by Alan Dyer and Terence Dickinson

New Sky-Watcher refractors and equatorial mounts

We test two ED refractors and two mounts—all with performance and prices that seem too good to be true

THE FIRST ASTRONOMICAL TELESCOPE, THE ONE GALILEO BUILT IN 1609 and used to observe Jupiter's moons, the crescent of Venus and the rumpled surface of the Moon, was a refractor. Galileo's best telescope had a single one-inch main lens and another lens element for an eyepiece. By the 18th century, refractor makers were using two or more lens components, known collectively as the objective lens, at the front of the tube to improve telescope performance. This design, called an achromatic refractor, is still used in commercial refractors today.

Although achromatic refractors work well, they have what is known as residual false colour—portions of the blue and red components of light are not properly focused by the objective. This produces a purple fringe around the edge of the Moon and a ring around bright stars and planets and tints such targets with a pale yellow-green cast. When the telescope is used for photography, this becomes a significant handicap, especially with digital cameras.

However, during the 1970s, the residual-false-colour problem was solved with the development of fluorite objective components, which bring all the colours to essentially perfect focus in a telescope shorter than the traditional achromatic refractor. This type of scope is the *apochromatic* refractor, also known as a fluorite or an ED refractor, which signifies the type of glass utilized.

Until now, fluorite and ED refractors were super-premium-priced, sometimes up to 10 times more than an achromatic refractor of the same aperture. The breakthrough achieved by Sky-Watcher with both the 80mm and the 100mm ED refractors is price: less than half that of comparable apertures from other manufacturers. The telescopes are made by Synta of China, now one of the largest telescope manufacturers in the world.

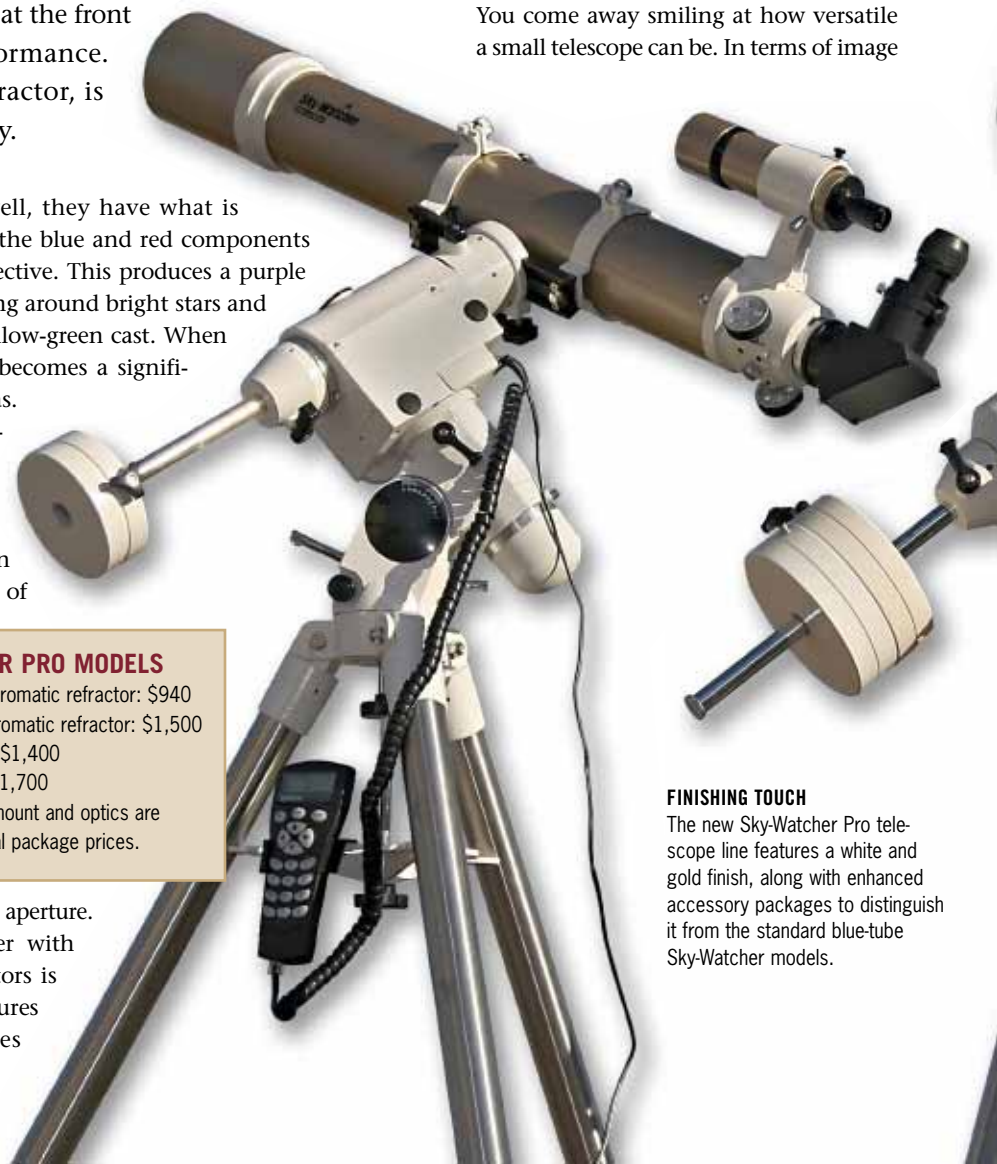
SKY-WATCHER PRO MODELS

ED80 f/7.5 apochromatic refractor: $940
ED100 f/9 apochromatic refractor: $1,500
HEQ5 Pro mount: $1,400
EQ6 Pro mount: $1,700
Combinations of mount and optics are available at special package prices.

SKY-WATCHER ED80 REFRACTOR

Because our test of this telescope occurred before the gold-tube ED80 Pro models were available, we used a standard version (blue tube) of the same telescope. We figured that if the standard version passed all our tests, the Pro version would surely do the same. And that's what happened. This compact, portable telescope can be used on a sturdy photographic tripod for quick celestial scanning or on an altazimuth or equatorial mount for more prolonged viewing. When teamed with the new Sky-Watcher HEQ5 equatorial mount, it becomes a potent astrophotographic instrument.

Using eyepieces ranging from 32mm to 4mm (19x to 150x), the small scope performed like a champ, giving splendid wide-field vistas of the entire Pleiades cluster at low power and tack-sharp views of Jupiter at 150x. The optics are simply superb. You come away smiling at how versatile a small telescope can be. In terms of image



FINISHING TOUCH
The new Sky-Watcher Pro telescope line features a white and gold finish, along with enhanced accessory packages to distinguish it from the standard blue-tube Sky-Watcher models.

brightness and crispness of definition, it was either equal to or (more often) better than a 90mm Maksutov-Cassegrain on a wide variety of celestial objects.

What proved to be most surprising was photographic performance. With a Meade compressor intended for use on Schmidt-Cassegrain telescopes, the ED80 became an f/5 astrograph, with very impressive results. A compact, go-anywhere telescope, the ED80 performs at the top of its class in every respect. Astrophotographers, especially, should give it a serious look.

SKY-WATCHER ED100 REFRACTOR

This telescope is patterned after legendary apochromatic 4-inch refractors made by well-known Japanese telescope companies such as Takahashi and Vixen. However, the apochromatic ED100 sells for far less than these and other 100mm-class apos. Unlike Synta's 80mm apo refractor, the ED100 features a relatively slow (longer) focal ratio of f/9, resulting in a focal length of 900mm. A slower focal ratio usually ensures consistently better-quality optics, essential for sharp high-power images.

Our test ED100, on loan from Pacific Telescope Corp. in Vancouver, is one of Sky-Watcher's new Pro models. It is durable and attractive, with a gold and white tube, but lacks the luxury of the machined and anodized components of the finest telescopes. It is only in the finish, however, that you'll see a significant difference between the Sky-Watcher and the much higher-priced alternatives. In all critical functions, the telescope is equal to or outperforms the competition.

The tube interior is well baffled and blackened for suppressing stray light. The 2-inch focuser is a well-made Crayford-style roller unit that moves with buttery smoothness and accuracy. As a Pro model, the telescope comes with an excellent 2-inch star diagonal with a full-thickness mirror that did not exhibit any of the pinched optics or astigmatism which plagues some low-cost, thin-mirror 2-inch diagonals. A lock tightens the focuser enough to prevent a heavy eyepiece or camera from sliding out of focus. Our only complaint is that the two setscrews on the focuser, which hold the star diagonal in place, are too small and too close to the diagonal for easy adjustment, especially in cold weather with gloves on.

The 9x50 finderscope (on both Pro models) has excellent optics and precise, solid adjustments for aligning it to the main optics. A quick-release dovetail bracket allows it to be detached easily for storage or transport without any tools.

When the ED100 is purchased as a separate tube assembly, the included tube rings come with a dovetail bar that allows the telescope to clamp onto most mounts imported from the Orient. At eight pounds, the tube is lightweight and is a good match for any medium-weight equatorial mount, such as Sky-Watcher's own EQ4 and HEQ5 Pro models, Celestron's CG5 mount, Meade's LXD-75 and the Vixen GP and Sphinx mounts.

In addition to the finderscope, tube rings, dovetail bar and star diagonal, a nice bonus included as standard equipment with the Sky-Watcher Pro line (as opposed to the standard "blue-tube" models) is a foam-fitted aluminum (CONTINUED ON PAGE 30)

TWO NEW SKY-WATCHER PRO MOUNTS The smaller HEQ5 mount, at left, holding the ED100 apochromatic refractor, is flanked by the more massive EQ6 mount, supporting a 9.25-inch Schmidt-Cassegrain. Though outwardly similar in appearance, the HEQ5 and EQ6 mounts differ significantly in weight and load-carrying capacity.

MAXIMUM TRANSMISSION The refractors' doublet ED lenses are fully multicoated for maximum light transmission for the aperture.

STAYING FOCUSED The Pro-model refractors include a fine 9x50 finderscope, 2-inch focuser and star diagonal and two long-eye-relief eyepieces.

KEEPING IT TOGETHER Both mounts accept dovetail plates compatible with many other popular mounts, such as the Celestron, Meade and Vixen models.

FINE-TUNING Polar-aligning the mounts is made easy with the excellent polar-alignment scope included as a standard item and the fine adjustments for aiming the polar axis in altitude and azimuth.

ALAN DYER (M13); TERENCE DICKINSON (NORTH AMERICA NEBULA)

THE GLOBULAR CLUSTER M13 recorded nicely in an 8-minute exposure with the Sky-Watcher ED100 telescope at f/9 on the EQ6 mount using a Canon 20Da camera. Note the 15th-magnitude galaxy IC4617 (arrowed).

THE NORTH AMERICA NEBULA was captured in a 12-minute exposure with the ED80 fitted with an f/5 compressor and a Hutech-modified Canon 20D digital camera.

THE SYNSCAN CONTROLLER features direct one-button access to Messier, NGC, IC, solar-system and up to 25 user-entered objects.

SKY-WATCHER REVIEW (CONTINUED FROM PAGE 17)

carrying case, an essential accessory for a portable telescope. You might spend $200 or more on such a case if you had to purchase it separately. Considering the included accessories, the Pro scopes represent an excellent value.

FINE OPTICS

Like the ED80, the Sky-Watcher ED100 employs a two-lens objective, with one lens element made of high-grade extra-low-dispersion, or ED, glass. In the Sky-Watcher ED100, stars and planets look neutral in tone, and the brightest stars and planets show no obvious false-colour halos, even at high power. Only when the object was racked out of focus did a mild magenta or cyan tint appear, as is typical of well-corrected doublet apos. You have to move w-a-a-a-y up the price ladder to costly three- and four-lens apos to exceed the colour correction of the Sky-Watcher's doublet ED lens.

In short, colour correction was as good as or better than that of any other competing doublet apo refractors we've tested. The manufacturer's literature suggests the telescope provides the "virtual elimination" of false colour, a promise that is certainly fulfilled.

While a lot of emphasis is placed on colour levels in refractors, even more important to sharp images is a lack of other debilitating optical aberrations. Under a critical high-power star test, the ED100 showed textbook-perfect images, with none of the miscollimation, spherical aberration or astigmatism that prevents a lesser-grade telescope from reaching a crisp focus. With the ED100, images snapped into sharp focus, a sign of high-quality optics. As expected, this proved to be an excellent telescope for exploring the Moon and planets, enjoying the subtle colours of double stars and splitting challenging tight doubles.

The ED100's f/9 focal ratio is a little slow for deep-sky imaging. Nevertheless, bright deep-sky objects recorded nicely in 10-minute exposures with a digital SLR camera. This would also be a fine scope for lunar and planetary imaging with a webcam. It is as a portable visual telescope, however, that the ED100 excels. The Sky-Watcher ED100 provides top-class optical performance at an affordable price for a premium apo.

THE PRO MOUNTS

One of the most common inquiries we get from backyard astronomers is for a recommendation of a high-quality mount—one solid and accurate enough to allow astrophotography yet light enough to be portable—that won't break the bank. It's been a long wait, but the search is finally over. With Sky-Watcher's Pro-level models, buyers have a choice of two excellent mounts suitable for a wide range of tube assemblies. Rarely have we been so impressed with a product. As with its new refractors, Sky-Watcher has set new levels of performance at breakthrough prices with its HEQ5 and EQ6 Pro mounts.

The EQ6 Pro is Sky-Watcher's top-of-the-line mount. Make no mistake, this is a big mount—the head alone, without the counterweights, tips the scales at 33 pounds. Add the 15-pound tripod, and you have a hefty package to haul out to the yard, even without the counterweights or a telescope.

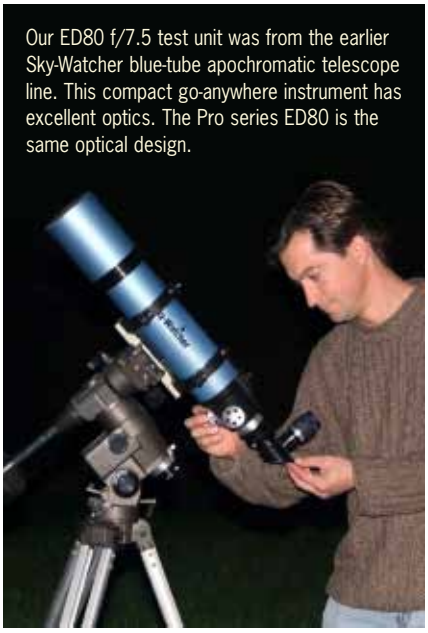
But it is solid! A Celestron C9.25-inch Schmidt-Cassegrain tube (weighing 20 pounds) and the necessary pair of counterweights barely fazed the mount. Vibrations damped down quickly in a respectable two to three seconds. The mount would comfortably handle a 10- or 11-inch Cassegrain tube, though with a bit more bounce. With a lighter telescope, such as the ED100 refractor, vibrations were almost nonexistent, damping out in less than a second.

If the EQ6 mount is a bit much for you to lift, consider Sky-Watcher's HEQ5 Pro, a scaled-down version of the EQ6. The head weighs 20 pounds and the smaller tripod 12 pounds, making a combination that is easy to carry outside for quick looks and is practical for airline transport. Yet even this midsized mount handled the Celestron C9.25 optics, though the damping time from a sharp rap to the tube was up to five seconds. This scope represents the upper size limit for this mount. But smaller optics, such as a 6- or 8-inch Schmidt-Cassegrain, a 5- or 6-inch Maksutov or Newtonian or a 3-to-5-inch refractor, would be perfect mates for the HEQ5.

GOTO FUNCTIONS

Both mounts come with the SynScan GoTo system for computerized finding of objects (our test units had firmware v2.05). The mounts worked beautifully, aligning and finding targets without flaw. Objects often ended up dead centre in the field and were rarely off by more than 10 arc minutes, ensuring they were in the field of a moderate-power eyepiece. However, accurate GoTo pointing does require good polar alignment. You can't simply plunk down these mounts oriented only roughly north. A built-in alignment scope in the polar axis and fine adjustments on the mount for altitude and azimuth make polar alignment easy and accurate enough to eliminate any drift in declination during a 15-minute exposure.

Our only complaint is that the SynScan software lacks some of the refined features of better-established GoTo systems. There is no Hibernate mode to allow the mount to power up and find objects without going through the initial process of locating and aligning on three stars to calibrate the mount to the sky. There is no "auto align" process in which the mount picks stars for you; it is up to you to select suitable alignment stars from the alphabetical list



Our ED80 f/7.5 test unit was from the earlier Sky-Watcher blue-tube apochromatic telescope line. This compact go-anywhere instrument has excellent optics. The Pro series ED80 is the same optical design.

the hand controller provides. There is no option for resyncing on a new object to refine pointing accuracy and no method of filtering objects by constellation, type or magnitude.

Nevertheless, all the Messier, NGC and IC objects are there, so if you know what you want to look at, the SynScan can be used to call them up and find them. Impressively, the EQ6's motors proved quieter than any other GoTo system we've used, letting out just a mild whirr when slewing at high speed, not the piercing screech or whine of some other brands. The smaller HEQ5 was a little noisier, but not by much. Both mounts slew quickly, then brake and find objects without any overshoot or prolonged centring.

Both mounts can be controlled by an external computer through an RS232 serial connection (a cable is supplied). TheSky 6, Cartes du Ciel, Earth Centered Universe v5, SkyMap Pro v10, Starry Night v5.7 (both Windows and Mac) and Equinox v5.3 (Mac) all worked fine, provided you selected Celestron NexStar 5 as the type of telescope to be controlled, as per the instructions.

ASTROPHOTO PERFORMANCE

Where these mounts really stand out is in their tracking ability. Typically, a low-cost mount has such large random and periodic error in its drive that any long-exposure imaging is a battle. Not so with the Sky-Watcher Pros. Both mounts exhibited no more than about 10 to 15 arc seconds of gentle periodic error—as good as mounts selling for two to three times the price. Training the Periodic Error Correction circuit reduced this to about 6 to 7 arc seconds.

The only complication came when the temperature dropped below about –5°C: The EQ6 started to bind and stall when slewing around its right-ascension axis, probably caused by grease stiffening in the cold and metal parts contracting. (The HEQ5 worked without complaint at such temperatures.) Backing off the gear tension (each EQ6 axis has two tiny hex screws for this) seemed to alleviate the problem. Some users have resorted to re-greasing the mount with a low-temperature lubricant. However, disassembling the gear systems is risky, possibly compromising periodic error, backlash and GoTo accuracy. In any case, Synta reports that the most recent shipments of the EQ6 mount are lubricated for use at lower temperatures.

In other respects, hand-guiding these mounts was a pleasure—guide stars barely moved off the crosshairs for several minutes. When corrections were needed, the mounts moved instantly and precisely, exhibiting no backlash or slack, performing as well as any high-end mount. As another plus, both mounts continued to track well past the meridian, with no software or hardware stops to limit exposure times. Nice!

We took a series of 18 two-minute exposures with the HEQ5, using a 600mm-focal-length telescope, with the mount unguided and freewheeling on its own. As a testament to the HEQ5's tracking ability, half the shots showed so little tracking error, they could be stacked for the equivalent of a single long exposure with pinpoint stars. Were you to try that with any lesser mount, every shot would be horribly trailed and unusable. This level of tracking ability opens up the possibility of deep-sky imaging with a minimum of expensive gear and effort.

Nevertheless, guiding long exposures is still the way to get the best deep-sky shots. Happily, both mounts also worked fine with an auto-guider (a Santa Barbara Instruments STV), calibrating and guiding without fuss the first time and every time. Fifteen-minute guided images turned out perfectly. If you want a solid, astrophoto-capable mount, look no further. Apart from the EQ6's cold-weather glitch, we can recommend the new Sky-Watcher Pro mounts without hesitation. ■