Meade's RCX400: Raising the Bar

Can the first radically new telescope design in more than 30 years live up to its advertising hype?

By Dennis di Cicco

S&T: DENNIS DI CICCO AND SEAN WALKER

S&T: CRAIG MICHAEL UTTER

WHAT WE LIKE:

- Excellent image quality
- Electric focus and collimation system
- Built-in dew heater

WHAT WE DON'T LIKE:

- Heavier than Schmidt-Cassegrain of same aperture
- Tube is not sealed due to openings around the corrector

Meade has designed its RCX400 telescopes for astrophotographers, but many of the scope's features have major benefits for visual observers. The author spent more than five months testing the 12-inch model shown here, including taking hundreds of images with a variety of cameras. His view of the nebulous complex vdB 142 in Cepheus is the result of 100 minutes of autoguided exposures through red, green, and blue filters with an SBIG STL-11000M CCD camera. The field is about $^1/_2$° wide with east up. Except for the cameras and optional wedge, all celestial photographs in this review were made with only equipment that comes standard with the telescope.

FROM A DISTANCE it looks like any of the ubiquitous Schmidt-Cassegrain telescopes that have blanketed the amateur landscape for more than 30 years. Look closer, however, and you'll quickly see that Meade's new RCX400 is anything but that. With its radically new optical design, the most sophisticated electronics ever offered in a mass-market telescope, and newly engineered mechanics from the ground up, the RCX400 is as revolutionary today as the Schmidt-Cassegrain was when it was introduced in the early 1970s. Furthermore, the RCX400 line of 10- to 14-inch scopes (a 16-inch is due out soon) fills a significant gap that existed between similar-aperture Schmidt-Cassegrains and custom-made Ritchey-Chrétien reflectors. And while they are priced like the former, they deliver performance like the latter.

When Meade announced the RCX400s at the beginning of last year, it created such a buzz in the astronomical community that I visited the company's Irvine, California, headquarters to look at prototypes and talk with people spearheading the project. Our preview of the scopes based on that trip appears in last May's issue, page 86.

At our request, last June Meade loaned us a production model of the 12-inch RCX400. I spent dozens of nights during the next five months testing the instrument, mostly from my front yard in the suburbs 20 miles west of Boston. I used the scope visually and photographically, imaging with cameras that included a Nikon D70 digital SLR, SBIG STL-11000M CCD, and Philips ToUcam Pro webcam. I also did side-by-side tests with a Meade 12-inch f/10 Schmidt-Cassegrain borrowed from a colleague. I stored the RCX400 indoors and set it up outside for each observing session. Because the telescope alone weighs nearly 100 pounds (45 kilograms), many people will find this a two-person job.

At the expense of giving away the punch line of this review, I am extremely impressed with the RCX400. Even when measured against the high expectations set by the RCX400 advertisements, the scope proved to be an outstanding performer.

Heavyweight Player

Meade's 12-inch f/8 RCX400 telescope supplied with an AutoStar II controller, heavy-duty tripod, 2-inch high-transmission star diagonal, 8 × 50 finder, and Meade 24-millimeter (104×) Ultra Wide Angle eyepiece.

US price: $6,799, including shipping in the continental US

Available from Meade dealers worldwide; see www.meade.com for a listing.

Out of the Box

One aspect of the RCX400 that repeatedly amazed me involves something that most people don't even think about when they're considering a telescope: ease of use. Working with the RCX400 was a very pleasant out-of-the-box experience. In a perfect world all products would be like this, but the road to a perfect world took a small detour at the Digital Age. As anyone knows who has recently bought a cordless phone, digital camera, or even a TV with a remote control, products that were once intuitively simple to use now come with hefty manuals and so-called "quick-start" guides that can go on for pages.

Since the RCX400 with its advanced Go To functions, internal electronic focusing and collimation, and built-in dew heater (to mention just the highlights) is the most electronically sophisticated mass-market telescope ever made, it's reasonable for owners to devote several nights to just familiarizing themselves with the scope's operation. That was my plan, but it proved unnecessary.

Two experiences stand out as examples of how easy the RCX400 is to use. One was my first night with the scope. Unpacking the boxes, assembling the tripod, and putting the finder and eyepiece holder on the scope were straightforward enough that I didn't need the manual. I leveled the tripod by eye, set the scope on it, secured it with the single hand-tightened bolt, and plugged in the hand control and AC power adapter. When I flipped the switch on, the hand control displayed several messages as the electronics initialized and then asked for the alignment method. Since "automatic" was offered as the default, I simply hit the Enter key

Until the end of February you can obtain a free PDF version of last May's preview article about the RCX400 telescopes at SkyandTelescope.com/rcx400. Also included are large-scale versions of the celestial images appearing with this story, plus a few additional images.

S&T: DENNIS DI CICCO

The author made a series of side-by-side tests comparing the Meade 12-inch f/10 Schmidt-Cassegrain (left) borrowed from a colleague with the 12-inch RCX400. Meade's high-transmission coatings (UHTC) come standard on the RCX400. Most of the tests and all of the celestial images for this review were made from this location in the author's front yard about 20 miles west of downtown Boston.

S&T: CRAIG MICHAEL UTTER

Most of the RCX400, including its heavy-duty tripod, has been designed from scratch rather than adapted from other Meade telescopes. The tripod legs remove quickly for easy transport, but two of the nicest features are quick-release leg locks that aid in leveling the setup and a spring-loaded center bolt that fully retracts to make connecting the scope a breeze.

and stepped back. The scope spent the next few minutes twirling around and nodding up and down as its internal sensors found true north, determined the amount and direction of any tip in the tripod, and leveled the optical tube.

The system then paused for a moment, displaying a message telling me that data gathered from orbiting navigation satellites by the RCX400's GPS receiver revealed that the scope was in a new location (this happens when you move the scope about five miles or more from where it was last used). The display also showed the name of the town in its database nearest my location and gave me the opportunity to edit the name. This is a mere formality, since the GPS-derived longitude and latitude used internally by the scope are accurate enough to resolve on which end of my driveway I set up the scope regardless of the site's name.

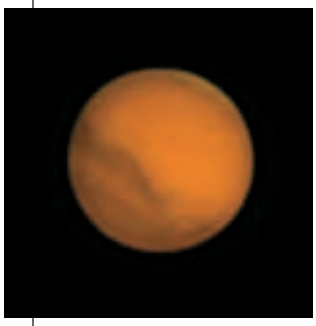
After I hit the Enter key to confirm the new location, the RCX400 thought for a moment and then headed to its first alignment star, in this case Arcturus. When the scope stopped moving, the star was just outside the finder's field. I centered the star on the crosshair and hit the Enter key. Another moment of thinking and the RCX400 headed to its second alignment star, Alderamin (Alpha Cepheus), which is not a star I could have identified by its name alone even though it will be our pole star 5,500 years from now! When the scope stopped slewing I simply centered the brightest star visible in the finder and pressed the Enter key again. I was rewarded with a message stating "alignment successful." I confirmed that things were indeed okay by executing several Go To commands for favorite objects then visible in the June evening sky, all of which ended up very nearly centered in the 0.85°-wide field of the 24-millimeter (104×) eyepiece supplied with the scope.

The entire alignment process took about 5 minutes and I never consulted the user's manual, since messages scrolling across the display always told me what was happening and what I needed to do. Later that night I performed a simple "calibrate-sensor" procedure, which should be done for a new scope, and on subsequent nights the automatic slews to alignment stars placed them nearly on the finder crosshair, making the process virtually foolproof.

My second noteworthy user-friendly experience occurred the first time I tried the scope with the autoguiding feature built into an SBIG STL-11000M CCD camera. As anyone who does autoguiding knows, getting a telescope to play well with an autoguider usually takes several nights of tweaking settings and learning the quirks of the telescope's drives, and I was prepared to do that. (For the record, on an earlier evening I had "trained" the scope's periodic-error correction, which reduced its tracking error to about 6 arcseconds.)

After focusing the camera and connecting the autoguider cable from the camera to the dedicated guider port on the rear housing of the telescope tube, I ran a single calibration routine from the camera's software. This makes short exposures to record star positions after moving the scope in right ascension and declination, "teaching" the system how the telescope moves.

The numbers looked good, so I tried a 5-minute autoguided exposure. The image was perfect, and those who have done autoguiding know what a "gee-whiz moment" it is to see such an image appear on the monitor. I went on to make 15 more 5-minute exposures that night, and every one was a keeper! As amazing as this first attempt at autoguiding the RCX400 was, the real story came after five months of testing and hundreds of autoguided images (most being 10-minute exposures): only one image failed because of unacceptable guiding.



S&T: DENNIS DI CICCO AND SEAN WALKER

While the RCX400's strength is in wide-field imaging, the scope also does well with the Moon and planets. This webcam view of Mars was made last November 12th.

Optics (or Shakespearean Philosophy)

It would be easy for me to spend this entire review talking about the telescope's optics, especially considering the flap that arose on Internet user groups over Meade calling the RCX400s "advanced Ritchey-Chrétien telescopes." (There's more background in last May's preview article.) While Meade made its case for calling its system a variant of the highly respected Ritchey-Chrétien design, some of the scope's critics went so far as to suggest that the RCX400 was little more than a Schmidt-Cassegrain with a new coat of paint. There are pros and cons to both sides of this argument, but what really matters is how the optics perform. Shakespeare summarized it beautifully more than 400 years ago: "What's in a name? That which we call a rose by any other name would smell as sweet."

The pictures here speak for themselves, but the bottom line is that the RCX400 does indeed perform like a Ritchey-Chrétien. The 12-inch model delivers almost perfectly round stars across all but the very corners of the 35-mm-size frame of the

STL-11000M camera. Purists working with this format will probably want the field flattener that Meade has promised, but I'll bet astrophotographers with smaller-format cameras, especially the popular digital SLRs, will opt to forgo this accessory.

Testing the RCX400 against a Meade 12-inch Schmidt-Cassegrain with the STL-11000M camera was a real eye opener. The autoguiding chip in that camera is located 15.4 mm from the optical axis. With the RCX400, guide stars appear round, albeit softened slightly because of the scope's inherently curved focal surface (there was also a slight asymmetry in the brightness of each star's image this far off the optical axis). With the Schmidt-Cassegrain, guide stars looked like sharply pointed little Vs with bright tips. The difference between the off-axis images in these scopes was dramatic, to say the least.

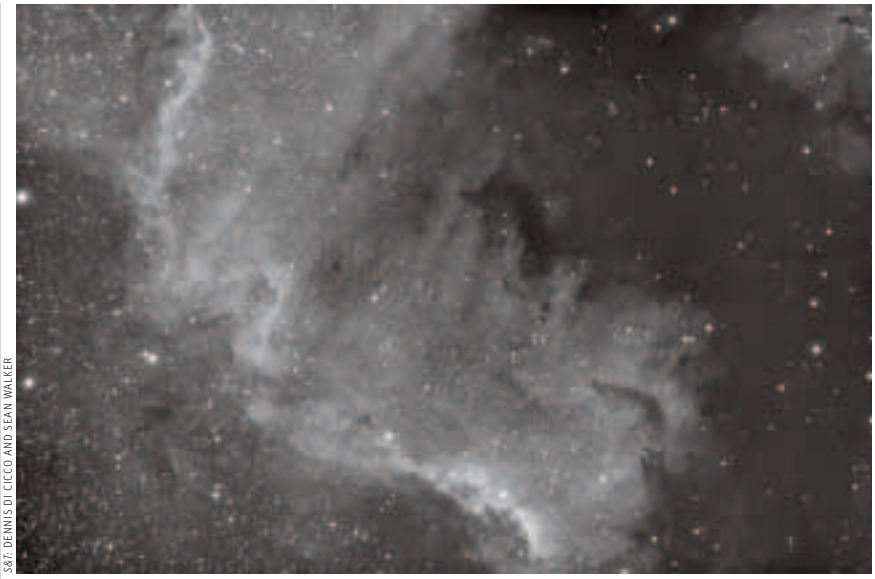
The 12-inch RCX400 worked well when it was fitted with a 0.63× focal reducer and DSLR camera. It produced excellent star images across the full 0.9°-wide field at an effective focal ratio of f/5.

The scope also performed very well visually, though depending on the eyepiece I selected, the difference between the views in the RCX400 and the 12-inch Schmidt-Cassegrain was subtle at best. The 12-inch RCX400 has the largest percentage of obstruction due to the secondary mirror (a little less than 39 percent) of any scope made by Meade, but if this increase caused additional image degradation, it wasn't apparent to my eye. This isn't surprising. Using the rule of thumb set forth by William Zmek (*S&T:* July 1993, page 91), when it comes to viewing low-contrast planetary features, the difference between the 12-inch RCX400 and Meade's 12-inch Schmidt-Cassegrain is equivalent to what one would expect between unobstructed telescopes of 7.4- and 7.9-inch aperture, respectively.

SPECIFICATIONS & MEASUREMENTS

Meade 12-inch RCX400	
US price	$6,799
Effective aperture*	11.94 inches (303 mm)
Central obstruction*	4.6 inches (117 mm), 38.6%**
Focal length*	2,495 mm (f/8.2)
Supplied eyepiece	24-mm Ultra Wide Angle
Magnification	104×
True field	0.85°
Power requirement*	12VDC at ~3 amperes maximum
Weight*	
Telescope	96 lb (43.5 kg)
Tripod	54 lb (24.5 kg)
Wedge	28 lb (12.7 kg)

* measured by *Sky & Telescope*
** expressed as a percentage of the aperture's diameter



S&T: DENNIS DI CICCO AND SEAN WALKER

The most demanding image-quality tests for the RCX400 were made with the 35-mm-format chip in the STL-11000M CCD camera. The results speak for themselves. Except for the extreme left and (more so) right edges, stars remain round and free of flare. This is a full-frame (uncropped) view of the "Yucatán Peninsula" portion of the North America Nebula recorded with 120 minutes of exposure through the camera's red filter. The field is 0.9° wide.

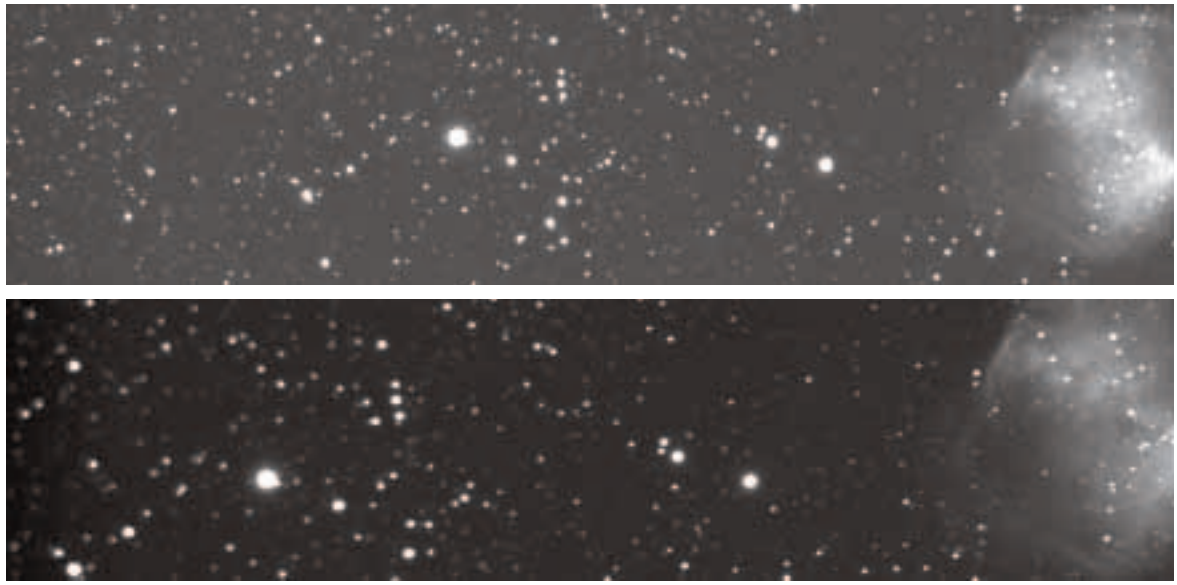
In the preview article I mentioned that the addition of a corrector in Meade's optical design introduces issues of color errors that don't exist in a telescope that has only mirrors. While the laws of optics dictate that some level of error must be present because of the corrector, I found that there was no discernible change in focus between the red, green, and blue filters in the STL-11000M camera, nor were there significant differences in star images recorded through these filters. In short, I saw no detrimental effects due to the corrector.

Electronic Focus and Collimation

Meade took a radically new approach to focusing and collimating the RCX400s. Everything is done with internal motors; there are no add-on accessories. You operate everything from the hand control without ever touching the telescope.

After spending a few minutes learning to operate the focusing system, I fell in love with it. Entering focusing mode is done with a single key press. From there the up/down arrow keys change the focusing speed, while the up/down direction keys (or the left/right keys) drive the focus back and forth. The scope I tested (as well as two others I've tried) had almost no image shift as the focus direction was reversed. And there was no focus or image shift as the telescope was moved around the sky.

There's a digital readout of the focus position (actually the location of the secondary mirror/corrector assembly on its sliding rails) displayed to hundredths of a millimeter. In practice, this readout was highly reliable at placing the focus at a given position. For example, I noted the readings that corresponded to the focus points of several eyepieces, and whenever I changed eyepieces I could always obtain perfect focus by setting the correct number before looking into the eyepiece. This is a bit frivolous for visual observing, but it's a huge benefit for those of us who use a variety of camera setups. The



S&T: DENNIS DI CICCO (2)

The difference in off-axis performance of Meade's 12-inch RCX400 *(top)* and Schmidt-Cassegrain telescopes is apparent in these 5-minute exposures of the Dumbbell Nebula made with the SBIG STL-11000M CCD camera. To preserve as much detail as possible, just a small strip is shown running from the center (nebula) of the camera's 35-mm-format frame to the edge of the long axis. Because of the RCX400's shorter focal length, it covers a 22 percent wider field than the Schmidt-Cassegrain.

user can even preset up to nine focus positions and recall them at the press of a few keys.

In the most critical imaging applications, I could jog the focus enough to detect a change in the image but not enough to change the digital readout. Thus, while the readout alone can be used to achieve "perfect" focus, some tweaking may be required depending on the user's own definition of perfect. Regardless, I've never used an electric focusing system that I liked more than the one built into the RCX400.

In recent years astrophotographers using Schmidt-Cassegrains and other compound optical systems have come to appreciate that the best images come from well-collimated (aligned) optics. And that makes the RCX400's electronic collimation system a very welcome feature.

While I rarely needed to collimate the RCX400 during my months of testing, I found the system very easy to use. All the instructions for adjusting collimation are displayed on the hand control, so you don't have to refer to the manual (a nice touch for a feature that isn't used often). Furthermore, you don't ever have to worry about screwing up the collimation, since there's a default setting that you can return to with the press of a button. And you can even set your own default if you feel it's better than the one that comes from the factory.

S&T: CRAIG MICHAEL UTTER

The construction of the RCX400's moving corrector assembly creates openings that don't exist on conventional Schmidt-Cassegrain scopes. While this assists airflow and reduces the time it takes for the scopes to acclimate to ambient temperature, it also provides access for insects and dust.

Carbon Fiber

One of the cool buzz terms to appear in telescope ads in recent years is *carbon fiber.* In the case of the RCX400, the thermal stability of the carbon-fiber tube is claimed to maintain the scope's critical focus as the ambient temperature varies — something that has been a major problem with metal tubes found on most Schmidt-Cassegrains. And, in the case of the RCX400, it works beautifully! Despite temperatures that often varied by 10°F (5.5°C), I couldn't perceive a change in focus during imaging sessions lasting several hours.

Late one night I critically focused the scope's 24-mm eyepiece when I shut down observing and the air temperature was 55°F. The next day, in the blistering noontime sun when the scope's internal digital temperature sensor read 117°F (black gets hot in the sun!), I barely had to tweak the focus when I began observing stars in the daytime sky (just one of the fun things you can do with a Go To scope).

Dew Heater

As with the electronic collimation, the RCX400's built-in dew heater is unique. And like the collimation system, the dew heater worked exceptionally well. During September and October I experienced several nights with such severe conditions that rivulets of dew trickled down the telescope tube and fork arms and filled cavities in the wedge with pools of water. The RCX400 corrector stayed perfectly clear with the heater set to a 70 percent duty cycle. Indeed, on two nights the dewing was so bad that by morning I had condensation on the scope's primary mirror, yet the corrector remained clear.

While you can power the RCX400 with eight internally housed C batteries, this is not practical if you intend to use the dew heater, since even at the 70 percent setting, the heater alone would deplete the batteries in about seven hours.

The warmth of the dew heater proved to be especially seductive to swarms of mosquitoes prowling around my summer evenings. And on several occasions a few of the little buggers found their way into, but not out of, the tube through openings around the corrector. Other RCX users have commented on dust and pollen getting into the tube through the same openings. While I didn't experience this despite a large stand of pollen-spewing pine trees at the edge of my driveway, I certainly consider it a good idea to keep the metal cover on the front of the telescope to seal the openings when the scope is not in use.

General Mechanics

Overall I was very impressed with the mechanics of the RCX400. The new tripod is solid, and its quick-release leg locks worked well, making it especially easy to level the tripod on uneven ground. The scope too is solid. Set on the tripod in altazimuth mode, with the supplied antivibration pads under the legs, the scope damped vibrations in less than 3 seconds, which is very acceptable.

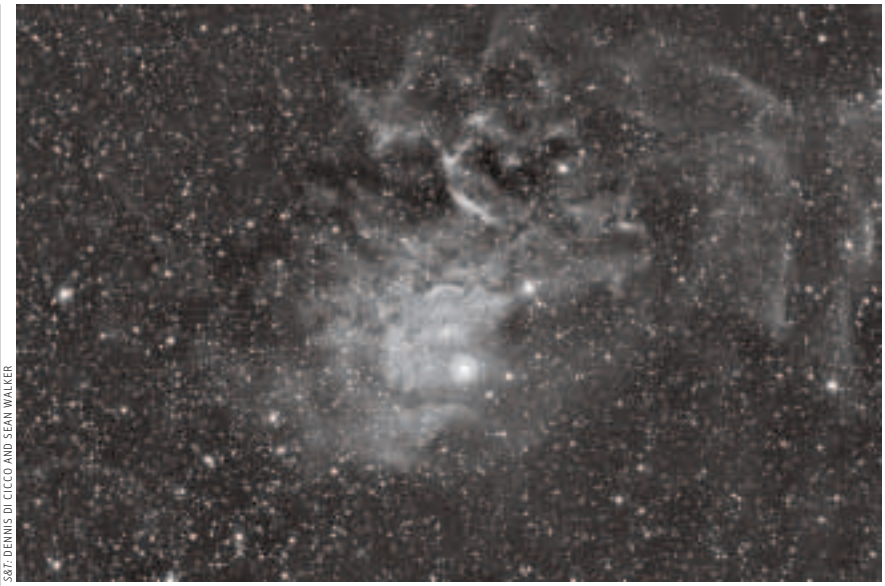
It was another matter, however, when the 12-inch RCX400 was set up in equatorial mode on Meade's new heavy-duty wedge, which is needed only for those people doing long-exposure imaging. Damping time was now 6 or 7 seconds, and at first I was concerned that this was too bouncy for imaging on breezy nights. But, in the end, perception proved wrong; I never lost an image to anything attributed to the mechanics of the scope. While I wasn't imaging during howling gales, there were gusts of wind that did worry me from time to time.

The right-ascension and declination drives are very smooth, and out of the box the scope had the most responsive declination guiding that I have ever experienced with a mass-market telescope. This was also confirmed by the nearly flawless performance I had when autoguiding with the STL-11000M.

While I wouldn't call the RCX400's high-speed slewing "quiet," I found the sound to be far less annoying than the night-piercing wail from Meade's 8- to 12-inch Schmidt-Cassegrains (the new 14-inch has the same quiet drives as the RCX400 line). Tracking was virtually silent, and simply reducing the maximum slewing speed (something that can be done during setup) reduces the slewing sound as well.

The Go To performance was impressive. I never had a night when the scope didn't consistently place objects close to the center of the 104× eyepiece. In fact, most of the time I could effortlessly hop from object to object using a Tele Vue 9-mm Nagler Type 6 eyepiece, which provided 270× and a field of view only 17 arcminutes wide.

There is, however, a price to pay for all of the RCX400's features and performance, and that's weight. There's no other way to put it than to say the scope is heavy. The assembled tripod weighs 54 pounds, and the optional Ultra-Wedge ($499.95) is another 28 pounds. The real issue, however, is the scope itself, which even when stripped of its finder and eyepiece holder weighs 91 pounds. It's subjective at best for me to say who can and can't manage an instrument of this weight without help. Furthermore, there's a big difference between the effort needed to set the scope on the flat-topped tripod for altazimuth operation and that needed to wrestle it onto the tilted wedge for equatorial use. Most strong individuals will succeed with the former. But after having done the latter numerous times, I don't think it's a wise thing to do without help; one misstep and you're sure to damage yourself or the scope or both.



S&T: DENNIS DI CICCO AND SEAN WALKER

Owners of popular digital SLR cameras such as the Canon EOS 20D and Nikon D70 will likely find Meade's 0.63× focal reducer to be an attractive accessory, since it allows them to record excellent star images across a 0.9°-wide field at f/5. The author used the focal reducer for this 60-minute exposure of the Flame Nebula, IC 405 in Auriga, through the STL-11000M's red filter. It has been cropped to about the size that would be recorded with the full frame of the DSLR cameras.

Approaching Perfection?

Some hobbyists mistakenly believe that a product review without equal doses of praise and criticism is biased or unbalanced. Truth is, I can't find many negative things to say about the RCX400. I did uncover several problems — mostly bugs and quirks in the AutoStar II software — but as of this writing, Meade has fixed all of them. There are no problems of which I'm aware that exist with scopes currently being shipped. Furthermore, the software issues are not a problem for older scopes if the owners update their systems with the latest software downloaded for free at www.meade.com (all this is explained in the user's manual).

Meade claimed that one of its goals in developing the RCX line was to address various problems, some bigger than others, that had dogged Schmidt-Cassegrains for more than 30 years. My feeling is that the company really has succeeded. Even when you judge it by the demanding criteria imposed by long-exposure imaging, the RCX400 is winner. It's ready to use right out of the box; just add a camera. ✳

Senior editor Dennis di Cicco *extends his thanks to the folks at Santa Barbara Instrument Group for the loan of the STL-11000M camera used for testing the RCX400.*

S&T RATINGS

Meade 12-inch RCX400	
Optics	★ ★ ★ ★
Mechanics	★ ★ ★ ★
Overall	★ ★ ★ ★ ½

★★★★★ Sensibly perfect. No meaningful improvements possible.
★★★★ Any shortcomings will go unnoticed in normal use.
★★★ Problems noticeable but do not seriously affect performance.
★★ Problems noticeable during normal use — performance compromised.
★ Problems so severe that the equipment is virtually unusable.

Ratings are intended to convey performance compared with equivalent equipment and should not be used to predict the relative performance of instruments having markedly different apertures or optical designs.

Bottom-line summary: *For deep-sky astrophotography, the RCX400 is the next-generation instrument up from the popular Schmidt-Cassegrain. Many of its features will be highly appreciated by visual observers. Considering its performance and price, it's an outstanding value.*