

If anyone does not believe that California had an uncommonly bad winter, consider the awful truth: I bought an Astro-Physics refractor in early December, 1998, and did not have first light until April.

High-end telescopes tend to change hands in lock-step whenever somebody buys a new one. A friend had ordered a 155 mm f/7 EDF from Astro-Physics when the company last took orders, and mentioned to several people that he would probably sell his old big refractor when the new unit arrived. I was the first person to express definite interest in the used instrument, and I continued to whine and whimper at regular intervals during the ensuing months, so I ended up getting the telescope. I have been trying to sell my own "old" instrument -- a Meade 127 ED -- but with no luck so far.

My new acquisition is the optical tube assembly for a 1987 model Astro-Physics 6-inch f/8 triplet refractor. It came with an assortment of tube rings and associated hardware, a right-angle finder, an electric focuser -- which I promptly removed -- and a simple wooden carrying case, which resembles either a weapons carrier for an anti-tank missile or a coffin for the cruelly murdered body of a half-starved and emaciated nine-year-old child.

Buying things from friends makes for weird pricing. The prior owner originally asked \$1750 for the telescope, but I protested that that wasn't nearly enough. We settled on \$2000, an amount which he thought too high and I too low. Yet our complaints were of roughly the same volume, so I suspect the price was fair.

I took it home and the rains began. Oh, there were two good nights between December and April, but I was anxious to carry on with my primary observing program, chasing down faint fuzzies with Harvey, my Celestron 14, so I kept putting off using the big refractor till a first-quarter Moon night, and never got one. The San Jose Astronomical Association's in-town public star party, at Houge Park in San Jose, California, on the night of Friday 23 April, finally provided a chance.

Carrying a big refractor in a Geo Metro is an interesting exercise in packing. The case is far too long to fit in the cargo area, even with the rear seats folded forward, so I ended up reclining the front seat as far as it would go, and loading the wooden container stiffly on top of it, much as if it were a very nervous passenger, trying to lean back and relax, and failing miserably. In that position it was clearly visible from the outside, so that every passing police officer could decide whether I was carrying a body or a bazooka. Fortunately, my Losmandy G-11 mount and my other observing gear all pack quite compactly, and I had plenty of bungee cords to hold the case in place,

so I managed, but even so, hauling the new refractor is a lot more hassle than hauling my C-14.

Setup was fairly quick. I have the pier extension for the Losmandy, which put the dovetail clamp pretty high, but the six-inch's tube is an easy lift. I had put it into the box with tube rings and dovetail plate attached, and it was no trouble to pick it up, slide it into position, and fasten it in place. I didn't actually think to weigh the tube, but I needed only one 10-Kg (22 pound) counterweight for the mounting, and it was further out than the telescope.

I used Venus to line up the finder, and happily noted through the main eyepiece that there was surprisingly little color visible. The newer Astro-Physics refractors have no color that I can detect, and this one isn't quite that good, but it has far less color than does my smaller and slightly slower Meade 127 ED doublet. A look at Sirius at 248x confirmed the good color correction, though seeing at its relatively low elevation was not up to doing a star test to check on spherical aberration.

Then I looked at the Moon, which was much higher in the sky and had better seeing. My 248x eyepiece -- a new Pentax 5 mm SMC ED Orthoscopic -- gave a little too much magnification, so I dropped back to an 8 mm Brandon and 155x. The view was wonderful. The terminator was past the Straight Wall and Birt, but I am not much of a lunar observer and had not happened to have seen the Straight Wall in such shallow illumination before, and so did not immediately recognize it. Rima Birt was prominent.

I moved north to the Alpine Valley, where persistent observation yielded no more than an occasional hint of the central rille -- not enough to log -- then dropped back to Archimedes and the Hadley area of the Apennines. I could see several rilles in the system that extends from Archimedes toward the Apennines, and had a particularly nice view of Rima Hadley, not only the portion that runs parallel to the Apennine front, but also the portion at nearly right angles to it, that passes close by the Apollo 15 landing site. This is one of my favorite areas on the Moon, for through a decent-sized amateur telescope I can identify features and vistas that I have seen via live video from the lunar surface, as the astronauts operated their camera. The view through the six-inch was almost the equal of one I once had through my C-14, the difference being that the six-inch did not show the crater that nearly bridges the rille where it turns outbound from the mountains -- I think that crater is sometimes called Hadley C.

I spent a fair amount of time showing this view to members of the

general public who showed up for the star party, and to other telescope operators. Most everyone thought it was wonderful. A few lunar and planetary enthusiasts, who did not have similarly-sized refractors, told me how sad it was that my new telescope had terrible optics, and hinted that if I wanted to reclaim my investment, they would be willing to take it off my hands, perhaps even for the price I had paid for it.

Mars was lower in the sky, and was disappointing, not only because of its position but also because the seeing deteriorated slightly as the night wore on. The central meridian was at about 230 degrees. At 155x, in good moments, I could see the Hellas Basin just coming around the limb, much dark area surrounding it, though sufficiently foreshortened not to show any structure, the north polar cap, and a more nearly central small darkish area, evidently Trivium Charontis. That's not too shabby for the conditions.

I spent a little while Messier hunting -- no easy task under the Moon and city lights. Nevertheless, at 78x (16 mm Brandon) I found and easily resolved most of the winter-sky galactic clusters. I looked at a few wide double stars, too, but never did think to try a star test.

So at the end of the first night out, I am well pleased with my new telescope. The 1987 Astro-Physics 6-inch f/8 shows every promise of being exactly what I expected; namely, a high-quality triplet refractor with immaculate optics, well-suited among moderate apertures for spectacular lunar and planetary views.

Nevertheless, some among you may be wondering why I bought it in the first place. Don't I have a Celestron 14, and don't I always say that aperture wins? Haven't I often said that it appears to me as if even high-end six- and seven-inch refractors are routinely outperformed not only by my C-14 but also by humungous but transportable Dobson-mounted Newtonians? Isn't it a little odd to buy a telescope which is lower in performance and more cumbersome to transport than one I already own?

Well, yes, yes, yes, and yes. With respect to the third question, I reiterate that I have compared six- and seven-inch refractors to the other telescopes mentioned on numerous occasions, and have yet to see circumstances when I preferred the view through the smaller instrument. (I should also hasten to add that many other observers who were present on those various occasions do not agree with me.)

I bought the telescope for several reasons. First, I like telescopes, and I enjoy having different kinds to play with. Second, I like quality in my toys, and the Astro-Physics refractors with which I have been familiar deliver that commodity in large lots. Third, I wish

to investigate more carefully the issue of relative performance between high-end refractors and some of the other telescopes I have mentioned, and it will help to own this one, even though I can neither transport nor mount both it and my C-14 at the same time.

The apparent awkwardness of size may diminish as I acquire more experience with the telescope. Even if it does not, there is probably a larger telescope transporter than a Geo Metro in my future. At that point, the big refractor will make an excellent telescope for public star parties, and for occasions where I do not wish to wrestle with the 23 Kg (52 pound) tube assembly of my C-14.

And there is another reason. I have thought of a wonderful color scheme for a fair-sized refractor. Just don't anybody tell Roland what it is...

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On the evening of Friday, May 7, 1999, I took my recently-purchased 1987 Astro-Physics 155 mm f/8 triplet refractor to Fremont Peak State Park (near San Juan Bautista, California), for its second time out in my possession. It was the best of nights; it was the worst of nights. After a disturbingly un-California-like winter, any dark, clear sky was much to be appreciated, but on this occasion, the early onset of fog and high humidity put an unhappy damper on observing.

Setting up the telescope is becoming much easier with experience. I have used my Losmandy G-11 mounting in the field several dozen times, and am getting to where I can deal with it quickly and efficiently. I have bought two sets of three of Losmandy's knurled knobs to speed up the attachment of the equatorial head, and of the pier extender that I use with the 155, and they are a noticeable improvement over having to fuss with Allen wrenches. The other telescope I use regularly with this mounting is my Celestron 14, though, so the big win in operational happiness is **not** having a 52-pound lift to attach the optical tube assembly. It also helps that I only have to install one 22-pound counterweight, not three.

The main shortcoming of the big refractor is the wide range of eyepiece positions. A Christen triplet is **heavy** -- there's a lot of glass in the front end of that tube. In consequence, the optical tube assembly balances nearer the front end than the back. The distance from the balance point to the eyepiece position is about three quarters of a meter. The range in eyepiece height is rather more, since the "high" position has the tube looking horizontally over the top of the mounting's right ascension axis: Swinging to look vertically lowers the

eyepiece, not only because of that three quarters of a meter, but also because the intersection of the optical tube assembly and the declination axis is swinging in an arc about the right ascension axis. All in all, the difference is something like a meter, and that's quite a lot for someone who has been spoiled by the much smaller range of eyepiece positions of a C-14. Perhaps I shall ballast the lower end of the tube -- actually, the lower end of the Losmandy dovetail plate -- to reduce the range. The mount has more than enough excess capacity to handle a couple of lead bricks.

I took a brief look at Mars shortly after setup, but the seeing was poor and the planet was presenting one of its more featureless aspects, so I did not bother to try to make sense of such faint detail as may have been lurking at the limit of vision. I instead went on with my standard means of familiarizing myself with new equipment, a Messier survey. I had logged a few the first time out, mostly wintertime galactic clusters, which were all easily resolved at 78x, I trust to no one's surprise. Now Leo and Virgo were riding high, and it was time for some serious galaxy work. I went through all the Messier galaxies in those two constellations, using a 12 mm Brandon eyepiece for 103x, and had just crossed the border into Coma Berenices, when an abrupt rise in humidity and the approach of tenuous wisps of fog prompted me to wimp out and cover my optics. I had been too lazy to pack my big battery, so I could not use my Kendrick anti-dew system, but it had been a tiring week, so I was just as glad to have an excuse to quit early.

The refractor was doing very well on the Messier galaxies. A magnification of 103x is higher than many people would use for deep-sky work with a six-inch telescope, but I have had good luck with a 1.5 mm exit pupil for galaxy observation in telescopes with apertures from 55 mm to 350 mm, and it seemed to be the right choice for the Astro-Physics as well. One of my first targets was M104, the Sombrero galaxy, and I was pleased to see it showing all the gee-whiz detail that people like to look at: concentrated nuclear brightness, fat bulging lens, and the long dark streak of the edge dust lane, clearly bordered on both sides by brighter material. Nearly all of the Messier galaxies had detail of some sort, such as bright nuclei, visible elongations of varying orientations and proportions, mottling, or dust lanes.

I could not help but notice many non-Messier galaxies as well. I casually logged NGC 3384 and 3389, near M105. NGC 3628, not far from M65 and M66, was almost a duplicate of the Sombrero: Its edge dust lane was delineated by bright stuff on both sides, but the nuclear concentration was not as great. I could see NGC 4388 and 4387, closely south of M84 and M86 -- 4388 was an obvious edge on. And it was simple to follow the brighter galaxies in Markarian's chain on the way from M84

and M86 out to M88 and M91 -- it was easy to see NGC 4435, 4438, 4458, 4461, 4473, 4477, and 4459, all without pushing the telescope, just casually wandering from stepping-stone to stepping-stone as I hunted Messier targets.

The six-inch instrument that I have most extensively used in recent years is an Intes Maksutov, generally with similar magnifications when chasing galaxies, typically 97x. The Astro-Physics refractor was obviously outperforming the Intes on deep-sky stuff, and a moment's thought showed why. There is a small increment in performance from the fact that the refractor is slightly bigger -- the actual apertures are 155 mm and 150 mm for the two telescopes. But the main difference stems from light loss in the Maksutov-Cassegrain because of the secondary obstruction -- exactly 50 mm diameter -- and because the reflective coatings on the primary and secondary are less than perfect.

Coatings are the tail that wags the dog in this matter, and coatings vary enough that generalization is difficult. Aluminum in poor condition might reflect 80 percent or less, so that light losses from two such reflections would reduce the incoming beam to 64 percent or less of its original intensity. On the other hand, whizzy high-tech coatings in sparkling new condition might reflect close enough to 100 percent for the losses to be negligible.

Let's assume my Intes has mirrors that reflect 90 percent of the light, and calculate from there. Both the Intes and the refractor have two air/glass transmissions (the refractor is a cemented triplet), and I use a star diagonal with both, but we can expect the effects of these things to be similar for the two telescopes, and so ignore them when making the comparison. Transmission through the glass certainly causes negligible losses. On that basis, the effective collecting area of the 155 mm Astro-Physics is $(\pi / 4)$ times the aperture squared, or $(\pi / 4)$ times 24025, or 18869 square millimeters.

The Intes has effective collecting area of $(\pi / 4)$ times 150 squared, times 8/9 (obstruction by the secondary), times .9 squared (the two extra reflections), which works out to 12753 square mm. The Astro-Physics therefore gathers more light than the Intes in the proportion 18869 : 12753, or 1.483 -- 48.3 percent more light. That works out to a limiting magnitude difference of 0.428 magnitude, which is certainly enough to be noticeable. I would have said that the refractor was doing vaguely half a magnitude better than the Intes, and so it was.

The same formulae can be used to compare this refractor with the more ubiquitous eight-inch Schmidt-Cassegrain telescopes. With truly

ratty coatings, that reflect only 80 percent, a 203.2 mm SCT with a one-third-diameter secondary has an effective collecting area of 18849 square mm -- such an "eight-inch" telescope would provide the observer with slightly *less* light than my "six-inch" Astro-Physics. With perfect (100 percent) coatings, the SCT collecting area rises to 28826 square mm, which gives it an 0.46 magnitude advantage over my refractor. With 90 percent coatings, the SCT's advantage drops to 0.231 magnitude. I expect that few SCTs in operation have coatings worse than 80 percent, and that none have coatings that are perfect. With average coatings, an eight-inch SCT is not quite as far ahead of an Astro-Physics 155 as mindless comparison of their apertures would suggest.

Of course, an eight-inch SCT doesn't cost as much as a high-end six-inch refractor, nor is it as heavy and cumbersome. Neither does it require as big and expensive a mounting as a Losmandy G-11.

The refractor might have another mild advantage for deep-sky work compared to some compound telescopes, perhaps including some SCTs. High-end refractors are generally extremely well-baffled -- there is none of this nonsense about light squeaking past the secondary mirror and sneaking down the baffle tube. I did not mention that point in comparing the Astro-Physics to the Intes, because the Intes is quite well baffled in its own right. But I am not sure that is so for all of the commercial SCTs.

Anyhow, it was an interesting night. I will continue to report as I gather experience with my old/new six-inch Astro-Physics.