At Fremont Peak State Park, near San Juan Bautista, California, on the evening of 31 May, 1997, several of us had planned an informal series of eyepiece comparison tests. Informal plans often come to naught, and when half the night had passed with no eyepiece comparisons, I was beginning to think that these arrangements would go that way, too, when up walked Joe Sunseri of Earth and Sky Adventure Products -- that's where I had gotten my 6-inch f/10 Intes Maksutov. I had sent Joe EMail about our proposed comparisons, and he had brought an eyepiece I was most curious about.

The unit was a 12 mm monocentric, made by the Russian company, Intes. Monocentrics have the reputation of small fields, superb correction, and extremely low scattered light -- qualities that might make them valuable specialized eyepieces for the dedicated observer of planets or double stars. I had never seen one, and was anxious to see whether the claims were true.

Strictly, "monocentric" is a technical term, not an eyepiece name -- it means that all the lens surfaces involved in the design have their centers of curvature at the same physical location, or very nearly so. One specific design, the Steinheil monocentric, uses several extremely thick pieces of glass cemented together; the resulting assembly is much thicker than its diameter. Others merely resemble fairly thick multi-element magnifying glasses, such as Hastings triplets. The unit Joe had was not a Steinheil (yes, I took it apart). It appeared to be a cemented triplet, with nicely blackened edges and very odd-colored coatings, almost the blue-green of a nice, fat, house fly. The designers had worked hard at eliminating stray light. The triplet was mounted between front and back retaining surfaces, with some 5 or 10 mm of clearance between its edges and the metal parts of the housing. Those parts were also well blackened, and threaded, too. All this, plus only two air/glass interfaces, gave the prospect of good performance.

But I am getting ahead of myself. I dropped the eyepiece into the telescope I had set up, which happened to be the Intes, and pointed it at Vega. The field of view was indeed narrow: No porthole on the universe this, the vista was more like looking up from the sewer through an open manhole. The apparent field was only about 30 degrees. Use of such eyepieces would require a good finder or finding eyepiece, and either a sidereal drive or extremely fidgety fingers with a Dobson. Furthermore, the design had a prominent out-of-focus ghost image. The ghost was at most an annoyance -- after a few minutes, we all forgot it was there. It would not interfere with observations of planets or double stars -- the drill is simply to set the object in view a hair away from the center of the field. That separates the ghost from the object in view. Yet I don't think this eyepiece would be suitable for

lunar work -- all those ghosts superimposed would likely add significant stray light to the image. Still, the field around bright Vega sure looked dark. The usual soft glow that surrounds the image of any bright star or planet, was obviously much diminished from what I am used to.

It was time for some comparison tests. I swung the telescope to epsilon Lyrae, the double-double, which was still bright enough to provide a glow, and which also gave the opportunity to judge contrast in the dark space between each pair of stars. (Seeing was excellent, incidentally, and the clouds that plagued us during other parts of that evening were not then about.) I dug out several eyepieces from my own box, and hollared to other observers to bring other interesting units for test. Besides the 12 mm monocentric, we gathered up a Tele Vue 13 mm Plossl, a 12.4 mm Meade Research-Grade Erfle, a 10 mm Vixen Lanthanum, an 8 mm Brandon (of fairly recent vintage), and a 7 mm Meade Research-Grade orthoscopic.

The monocentric out-darked all the others, showing much better contrast in the narrow black space between each close pair of the double double, and less soft glow surrounding each of the pairs itself. Note that we were *not* attempting to judge the brightness of the background sky -- other things being equal, the higher magnifications should have won easily, just by spreading the light out more. Rather, we evaluated the brightness of the ball of light that more closely surrounds each bright image. We also switched eyepieces back and forth many times, to be sure we were not merely seeing small variations in transparency instead of real variation in eyepiece characteristics.

As I was saying, the monocentric won, and it was no contest. A distinct second was the Meade 7 mm orthoscopic, followed by the 8 mm Brandon, then a tie between the 10 mm Vixen Lanthanum and the 13 mm Tele Vue Plossl, with the Meade 12.4 mm Erfle last. Everybody was quite impressed with the monocentric, and beginning to be a little disappointed with the performance of several standard favorites.

It's not as good a test to compare eyepieces of different focal lengths as ones of the same focal length -- if any of the glow is due to scattering in the atmosphere or off the optics of the rest of the telescope, then short focal-length eyepieces might obtain an edge, by spreading out that scattered light over a wider area. But we had to test what we could find, and note that the monocentric outperformed all the shorter focal-length eyepieces against which we compared it.

(I should say in passing that I have hearsay reports that at different times, Meade sourced its "Research-Grade" series of eyepieces from several different vendors, so that different year's versions of

what is nominally the "same model" eyepiece have substantially different performance. The Meade eyepieces used for this test were my own, and were purchased in 1979 or 1980; your mileage may vary.)

Later in the evening, after I had put the Intes away and set up my 98 mm f/6.7 Brandon refractor (yes, 98 mm -- no typo), another observer came by with some more eyepieces for test. In that instrument, we compared the 12 mm monocentric with a 7.5 mm Takahashi, a 12 mm Brandon, and the Meade 12.4 mm Research-Grade Erfle. We used epsilon Lyra once more, and once again the monocentric won handily. The Takahashi was second -- I did not think to pull out the Meade 7 mm orthoscopic again, but I believe that the Takahashi was approximately as good as the Meade 7 mm with respect to darkness of field. The 12 mm Brandon was third, and the 12.4 mm Meade Erfle last.

I had planned to bring my set of Ramsden eyepieces for our eyepiece comparison night, but forgot. My old Ramsdens are coated, and seem to give quite contrasty views, probably because they are assembled from military surplus lenses, and the military had no-nonsense specifications about quality of polish. I will try to remember to check the monocentric against a 12 mm Ramsden in the future. I have checked a Ramsden against a Takahashi, and found them comparable in contrast, so the monocentric will probably beat the Ramsden, but likely not by much.

Many of us also wondered how the monocentric would stack up against Pentax's high-end eyepieces, or against units by Zeiss or Clave'. Alas, none were handy for testing. Perhaps some other time.

I think that the bottom line on the monocentric is, that serious observers of double-stars or planets (but not just the Moon) should try one. Yet monocentrics are NOT general-purpose eyepieces: The narrow apparent field will be an impediment to many uses, and the strong ghost image will bother some (and will scatter light across lunar views). Notwithstanding, the very low scattered light from sources other than the ghost, will result in noticeably improved ability to detect faint companions of double stars, and to see low-contrast planetary detail.

Intes exports monocentrics in 6, 9 and 12 mm focal lengths. Earth and Sky Adventure Products has them at about $100 each; perhaps other vendors carry them as well.

On 9 June, 1997, I continued the series of eyepiece comparison tests involving Intes monocentric eyepieces, that I began a week earlier. The objective was to compare the amount of light from a bright source -- such as a star -- that was scattered into the immediate vicinity of the image of the source. Less scattering improves the detectability of

low-contrast, low-brightness features nearby; eyepieces that do well might be particularly useful for observing planets, or for observing doubles in which one star is much fainter than the other.

These tests were by no means intended as comparisons of all important features of the eyepieces -- I was solely interested in the matter of scattered light. These units differed in many other respects, such as apparent field, and such as quality of images at fast f-numbers.

I used an 80 mm f/11.4 Celestron refractor, manufactured by the Japanese company, Vixen. This conventional doublet has excellent, well-baffled optics, and its small aperture made my observations less subject to seeing problems. I used Polaris as the target: It was bright enough visibly to scatter noticeable light with all the eyepieces, and the visibility of its faint companion provided an additional check on how well they were doing.

I did not have all the eyepieces I used for the earlier tests -- many were borrowed -- but I had some new additions. Joe and Karin Sunseri, of Earth and Sky Adventure Products, had lent me a 9 mm and 6 mm Intes monocentric for testing, and this time, I had my collection of Ramsden eyepieces handy. All in all, I used:

12.4 mm Meade Research-Grade Erfle (6 air/glass interfaces; multicoated)
12 mm Ramsden (4 air/glass interfaces; coated)
12 mm Intes monocentric (2 air/glass interfaces; multicoated (?))
8 mm Brandon orthoscopic (4 air/glass interfaces; multicoated, I think)
7 mm Meade Research-Grade orthoscopic (4 air/glass interfaces; multicoated)
6 mm Vixen Lanthanum (6 air/glass interfaces, I think; multicoated)
6 mm Ramsden (4 air/glass interfaces; not coated!)
6 mm Intes monocentric (2 air/glass interfaces; multicoated (?))

All these eyepieces had 1.25-inch barrels, and were in good to excellent condition.

The Intes monocentrics had an unusual coating, nominally a multicoating, but with a bright blue-green color reminiscent of a house fly. A correspondent reported testing the actual reflectivity of these coatings, and finding them inferior to uncoated glass. I am inclined to believe that result, though I have no way to verify it quantitatively. The Intes units exhibited a strong green ghost image, which could easily be displaced away from the image of a star or planet, but which would interfere with Lunar observation.

The Brandon was at least coated; I am simply not sure whether it was

multicoated. It was a late model, black-anodized unit with a flexible eye cup.

I am not sure whether the Vixen Lanthanum had six or eight air/glass interfaces.

The results featured no surprises. I did not do all possible comparisons; rather, I paid particular attention to comparing eyepieces of similar focal lengths. In essence, the Intes units won handily, but truth is in the details, so...

First, I compared the 12 mm Intes to the 12 mm Ramsden and the 12.4 mm Erfle. The Intes out-darked the Ramsden, though not by much, and the Erfle was a distant third. The Ramsden even out-darked the 6 mm Lanthanum, whose shorter focal length and higher magnification might have been expected to give it an advantage, at least in smearing out that part of the scattering that was due to things other than the eyepiece (telescope, atmosphere, and so on).

Among the shorter focal-length eyepieces, the 6 mm Intes was the clear winner. The Meade 7 mm took second place. It was only a hair better than the 8 mm Brandon, and the pattern of scattered light in the two eyepieces was sufficiently different to make the comparison hard to call; the Brandon appeared to scatter as much light as the Meade, or more, but it scattered it more widely and more evenly. The Brandon might thereby give better results for particularly fine low-contrast detail, than the Meade. Furthermore, both the Brandon and the Meade might have suffered from their lower magnification; that is, they would have spread out any scattering from atmosphere or from the rest of the telescope, less than a higher magnification, so that the scattered light would have appeared brighter.

The uncoated 6 mm Ramsden was a close runner-up to the 7 mm and 8 mm eyepieces. The 6 mm Vixen Lanthanum was last, among the short focal-length units that I tested.

I could hold Polaris resolved with all of these eyepieces, but the visibility of the companion was in general better with those eyepieces that had less scattered light. The effect was noticeable, but I would say that the difference between the best and the worst of these eyepieces was small.

A few general conclusions seem to emerge. To begin with, there are indeed differences in the amount of scattering within various eyepieces. I observe double stars regularly; there is no doubt that some of these eyepieces would help more than others, when it comes to separating close

doubles of unequal brightness.

Second, the number of air/glass interfaces is paramount in reducing scattering. Despite multicoatings of possibly low quality, the Intes monocentrics, with two air/glass interfaces, were clear winners. The 12 mm coated Ramsden did better than multicoated eyepieces with more air/glass interfaces. The uncoated 6 mm Ramsden was within spitting distance of multicoated units with the same number of air/glass interfaces.

Third, coatings matter. The multicoated Brandon and Meade orthoscopic did beat the uncoated Ramsden. I wish the Intes folks would get their high-tech coating act together.

Fourth, it's amazing how good an eyepiece you an make with two tiny bits of well-polished window glass. The two-hundred-year-old Ramsden design is implemented with simple plano-convex crown glass lenses, yet it outclasses many whizzy modern types with lots of fancy glass, for planetary or double-star work at medium to slow focal ratios. What's more, it comes close to even the best of more modern eyepieces for that purpose. The Ramsdens' advantage stems in part from having only four air/glass interfaces. Furthermore, the origin and age of the units I have (Edmund Scientific and A Jaegers, bought almost two decades ago), makes me think they were assembled from military surplus lenses, and I suspect the military had a no-nonsense attitude about quality of polish.

In 1980, Ramsdens sold for about $10 each. If you can find any at low prices, grab them -- they will be very handy for planetary or double-star work on those occasions when your high-tech modern units -- the ones that weigh several pounds and cost several hundred dollars -- aren't good enough.

The major practical conclusion of the previous test run still stands: The Intes monocentrics are not general-purpose eyepieces, but dedicated double-star and planetary observers might be well advised at least to try them out. And I still would like to run some tests involving Zeiss Abbe orthoscopics; their polish and coatings are reported to be particularly good.