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THE SKY-WATCHER USA EVOLUX 82ED REFRACTOR

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Our cover article features Dr. James Dire's review of Sky-Watcher USA's newly introduced Evolux 82 ED Refractor. The background astro image was taken with telescope and is of Markarian's Chain.

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ATT Contributing Writers

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. He is the president of Methodist College in Peoria, Illinois. 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.

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Erik Wilcox lives off the grid on the Big Island of Hawaii and has been observing for over 25 years. When he's not viewing from his dark backyard skies, he spends time hiking, kayaking, snorkeling and playing music.

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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THE SKY-WATCHER USA EVOLUX 82ED REFRACTOR

By Dr. James R. Dire

There are a lot of doublet refractors on the market now containing one element of extra-low dispersion (ED) glass. In this article, I review Sky-Watcher USA's 82mm entry into this market. They also have a 62mm refractor in this series. I suspect they both perform similarly.

Before I jump into the telescope review, I should explain the types of refractors. Simple convex lens do not focus all colors of light at the same focal point (**Image 1**). This is an imperfection known as chromatic aberration. Early refractors used two lenses in the objective (called a doublet). The two lenses are designed to bring two wavelengths of light to the same focus point. Such telescopes are called acromats.

These early acromatic refractors had very large focal ratios; the ratio of the focal length to the objective diameter. Focal ratios are sometimes called f numbers (f/#). The larger the f/#, the less of a problem exists from chromatic aberration. Thus, refractors from the 17th century through most of the 20th century were large f/# acromats.

I have often used the 8-inch f/12 Clark refractor at the U.S. Naval Academy. I have never seen chromatic aberration on bright objects such as the Moon or Jupiter, and my photographs through this instrument are aberration-free.

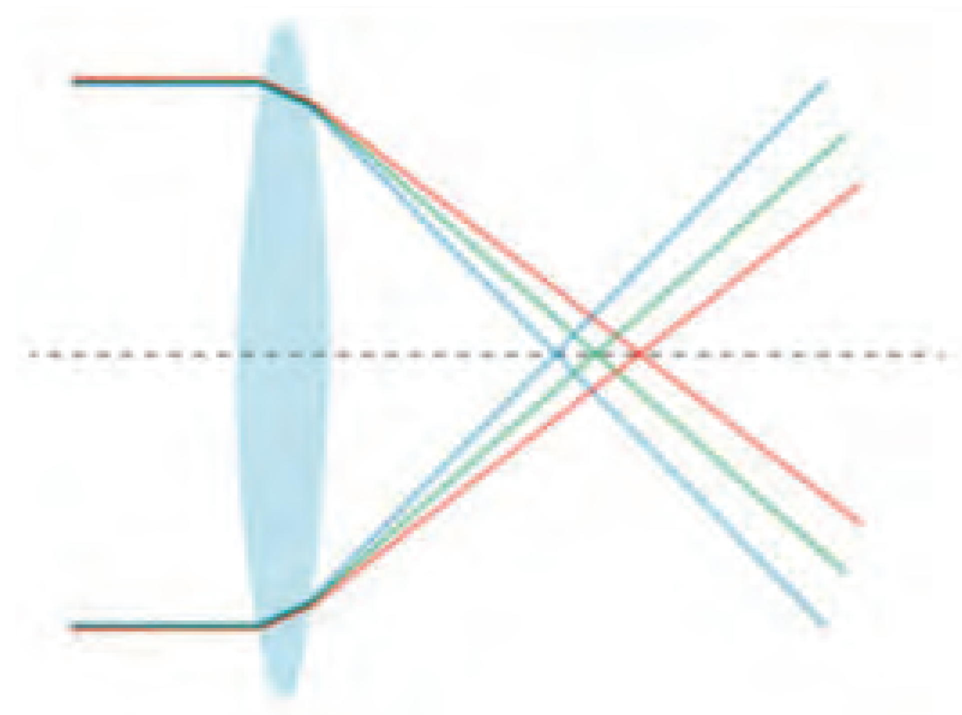

Image 1 - Single convex lenses suffer from chromatic aberration where different wavelengths do not come to focus at the same point. This is why refractors are made with two or more lenses.

Some telescopes use three lenses in the objective (a triplet). The three lenses ensure that three wavelengths of light all focus at the same point. These telescopes are called apochromats (Apo for short). Apochromats eliminate most of the chromatic aberration. Although, I have seen a few Apo's in my day with smaller f/#s that suffered from chromatic aberration.

Amateur astronomers don't use 8-foot or longer telescopes these days. Most refractors now in use have small

Image 2 - The Evolux 82ED refractor comes in an aluminum hard case.

Image 3 - The Evolux 82ED refractor fits securely in the case with an ample supply of foam. Pre-perforated cutouts will allow storage of eyepieces and other small accessories in the case.

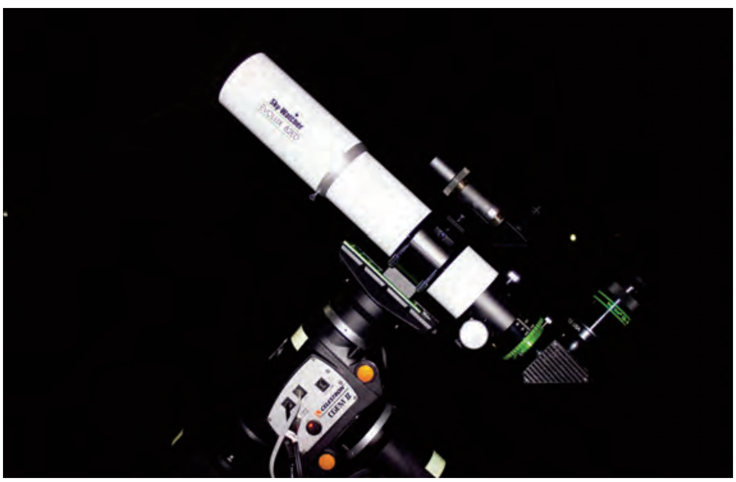

Image 4 - The author tested the Evolux 82ED refractor using a Celestron CGEMII mount.

Image 5 - The object end of the Evolux 82ED refractor.

f/#s and would suffer severely from chromatic aberration if made with crown flint glass. But, modern telescopes now incorporate at least one element with ED glass in the objective. Triplets with one ED element haves essentially zero chromatic aberration. In doublets, the use of ED glass drastically reduces the chromatic aberration inherent in short f/# refractors.

So why would someone buy a doublet over a triplet. The answer has to do with cost. Not only is there 50% more glass in a triplet over a doublet, but it is more costly to make a matched triplet objective than a doublet objective. Fortunately, ED doublets perform reasonably well over refractors that don't use ED glass. Some perform nearly as good as an Apo.

The Evolux 82ED came shipped in a very nice metal storage case (**Image 2**) inside a well-padded cardboard box. Most scopes in this class do not come with a metal case, if any case at all. This is a nice feature provided by Sky-Watcher! With the dew shield retracted, the optical tube assembly (OTA) fits securely in the case (**Image 3**). There is plenty of room the in case for a few eyepieces, and or a red dot finder, once some of the precut foam is removed! One could probably fit a 1.25-inch diagonal in the case, too.

The telescope comes with the OTA, caps on each end, a clamshell ring system, and a Vixen-style dovetail plate colored green to match the telescope's trim. Atop the clamshell bracket are two mounting shoes for finders or guiders. That's it. I have my own arsenal of telescope accessories, so I was ready to roll night one out (**Image 4**).

The Evolux 82ED is an 82mm f/6.45 refractor (**Image 5**). The telescope has a 530mm focal length. The OTA with everything attached to it in the case weighs a mere 6.5 pounds. The telescope has a 2.4" dual speed (11:1) rack & pinion focuser that operates quite smoothly!

In the case the telescope is 16.375 inches long. With the dew shield fully extended, the length is 22.25 inches. This telescope has the longest dew shield I have ever seen on a telescope of this size. It will do a most excellent

Image 6 - The author attached a Canon 600D DSLR camera to the telescope for lunar photography.

Image 7 - Image of a nearly full Moon captured with the Evolux 82ED refractor and a Canon 600D camera.

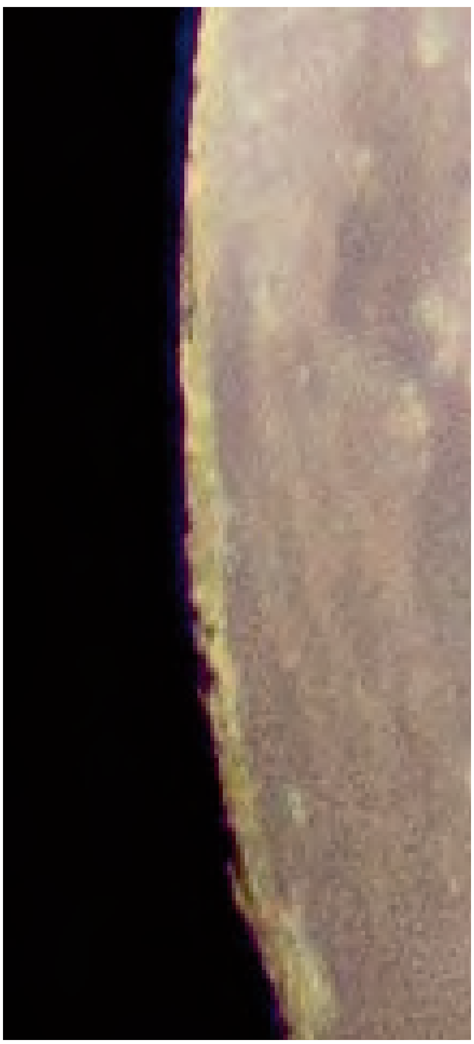

Image 8 - The author zoomed in and cropped the left side of the Moon from Image 6 to show the ever so slight hint of false color on the edge of the Moon.

job keeping condensation off the optics when not pointed near the zenith.

The first clear night after the telescope arrived was the day before the Full Moon. That didn't stop me from running my initial tests on the scope. I attached a 9x50mm finderscope and a two-inch diagonal to do some lunar observing with Tele Vue 26mm Naglar (20x) and 13mm Ethos (41x) eyepieces. I mounted the OTA on a Celestron CGEM II German equatorial GOTO mount as seen in Image 4.

The two-inch focuser has two thumbscrews to hold the two-inch diagonal. One problem I immediately noticed was when I hand tightened them as tight as I could, it still wasn't tight enough for the weight of my diagonal and large eyepieces. The diagonal would come loose due to the gravity torque of the eyepiece.

A bright full Moon is the ultimate test to spot chromatic aberrations. There wasn't much false color except for a faint green ring of light on the edge of the Moon. I pointed the scope at the brightest stars above the horizon, Capella and Vega. No false color was seen on these bright stars.

I next attached a Canon 600D camera to the telescope. This configuration is shown in **Image 6**. I used a cable released with the camera's mirror lock up feature to image the Moon. A sample picture appears in **Image 7**. Image 7 was taken prime focus and is uncropped. I was very pleased at the quality and sharpness of the image. One has to zoom in to the edge of the Moon considerably to see any hint of chromatic aberration. Zooming Image 6 on the edge of the Moon (**Image 8**) shows the faint hint of the false color I saw at the eyepiece. Regardless, the telescope takes a pretty darn good picture of the full Moon!

Besides the Moon, this telescope would be perfect for taking images of sunspots or solar eclipses. All that would be needed is an appropriate solar filter.

I waited two weeks for a clear moonless night to do my second round of testing. On this night, I did more visual tests as well as some CCD imaging with a SBIG ST-2000 single-shot, color camera. I decided to use a 1.25-inch diagonal with my 8.8mm and 5mm 82° eyepieces. **Image 9** shows this configuration, although for the telescope mount setup, I used the shown 25mm Plössl eyepiece to center my alignment stars. Image 8 also shows both a finderscope and red dot finder mounted atop the OTA. The 1.25-inch diagonal and eyepieces are much lighter in mass and worked much better with this than the two-inch accessories I used for the night of lunar viewing.

The 8.8mm eyepiece provided a magnification of 60x, perfect for resolving star clusters and many double stars. The 5mm gave a 106x magnification. This magnification works great for planets or very closes binary stars. The Dawes limit for this size telescope is 1.4 arc seconds. So if the seeing cooperates, very close binary stars can be split with this telescope.

I pointed the telescope at many Messier objects such as clusters M35, M36, M13, M3, M4, and galaxies M51, M81 and M82. All Messier objects are within reach of this telescope. Some will be faint. I could resolve M13 into myriad stars at the higher power.

Image 9 - The author conducted visual test of the Evolux 82ED refractor using a 1.25-inch diagonal with two high quality 1.25 inch eyepieces.

Open star clusters were especially a treat!

An 82mm refractor is a great sized telescope for CCD imaging. So I attached a CCD camera to the telescope to test its imaging capabilities (**Image 10**). Although I used a single shot color CCD camera, one with RGB filters would work just as well, if not better since exact focusing with each filter will completely eliminate any minimal chromatic aberration.

Sky-Watcher makes a field flattener for this scope, which is necessary for imaging. The field flattener also slightly reduces the focal length by 0.9x (**Image 11**). Three objects appear in Image 11. On the right is the field flattener. On the left is a ring that threads onto the focuser in place of the one use to hold diagonals. This ring has the threads to accept the field flattener. The camera end of the field flattener has M48 threads. My camera equipment uses M42 threads. In the middle of Image 11 is an adapter ring I purchased to convert from M48 to M42 threads.

Image 12 shows a side view of the camera and field flattener attached to the telescope. The field flattener requires 55mm spacing between the field flattener and the CCD sensor. As can be seen in Image 12, I added a few M42 spacer rings between the camera and field flattener to achieve the 55mm spacing. This spacing is crucial to eliminate all the field curvature inherent in a small f/# refractor.

Before I could start imaging, I had to balance the telescope camera system on the mount. As can be seen in **Image 13**, due to the weight of my CCD camera, I had to slide the clamshell ring all the way towards the focuser end of the OTA to achieve balance along the declination axis. Tracking and guiding were no problem once balance was achieved.

My first target was M35 and its neighbor cluster NGC 2158. Both cluster just fit into a one-degree span of the sky. The 80-minute exposure is shown in **Image 14**. The telescope resolved myriad stars in the tiny NGC2158. Next I captured M13 (**Image 15**), the largest globular cluster north of the celestial equation. On the upper left hand side of this image, the faint galaxy NGC6207 is clearly visible! The M13 image was a 60-minute exposure.

Next I wanted to see how smaller and fainter globular clusters would fare. **Image 16** captured M53 and the much fainter cluster M5053 in the same field of view. The exposure was 70 minutes. M53 is on the upper right and NGC5053 on the lower left. I sus-

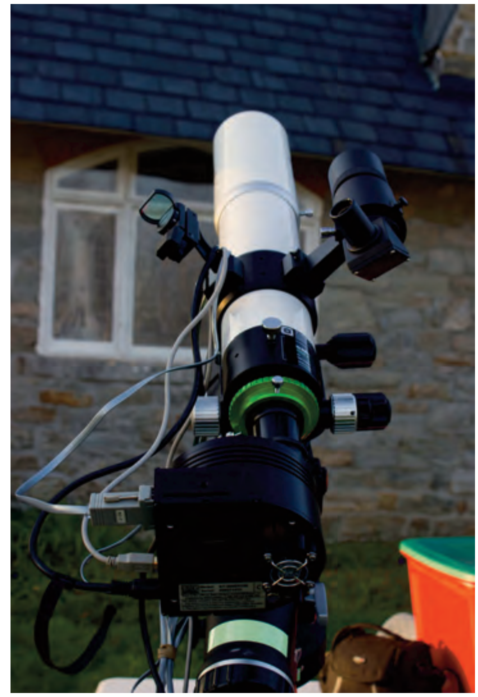

Image 10 - CCD imaging with the Evolux 82ED refractor was conducted with a SBIG ST-2000XCM CCD camera. This image provides a good view of the two piggyback shoes on the clamshell ring: one holding a red dot finder and the other holding a 9x50 finderscope.

Image 11 - Left to right: 1) an accessory to attached the Evolux 82 focal reducer/field flattener to the focuser, 2) the author's M48 to M42 adapter to use the SBIG camera with the telescope, and 3) the Evolux 82 0.9x focal reducer/field flattener. All of these items are purchased separately from the telescope.

Image 12 - The CCD camera, M42 spacers and Evolux 82 focal reducer/field flattener attached to the telescope. Note the graduations in inches and millimeters on the focuser drawtube.

Image 13 - The weight of the camera required balancing the telescope by sliding the clamshell ring all the way towards the focuser end of the telescope tube. The camera and all the accessories used threaded connections, safely securing them to the telescope.

pect if I doubled the exposure, I would have captured enough of both clusters for a decent image.

My next target was Markarian's Chain, an arcing swath of 10 or so galaxies crossing the boundary between Virgo and Coma Berenices. A two-hour exposure was perfect for capturing this galaxy chain. **Image 17** contains the galaxies, while **Image 18** has them all labeled. The Evolux 82 is ideal for taking these type of images!

The last image I attempted was of the Western Veil Nebula (NGC6960) centered on the star 52 Cygni (**Image 19**). In one hour, I was able to capture enough of the nebula to see it snaking from north to south passing behind 52 Cygni. At darker sites, I have captured more of this nebula in one hour with this CCD camera. There was just enough light pollution at this site to drown out the nebula. However with a much longer exposure, the results would have been more satisfying.

After a long night of CCD imaging, I removed the camera equipment and put the 5mm eyepiece back into the scope to view Saturn, which had just risen above the tree line in the southeast. At 106x, the rings and planet were beautiful. The seeing at that altitude was poor, but I could still resolve the Cassini division. I would have liked to pop in a 2x Barlow to view Saturn at 212x. But Saturn would not have been high enough in the sky that morning before sunrise to view it through a small enough air mass to hold that power.

All of my images had pinpoint stars throughout the frames attesting to the quality of the optics, including the field flattener. The small star sizes also confirm the lack of appreciable chromatic aberration!

I had a lot of fun imaging with this telescope. The telescope is well made, has a great focuser, and is easy to use. The aluminum case makes it easy to transport. ATT

Image 14 - Galactic star clusters M35 and NGC2158 taken with an 80-minute exposure.

Image 15 - Globular cluster M13 from a 60-minute exposure.

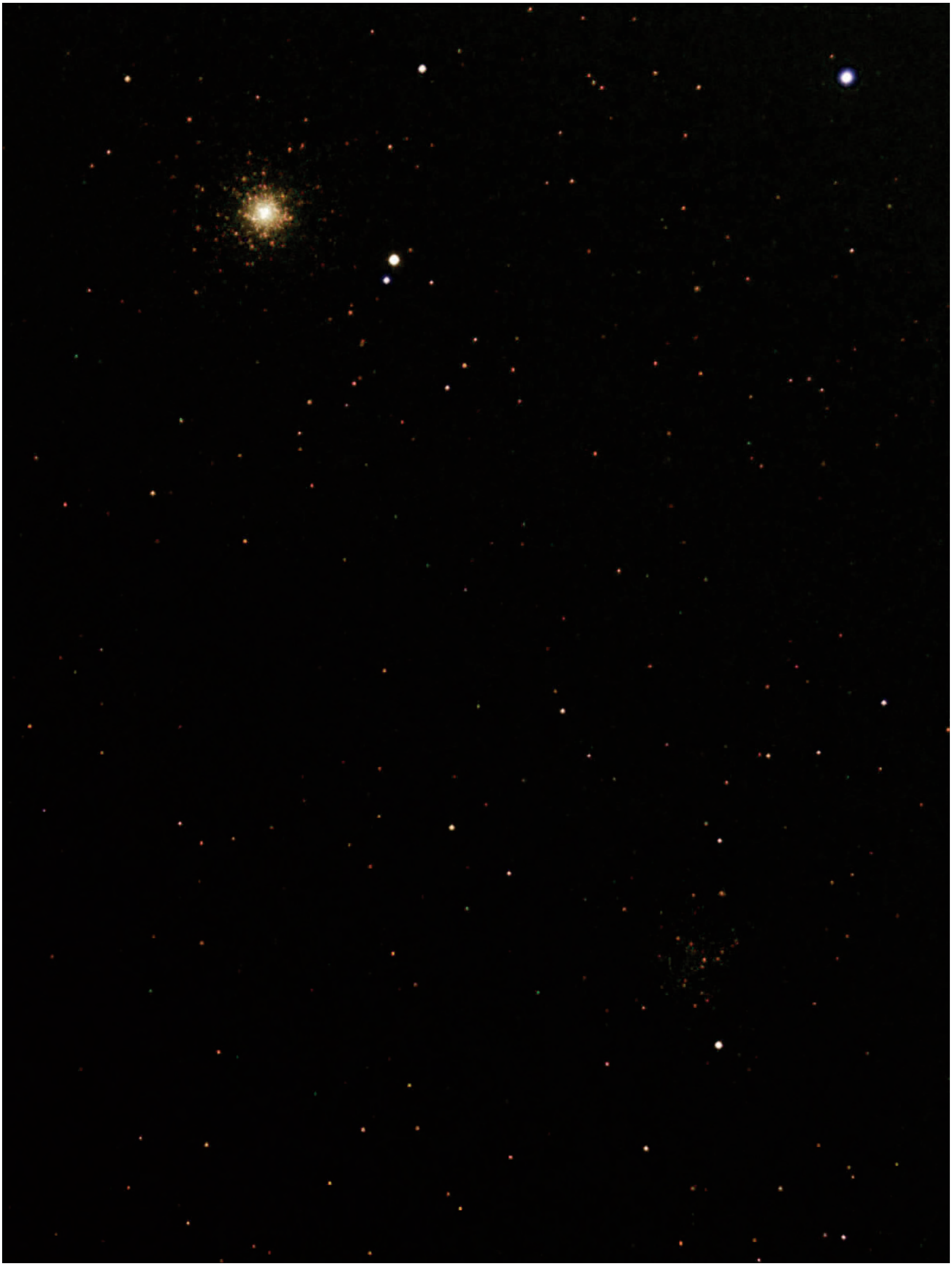

Image 16 - M53, upper right, and NGC5053, lower left, from a 70-minute exposure.

Image 17 - Markarian's Chain was captured with a two-hour exposure.

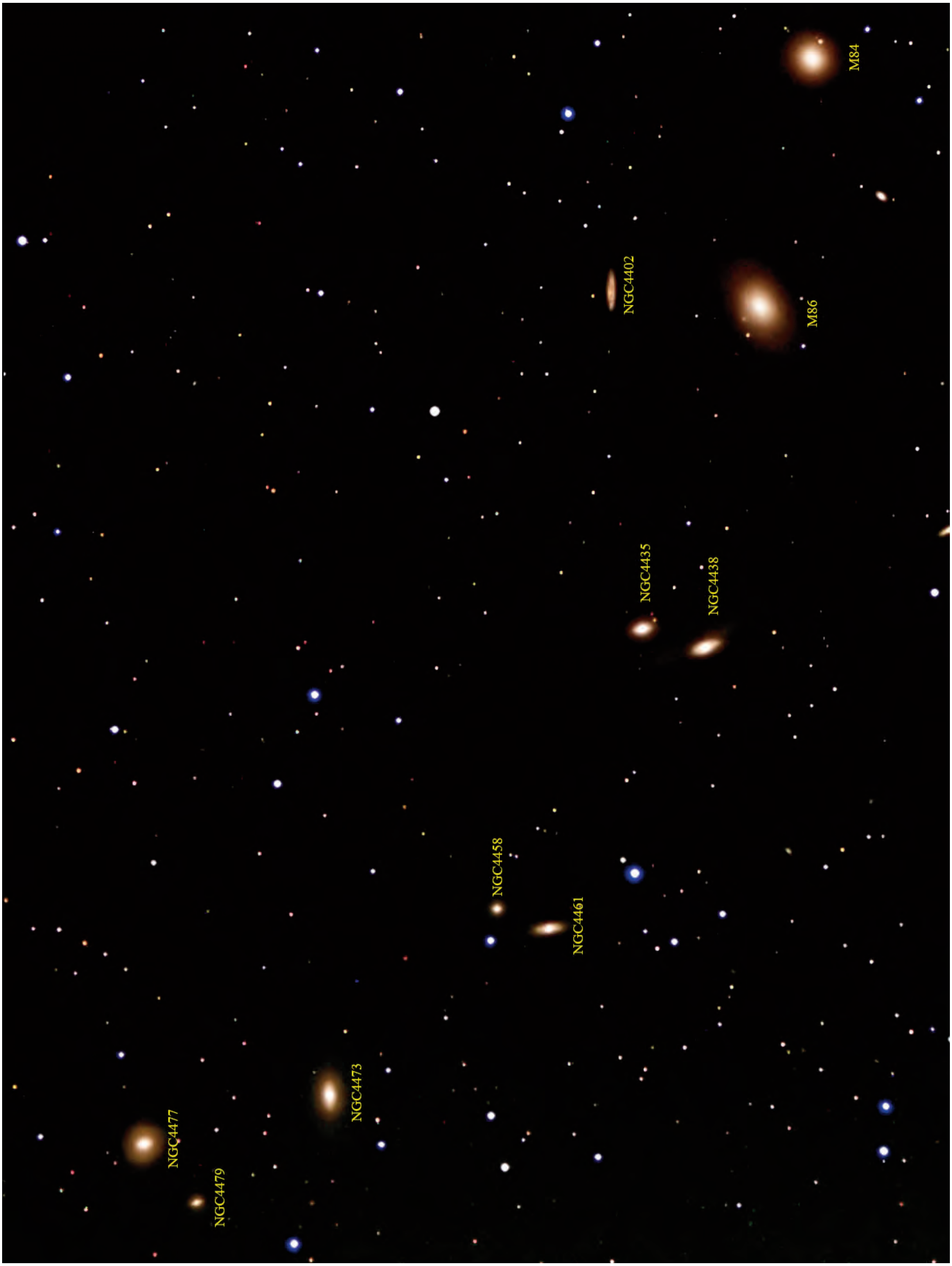

Image 18 - The ten brightest galaxies in Markarian's Chain are labeled here.

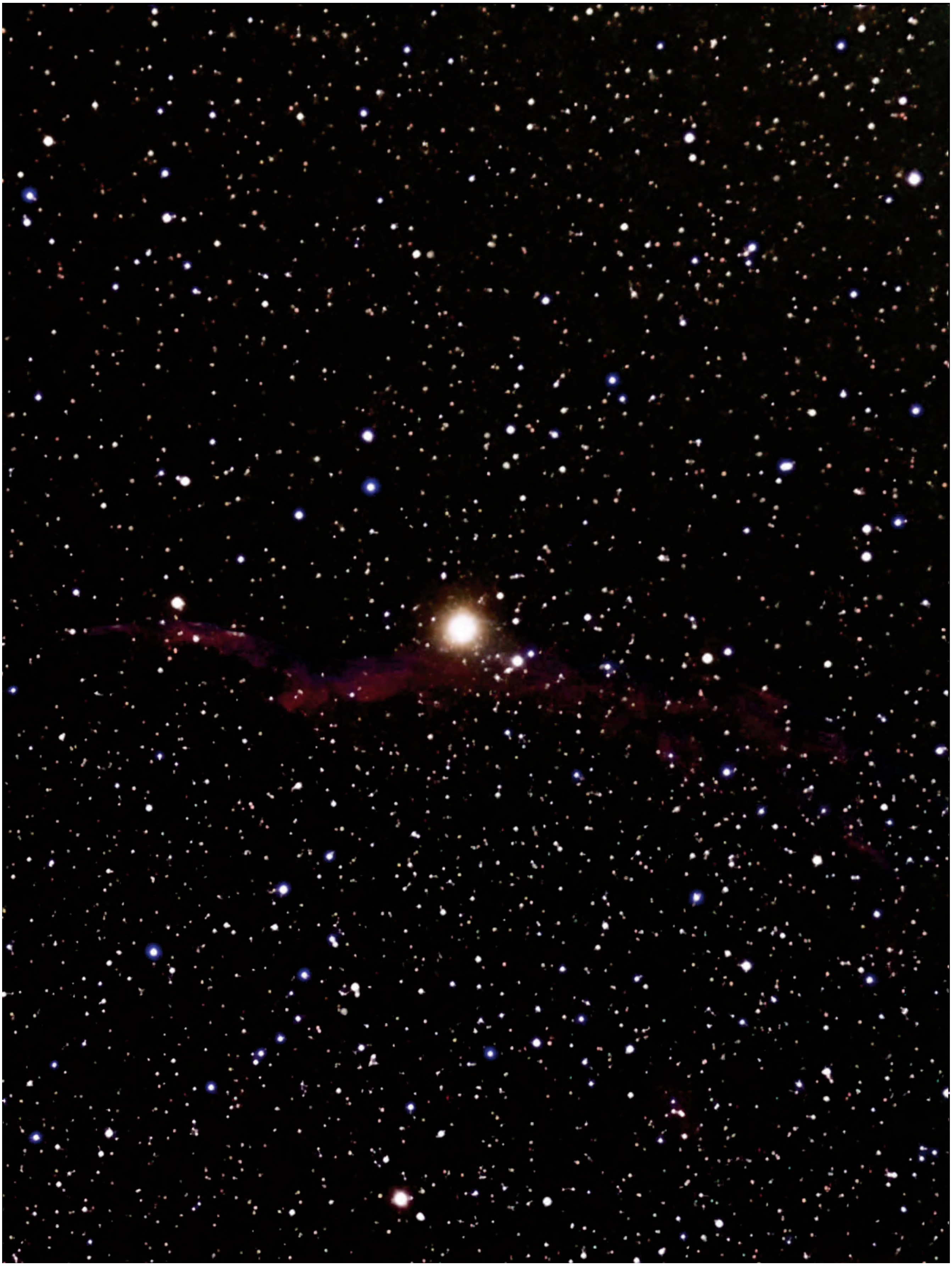

Image 19 - The Western Veil Nebula was faintly captured with a one-hour exposure.