that my lightweight 8-inch f/4 Newtonian was the best choice. It has excellent optics, so I could check out the CGX visually with low and high powers, and I could also make images with a digital SLR camera to evaluate the mount's tracking for short exposures.

Second, I wanted to determine how well the CGX would serve as the principal attraction of my small roll-off-roof observatory. Since the base of the equatorial head is designed to drop over and bolt to a 6½-inch O.D. steel pipe, the CGX comes ready and willing to serve atop a permanent pier in an amateur's backyard observatory. For the observatory setting, my plan was to load it down with my rather heavy 11-inch f/2.2 Rowe-Ackermann Schmidt Astrograph—the RASA—and its guide telescope. Could the CGX meet the needs of serious long-exposure imaging?

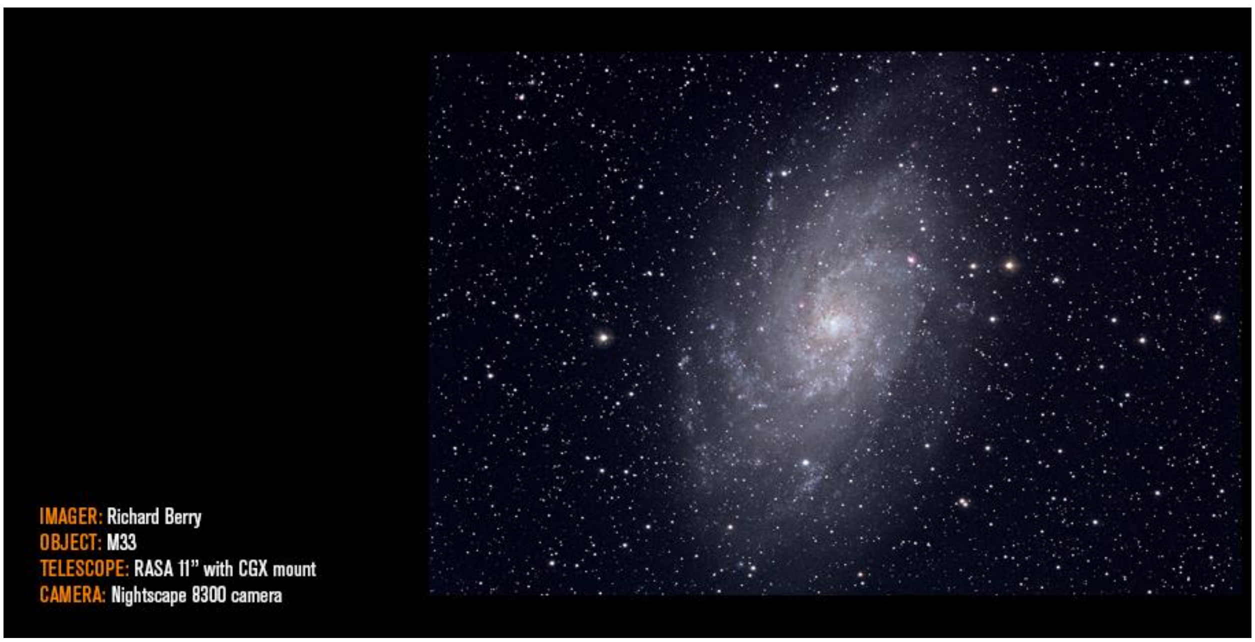
Because the Moon was too bright for imaging when the CGX arrived, I began with the portable observing scenario. I stretched a canvas drop cloth on the ground, placed the tripod (with its jumbo-sized accessory tray) in the center, set the equatorial head in place, and added the counterweight. The CGX head accepts both narrow and wide dovetails, so the narrow dovetail on my Newtonian posed no problem. I set up a camping table beside it to hold my eyepieces, camera, and star charts. A portable 12-volt "car starter" supply from Sears provided power for the CGX.

The first thing I noted when it powered up is that initialization has become much easier. The CGX begins by seeking its "home" switch and then proceeds to the standard two-star alignment. The second thing I noted is how quiet the slews are. Even at the highest rate, slewing makes a businesslike whir. Slow speeds are virtually silent! When you're observing at high power, you press a button and the star moves. No fuss and no muss. Star parties will sound more pleasant without the buzz of little coffee-grinders all around you.

As a long-time telescope maker, I am always on the lookout for any shake, wobble, or looseness that a few turns with a wrench might cure. I push, pull, tap, tug, thump, and wiggle any telescope I encounter. The CGX does very well in this respect. A sharp rap on the telescope tube damps out in a few seconds, and it's possible to focus even at high power without undue wiggle and wobble. Visual observers especially will appreciate the improved stability.

And I always want to know how things work. So I took out my #1 Phillips-head screwdriver and removed the covers on the RA and Dec drive gears. Celestron's engineers have redesigned the drives. The stainless-steel worm rides in a spring-loaded assembly against a 180-tooth brass gear. Spring loading means the worm engages the gear with a constant force of about five pounds, so they always mesh properly. In addition, the worm is belt-driven and the belt is under light tension, so there should be less backlash than found in the classic spur-gear and fussy-to-adjust worm-gear designs. As I noted earlier, these drives are quiet when slewing and almost silent when guiding.

How well does the CGX track? To answer that question, I placed my DSLR camera at the focus of the Newtonian and took some time exposures. With an 800 mm focal length, unguided 60-second exposures produce reasonably round star images. With today's remarkable CMOS sensors, even 30 seconds exposure is enough to capture many deep-sky objects, and a stack of 20 to 30 such exposures is quite enough to produce an excellent deep-sky photo of any Messier object.



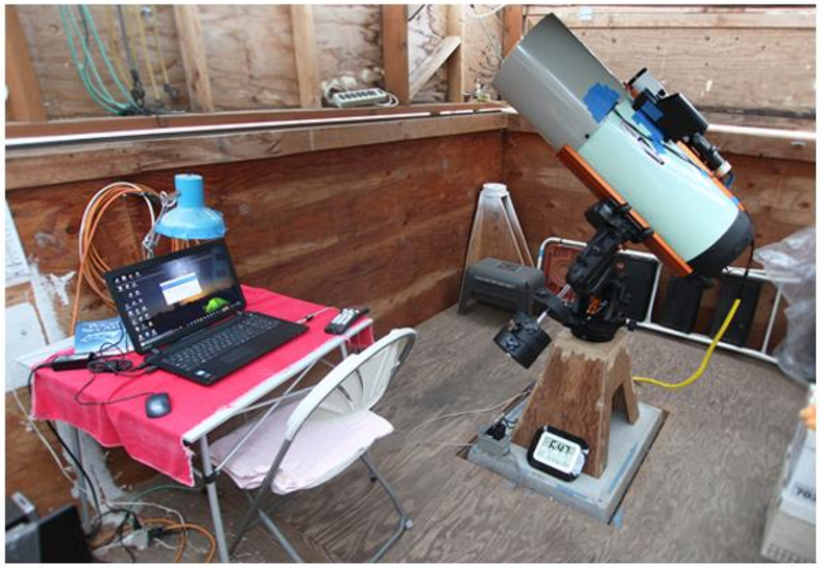
Back in the olden days, periodic errors in clock drives often ran as large as 60 arcseconds peak-to-peak. To see how the CGX would do, I made a series of five-minute exposures while holding down the declination slow-motion button at the lowest rate. This produced north-south star trails. Over any 60-second interval, the peak-to-peak error proved to be under 2 arcseconds, and often less. For an observer who wants to get started in astro-imaging without a lot of complexity, the CGX can do the job. Longer exposure times will require near-perfect polar alignment and/or guiding.

After a week of visual observing and test exposures with my camera in the middle of a grassy field, I was ready to move the CGX to a permanent pier in my small roll-off-roof observatory. Instead of the lightweight Newtonian, I wanted to evaluate the CGX carrying the much heavier load of my 11-inch f/2.2 Rowe-Ackermann Schmidt Astrograph—the RASA—and its guide refractor. Ultimately, I'd like to operate the mount, telescope, CCD camera, and guider remotely from my home office. Could the CGX do the job?

Bolting the CGX to the top of a permanent steel pier would be easy; any machine shop could handle making a suitably solid pier. For remote observing, the CGX provides two levels of protection against driving the telescope into the pier; first, you can configure the mount via the hand control with "soft stops" to prevent slewing or tracking too far. Second, the CGX has internal mechanical "hard stops" that cut off the motors if you should accidentally slew into an extreme position. Another plus for remote imaging is that the cabling on the CGX is internal, so there's no dangling wire to the declination motor. Fewer wires mean fewer potential tangles.

As a general rule, I don't like to place a heavy telescope on its mount without help, but the jumbo dovetail clamp handles made this tricky job considerably easier. I balanced the RASA nose-down on a sturdy box covered with towels and swung the polar axis so the dovetail head was at the same height as the RASA dovetail. Maneuvering the RASA's into place was easy enough, and so was clamping them firmly. Then I cautiously added one, then two, then three counterweights. It took four counterweights to reach the balance point. After a few iterations, I had the tube balanced in both axes. With the RA and Dec axes unclamped, the heavy RASA swung smoothly and freely to any position, and the CGX carried the load without difficulty. It seemed almost to be floating. With the clamps fully set, the RASA felt solid. I pushed and tugged on the tube to see if there were unwanted shakes; aside from a slight bounciness in the RA axis, there were none. Since the RASA is both longer and heavier than a standard C11 or EdgeHD 11-inch, the CGX should handle those instruments easily.

I was also pleasantly surprised how smooth polar alignment turned out to be. The polar altitude and azimuth adjusters handled well over 100 pounds of mount, telescope, and counterweights without complaint. To evaluate and test the setup for no-hands operation, I placed my laptop and the hand control on a table six feet from the CGX and RASA. I dressed the RASA and its guide refractor with power and signal cables and trailed them off the lower end of the tube, then powered up the CGX and pointed the RASA in all directions, checking against tangles or snags. This is the time to set the software slew limits in the hand control, and to make sure that the telescope tube won't collide with the pier. As soon as that was done, of course, the clouds rolled in.



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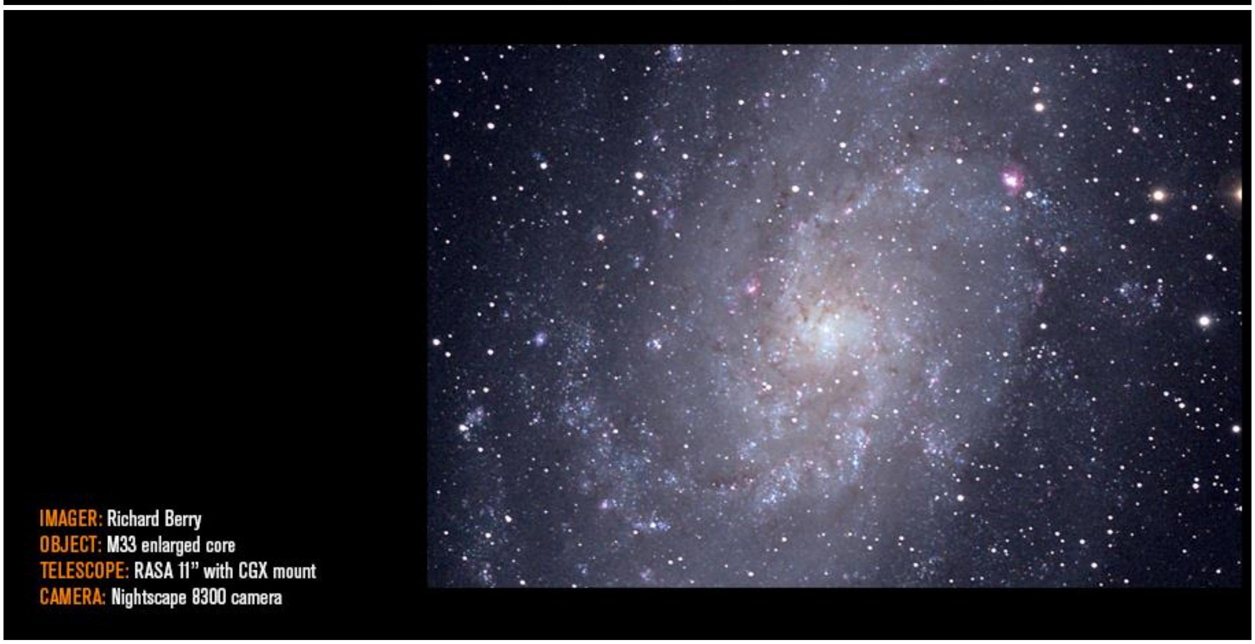
After the initial setup in my observatory, I spent three partially clear dark-sky nights with set-up and testing. The first night I spent getting everything focused and balanced, did a careful sky alignment, then hibernated the CGX. The second night, I woke up the CGX, fired up the guider, and ran a series of tests that were interrupted again and again by clouds. I wanted to determine the best combination of autoguiding rates (set with the CGX hand control) and guider aggressiveness set in the guiding software. I also checked to see how the CGX would respond when I gave the RASA's tube a solid thump with my fist; as long as the star had not been bounced entirely outside the guide-star box, the mount and guider recovered quickly. The guide error log suggested that, aside from my test thumps, I could expect guiding errors under 0.6 arcseconds R.M.S. during a 60-minute run.

On the third night, I was ready to take images. A beautiful crescent moon lay low in the western sky among scattered clouds. On the hand control, I pressed "Solar System," scrolled to "Moon," pressed "Enter," and the CGX slewed south and westward. I shot a quick test image, and the moon was there in the frame. After touching up the focus, I shot six images of the old moon embraced in the arms of the new lunar crescent. Before a solid cloud deck moved in at midnight, I shot over 20 guided test exposures of the North America Nebula and the Andromeda Galaxy using 300-second exposures with the Rowe-Ackermann. Stars in these image frames were perfectly round.



The real proof came the next night, after a day of bright blue skies. After the Moon set, I rolled back the roof of my observatory, put my laptop computer on the table, powered up the RASA's CCD camera, the guide refractor camera, and then powered on and woke the CGX from hibernation. Go to M33. The CGX slewed and settled on the spiral galaxy. I checked focus in the RASA, set the guider to guiding, and began the night's imaging.

In summary, the CGX has proved it can do the job. I'm impressed with the thoughtful, clean mechanical design embodied in the CGX. The CGX handles the hefty tube and guide refractor of the Rowe-Ackermann like a champ. Five-minute-long sub-exposures with the RASA on the CGX mount show round star images in hours-long imaging sequences. And since I was running the whole system hands-off from a table six feet away, the CGX has shown itself friendly to remote imaging. I look forward, in the near future, to testing the Celestron/Planewave Telescope Control Software, running the CGX through its USB port from a remote PC. Celestron's engineers have created an all-new good-looking mid-range mount to their AVX-to-CGE-Pro series, a mount capable of carrying a 50+ pound payload with aplomb. I fully expect it to be a great performer both in the field and in the amateur astronomer's observatory.

Richard Berry is a lifelong amateur astronomer, editor, programmer, astro-photographer, and writer. He has designed rocket payloads, edited a major magazine (*ASTRONOMY*), written software for plotting sky maps and astronomical image processing, authored *Build Your Own Telescope*, and coauthored *The CCD Camera Cookbook*, *The Handbook of Astronomical Image Processing*, and *Telescopes, Eyepieces, and Astrographs*. He continues to shoot images and pursue observing from his home in rural Oregon.