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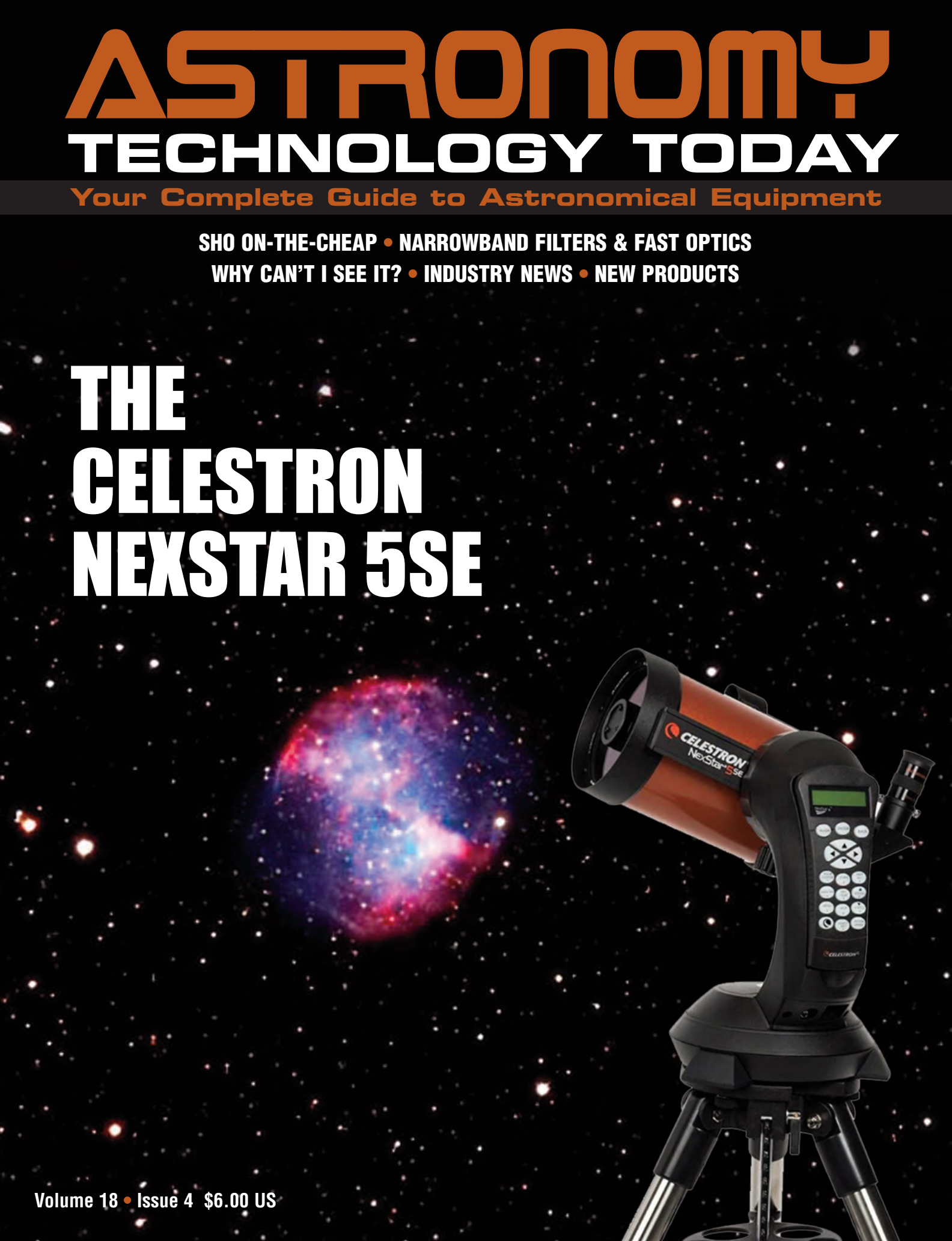
THE CELESTRON NEXSTAR 5SE



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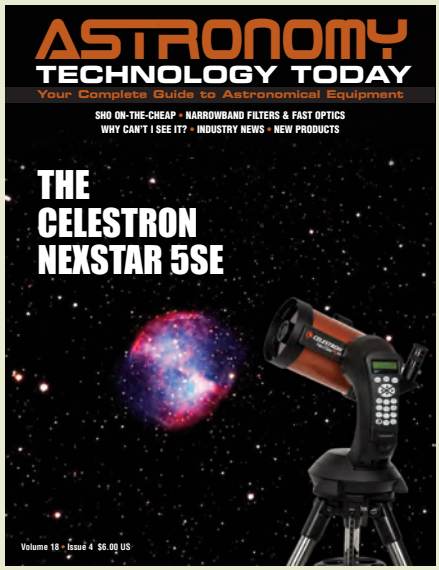
In his cover article, Dr. James Dire discusses why, having missed owning a small SCT, he invested in a Celestron NexStar 5SE telescope system.



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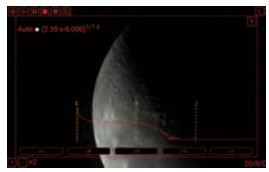

ATT Contributing Writers

Dr. James Dire has a 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 chemistry, physics and astronomy and an administrator at several colleges and universities. 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. Dire is a seasoned visual observer and veteran astro-imager.

Matt Harmston is an educational researcher whose appetite for the heavens has been whetted by increasing aperture over the years. More recently, Matt has immersed himself in video astronomy - a means of probing deeper into the night sky while making astronomy accessible to all ages and abilities. With this technology readily available, Matt is considering a career as a sleep-deprivation research subject.

Stuart Parkerson has been the publisher of Astronomy Technology Today since its inception in 2006. While working primarily in the background of the company's magazine and website business operations, he has an active role in contributing content covering industry news and other company centric topics.

Jim Thompson acquired his passion for astronomy growing up under the dark skies of Eastern Ontario (Canada) cottage country. He has over 25 years of experience working as an Aerospace Engineer in the defense industry, and enjoys applying that same skill set to his amateur astronomy hobby. Jim is a strong advocate for Electronically Assisted Astronomy (EAA) which he uses frequently from his urban home in Ottawa, Canada. The severe light pollution in his backyard is the primary impetus for him becoming an expert on astronomical filters.

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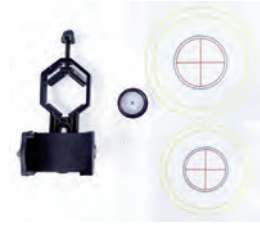

THE CELESTRON NEXSTAR 5SE

By Dr. James R. Dire

Schmidt Cassegrain Telescopes (SCTs) are classified as catadioptrics because lenses and mirrors are both used to bring light from distant objects to focus. The telescope size is given by the diameter of the primary mirror. A secondary mirror is held in place by a corrector plate (the lens component). Light passes through the corrector plate, reflects of the primary then secondary mirrors, and then passes through a hole in the primary mirror to where it comes to focus for visual or photographic use. The primary and secondary mirrors are spherical in shape. The corrector plate corrects for spherical aberrations, but SCTs still suffer from an aberration called coma. They typically have focal ratios equal to ten (f/10). [The focal ratio is a focal length of the telescope divided by the objective diameter.]

I have used about every size SCT ever made during my career. The 11- to 14-inch versions were installed in college or club observatories that I managed. I have personally owned at one point in my career every size between four- and ten-inches. The large models I have used had high thermal inertia. If stored somewhere warm during the day, such as inside unairconditioned observatory, they could take hours, if not half the night, to reach thermal equilibrium with the ambient nighttime air. When not at thermal equilibrium, heat radiating from the telescope distorts the view.

The best view I ever had of Saturn was through a Celestron 14-inch SCT the night of the 2000 Leonid meteor shower. That night a large group of us viewed the meteor shower in a field adjacent to a campus observatory in rural Connecticut. The overnight temperature dipped below freezing. At sunset, the temperature in the observatory was about 50 degrees. I opened the dome

Image 1 - The author with his 4-inch Schmidt Cassegrain Telescope at a solar eclipse in Turkey in 2006.

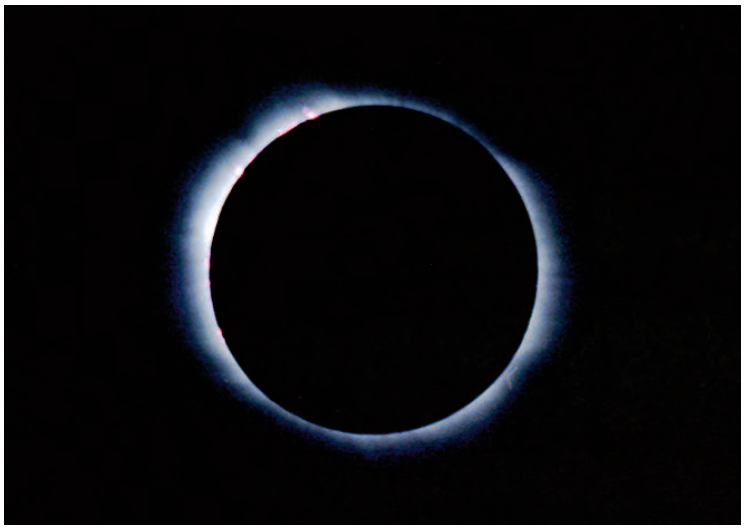

Image 2 - Image of the March 29, 2006 total solar eclipse taken with a Bauch and Lomb 4000 Schmidt Cassegrain telescope with a Minolta X-570 camera using Fujicolor Super Q 100 film. The exposure was 1/250s.

Image 3 - The author previously used a Celestron C5 Schmidt Cassegrain telescope attached on top an 8-inch Newtonian in his observatory. Here it is shown with a SBIG ST-2000XCM CCD camera.

shutter and observatory doors and uncovered the telescope to let it cool down.

Apparently, I had never stayed late enough for that telescope to truly come to thermal equilibrium. But this night around 3:00 am, I went into the dome and pointed the telescope at Saturn. The view almost knocked me over. The detail in Saturn's belts, zones and the rings was incredible.

Another issue I have had with many SCTs was when trying to focus them for imaging with a CCD camera. The focuser moves the primary mirror back and forth to achieve focus. In a lot of cases the tilt of the mirror can change ever so slight to shift the image in the field of view while focusing, and disrupt the optical collimation.

The two I enjoyed using the most were a four-inch Bausch & Lomb Criterion 4000 telescope and a five-inch Celestron C5 telescope. These smaller telescopes, like some their larger cousins, have enclosed tubes with no airflow. But the small size of the instruments allowed them to reach thermal equilibrium very quickly after dark. Also, image shift was virtually non-existent in them.

I used the Bausch & Lomb Criterion 4000 as my travel scope for solar eclipses (**Image 1 and Image 2**) and the Celestron C5 as a guide scope for an eight-inch Newtonian in my first personal observatory. Occasionally, I would take images with the C5 (**Image 3 and Image 4**). About 15 years ago, I discovered the imaging capabilities of high-quality refractors. So, I sold my SCTs and replaced them with small refractors for imaging (102mm) and airline travel (70mm).

Recently, I missed owning a small SCT. So, I invested in a Celestron NexStar 5SE telescope system (**Image 5**). As can be seen in the image, the telescope comes with a one-armed fork mount with a nice, lightweight tripod with a spreader/eyepiece tray. The tripod legs extend plenty high enough for a six-foot person to reach the eyepiece without leaning over too much.

The Optical Tube Assembly (OTA) has a Vixen style dovetail plate, a visual back for attached a diagonal and eyepiece, and a shoe for a finder scope with a red dot finder. A hand controller controls everything. I added the 3D-printed bracket that holds the hand controller in a better position to see while observing. The entire telescope system weighs under 28 pounds making it easy to transport. The tripod and mount each are about 10 pounds with the rest being the OTA.

Image 6 shows a closer view of the mount and the OTA. I swapped out the stock finder scope shoe with one that would hold my 9x50 finder scope, my 6x30 finder scope, and the higher quality red dot finder shown in the image. Note the small white arrow on the black rotating piece that clamps onto the telescope. It lines up with another arrow on the top of the arm when the scope is pointed horizontal, the home position. **Image 7** shows a cover that pops off for adding eight AA batteries to power the mount.

When not in use, the hand controller stores inside of the mount arm (**Image 8**). To store it, I have to remove the 3D-printer holder bracket I obtained. The jack where the hand controller plugs in is inside of the arm housing. The hand controller can be unplugged and stored elsewhere.

On the other side of the mount are two ports (**Image 9**). One is labeled AUX and the other has a camera symbol. The

Image 4 - M27, the Dumbbell Nebula captured with a Celestron C5 Schmidt Cassegrain telescope and a SBIG ST-2000XCM CCD camera. The exposure was 35 minutes.

Image 5 - The complete set up NexStar 5se telescope system.

AUX port is for attaching optional Celestron devices such as a GPS or SkyPortal WiFi module. A GPS device supplies the location, date and time to the telescope so those don't have to be entered into the hand controller manually.

The SkyPortal WiFi module allows the telescope to be wirelessly controlled with a phone, tablet or computer with the appropriate software. I have used both add-on accessories and they work quite well. The camera port allows a camera to be controlled with the hand controller to slew to and take images when the camera is attached to the telescope. A firing cable is required specific to individual camera models. I have not used this feature of the telescope.

Image 6 - A close up view of the NexStar 5se telescope and mount. The author acquired a removable 3D-printed bracket to hold the hand controller at a better viewing angle while using the telescope.

Image 7 - A removable cover on the top of the mount base has a compartment for 8 AA batteries to power the mount.

Image 8 - The hand controller can be stored in the outside portion of the mount's arm when not using the add-on 3D-printed bracket.

On the bottom of the fork arm is jack to plug in an external 12-volt power cable. To the right of that is the on/off button (**Image 10**). I like powering the telescope with an AC adapter or a rechargeable lithium battery powers supply like the one seen near the back leg of the tripod in Image 5.

Image 11 shows the inside of the OTA. The telescope has a 125mm (nearly 5 inches) of aperture with a 1250mm focal length. The optics are coated to stay in pristine conditions for a long time! With a sealed tube, the mirrors never need cleaning.

The C5's optical design provides a long focal length in a short tube. This provides a higher magnification than found in most refractors and small Newtonians using the same eyepiece. The secondary obstruction is 35% by diameter, typical for SCT, or 12% by area. So, the telescope has the same light gathering power as a 4.69-inch diameter refractor. The scope excels for lunar and planetary viewing, double stars, and viewing the brighter star clusters, galaxies and nebulae like those listed in Charles Messier's catalog.

The brains of the telescope are in the hand controller (**Image 12**). The hand controller contains 40,000 objects to explore including named stars, double stars, variable stars, asterism, and 8 planets (counting Pluto as one). It has the entire Messier catalog and selected NGC and Caldwell objects, as well as many stars from the SAO catalog. Without a WiFi module, a computer can be connected to the telescope though a jack on the bottom of the hand controller. The USB cable must be purchased separately.

Before being able to slew to objects, the telescope must be leveled and powered on. The location, date and time must be entered therein if not using a Celestron GPS module. A city database is built in to make it easier than entering latitude and longitude manually. Selecting the closest city in the database is sufficient for most applications.

There are many alignment routines to choose from. The Sky Align is the easiest since you don't need to know the name or location of any celestial object. It will walk you through pointing the telescope at three bright objects (planets or stars) and

Image 9 - There are two ports on the mount base. One is for attaching Celestron auxiliary devices to the mount. The other port is to connect a firing cable from the mount to a DSLR camera to control the camera with the mount's hand controller.

Image 11 - Inside view of the optical tube assembly. The corrector lens assembly holds the secondary mirror in place. The three Phillips screws on the secondary assembly are for collimating the optics.

Image 10 - The on/off switch is at the very bottom on the mount's arm next to a jack to attach an external 12-volt power supply to use in lieu of AA batteries.

Image 12 - A close up view of the NexStar hand controller.

it will figure out what they were.

The next choice is an Auto Two Star alignment where it prompts the user to point the telescope successively at two named stars. The third choice is the Two Star Alignment where the user gets to choose the two stars to align the telescope on. There is a One Star Alignment choice, but it is not accurate for finding objects and is best just used for going out and viewing the Moon or a planet to track it while viewing.

I tried all of the alignment methods and all but the one-star method found every object in a 30mm eyepiece I called up. The one-star method did allow tracking of the Moon quite well. There is a method to align on a solar system object, which is similar to the one-star alignment and can be used for the Moon during the daytime. If the Sun doesn't show up as a choice for an alignment object, go into the Utility menu and enable the Sun as an alignment choice. You will want to do this to track the Sun if you have a safe full aperture solar filter for this telescope (**Image 13**).

The NexStar 5se can also be set up in equatorial mode. There is a latitude-locking lever on the side of the mount and a rod graduated with latitude degrees (**Image 14**) that allows for this. The lever must be loosened and tilted on a hinge until the correct latitude is obtained. Then the lever must be tightened. The hinge side of the mount must be pointed north if in the northern hemisphere and south if in the southern hemisphere. There are star alignment choices in the hand controller for use in either hemisphere. **Image 15** shows the telescope set up in equatorial mode for my latitude.

It is difficult to obtain an exact polar alignment with this setup since there are not fine adjustments that can be made in the tilt or azimuth of the mount to zero in on a celestial pole. Also, unlike Celestron German Equatorial Mounts, there is no polar alignment procedure in the hand controller, nor a polar alignment scope add on. Because of this, I found the GOTO pointing accuracy to be better using the telescope in alt-azimuth mode more accurate than in the equatorial mode. However, once an object is acquired, the tracking seems to keep it in the eyepiece long enough to thoroughly observe it.

So why use the telescope in equatorial mode? The long focal length of the telescope makes it difficult for prime focus imaging of faint objects. The mount also does not have an autoguider port. I would not recommend this mount for long exposure imaging. A better mount for deep space imaging would be the Celestron AVX (**Image 16**). One reason for using this telescope in equatorial mode would be wide-angle piggy-back photography. A DSLR camera can be attached piggyback

Image 13 - The author used a full aperture solar filter to view

Image 14 - The mount has a built-in equatorial wedge with a latitude scale. This allows the telescope to operate in equatorial mode.

Image 15 - The NexStar 5se in equatorial mode is polar aligned by pointing the hinged side of the wedge due north and adjusting the latitude scale to the correct latitude.

Image 17 - Image of the Sun taken with the NexStar 5se telescope using a Canon 600D camera.

Image 16 - The Celestron Advanced VX mount may be more suitable for long exposure photography than the NexStar 5se mount.

on the OTA. The mount should achieve a sufficient polar alignment to take exposures lasting several minutes without star streaks depending on the focal length of the camera lens used. Alternately, a DSLR camera or CCD camera with a wide-angle camera lens can be secured to a dovetail plate and attached to the NexStar mount without the telescope for the same type of imaging.

The telescope does a great job of capturing photographs of the Moon and the Sun (with an appropriate solar filter). If one is taking a series of solar or lunar images, say during an entire solar or lunar eclipse and one desires to have the image series all with the same orientation (i.e. north up on each image), the images need to be shot in equatorial mode. In alt-azimuth mode, field rotation as time progresses will change the north up orientation. A sample Sun image taken with the NexStar 5se appears in **Image 17**.

It would also be possible to do planetary imaging with the NexStar 5se. Attaching a planetary video camera to the telescope and acquiring a planet should not be too difficult. In equatorial mode, the planet won't rotate in the field of view making image processing easier. It may drift in the field of view due to an imperfect polar alignment, but processing software can competently align and stack the video frames.

There may be other reasons to use the telescope in equatorial mode. But for normal stargazing, it works best in alt-azimuth mode.

The NexStar 5se is a great all-around telescope. It is easily transported and set up. It has accurate GOTO capability. The 5-inch aperture captures a plethora of celestial objects. And the price won't break the bank! ATT