CHAPTER NINE

Tour 1

M78: Return of the Hunter

Walk outside on any early winter evening and your eyes and mind are filled with beauty. With the coming of this season our city skies seem transformed. The constant cold fronts passing though leave clear and, even in badly light-polluted areas, comparatively *dark* skies. Front passages sweep away particulate matter and moisture in the atmosphere, dramatically reducing light scatter. The sky appears darker because it actually *is* darker. Then there are the glorious stars of the winter Milky Way. Their names trip off our tongues as we stand awed: Castor, Pollux, Capella, Rigel, Betelgeuse. It's true that the summer sky actually features more bright stars, but the luminaries of winter, set against black-velvet skies and arranged in artful forms stand out better in our eyes and in our hearts.

Yes, there are many riches in the winter star fields for the urban observer, but there's one constellation amateur astronomers long for all summer, one constellation that stands apart even in the fiery winter skies, and one constellation that is the very essence of the winter heavens: glorious Orion. This legendary figure with his rectangle of bright stars, his blazing belt, and his mysterious sword is so distinctive that many people learn his shape even before that of the Big Dipper/Plough. For the telescope user, it's even better. Orion *is* the Milky Way. This great star-figure has those beautiful objects that draw us back to our home galaxy from nights of galaxy hunting: beautiful open clusters and nebulae of all kinds. There's also the added

bonus that we have deliciously long winter nights in which to enjoy the Hunter's majesty.

The Milky Way's galactic star clusters can be beautiful and are easy to see in the city, but to me Orion has always meant *nebulae*. This constellation holds what are the Northern Hemisphere's best examples of the main classes of diffuse nebula: emission and reflection. Emission nebulae, glowing clouds of hydrogen gas, shine because they are "excited" by the radiation of hot nearby suns. Nebulae of this type are the birthplaces of the stars. As these clouds of hydrogen collapse under the influence of gravity and the shock waves produced by dying supernovae, massive newborns blaze into existence, blue–white "O" and "B" infant stars howling into the night with torrents of ultraviolet light. These high-energy ultraviolet photons turn a simple cloud of hydrogen into an indescribably beautiful artwork like the Lagoon Nebula glowing red in Sagittarius, or Orion's prize, the Great Nebula, M42, unsurpassed in the Northern Hemisphere for deep sky beauty.

Reflection nebulae are different. They are not as lovely as most emission nebulae. Or, at least, they're beautiful in a different, more subdued way. Reflection nebulae are lit, as the name implies, by the reflected light of nearby stars. They are not excited as are emission nebulae, and appear in photographs as distinctly blue in color (emission nebulae tend to shades of pink and red). What's the reason for this difference? It's due to the make up of these nebulae and the types of stars embedded in them. Reflection nebulae, like their emission cousins, are composed mainly of hydrogen gas, but they also contain a large amount of dust. The real key, though, is the stars inside or near them. They are not luminous enough to excite the hydrogen into a glowing red/pink wonderland, but their light *is* strong enough to be well scattered by the nebula's dust. Why blue? They are blue for the same reason our daytime sky is blue: light of shorter wavelengths (blue) is scattered more readily under these conditions.

In photos, reflection nebulae are truly wondrous, shining with a dramatic icy-blue sheen. But, unfortunately for visual observers, especially those in light-polluted urban areas, they are usually terribly difficult objects. A prime example is the reflection nebulosity surrounding the star Merope in the Pleiades. Many visual astronomers go their entire lifetimes without being certain they've *really* seen the Merope Nebula. "Baby's breath on a mirror," doesn't begin to describe how elusive the Pleiades' nebula can be, even under the darkest skies.

Almost all reflection nebulae are at least as hard to see as the Merope cloud, but the winter sky does hold one of the few easy to observe examples of reflection nebula. One that is surprisingly impressive in city skies with small aperture telescopes: M78. That's our first stop this evening. Oh, don't worry—of *course* we'll visit the Great Nebula—but let's leave it for the end. We've got a lot of ground to cover first.

M78

M78 is almost as easy to locate as naked-eye-visible M42. You may not even need your trusty star atlas, though you'll probably want to refer to it if this is your first visit to this area of the Hunter. A glance at *Sky Atlas 2000*, your atlas of choice, or Figure 9.1, will reveal that M78 is about 2° 30′ north-northeast of brilliant magnitude 2.05 Alnitak,

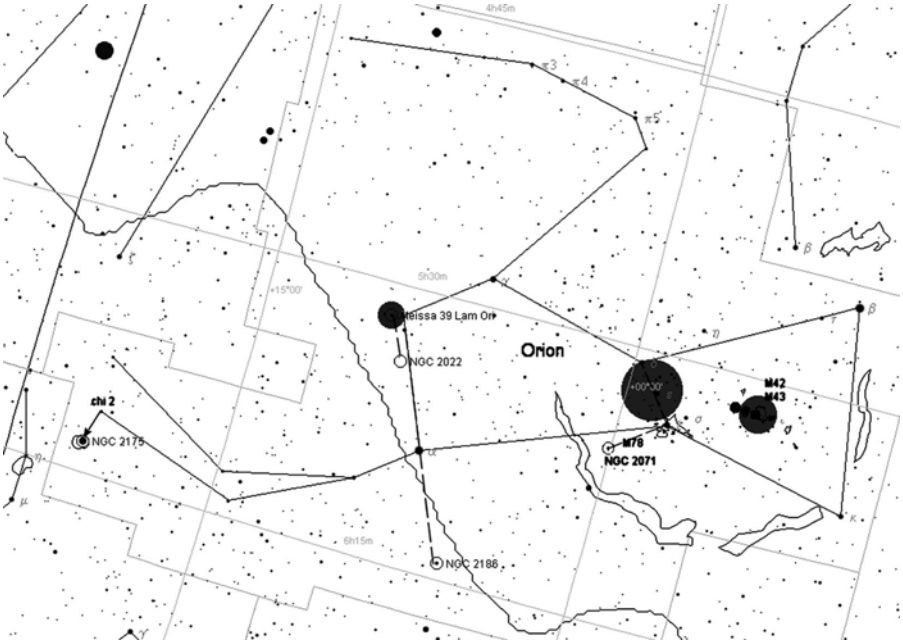

Figure 9.1. Orion, the Mighty Hunter.

Zeta Orionis, the easternmost star in Orion's belt. An easy way to locate the nebula without doing a lot of hunting is to visualize it as forming a 90° angle with the stars of the belt. While searching, use an eyepiece that yields approximately 50×. This will give a reasonably wide field of view, but should also provide enough contrast to make the nebula appear. When you've got the telescope positioned in the general area using your finder, switch to the main scope and look for a 10th magnitude double star in the field. These stars, 55″ apart, should look obviously enveloped in nebulosity, and resemble my drawing in Figure 9.2. You may have to use averted vision to see the nebulosity easily.

If you have trouble locating the right spot, go back to your chart to make sure you are in the right area. I've often found that when I cannot locate an object after an extensive amount of sweeping, I'm usually many degrees away, not even in the right part of the constellation, not just a field or two off. If you think you do have the double star in your field, but can't make out the nebula, switch to an eyepiece that gives you about 100–150× to help spread out the background sky glow.

The true size of M78 as revealed in photographs (see Plate 50) is 8′ × 4′, but you will undoubtedly see less. You should, however, be able to discern over 1′ of nebula with an integrated magnitude of about 8.0 in the form of a circular patch around the double star. I was frankly amazed at how good this object looked in the 80-mm *f*/5 refractor on an above-average night in the city. It was not at all difficult to see, and the nebulosity was prominent enough to almost assume the character of a "deep sky showpiece." My observing logbook notes:

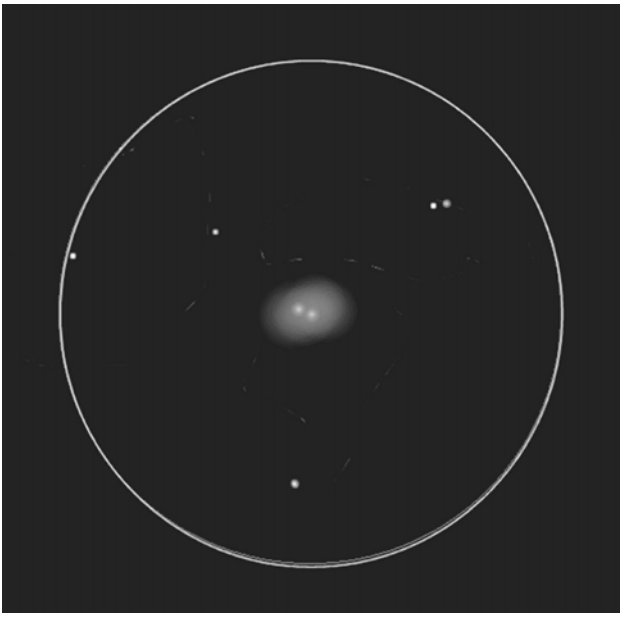

Figure 9.2. M78 is a little fuzzy cotton ball in amateur scopes.

> Once found, the nebula is very easy to make out in the 80-mm refractor. Certainly easier than M1 from these skies. Amorphous and elongated. With some difficulty, using averted vision, it seems to morph into two lobes of nebulosity rather than one round patch, at times appearing peanut shaped and looking almost like the Little Dumbbell Nebula in Perseus.

Like many dimmer nebulae, you may need to wait for an especially good night and for Orion to be on the meridian for much of a look at M78. While the Short Tube 80 has revealed the nebula nicely on better than average evenings, there've been plenty of times when it's been invisible in it or in the slightly larger 4.25-inch Newtonian. It has never eluded me with an 8-inch scope, however.

I've observed M78 on countless evenings with a wide range of telescopes and, until recently, if you'd asked me, I'd have told you that I have seen just about everything this little cloud has to offer and know exactly what to expect from it in everything from a 60-mm refractor to a 30-inch Dobsonian. Naturally, it's when you start entertaining grandiose ideas like that that the sky decides to teach you a lesson. Out with my 11-inch SCT on an only fair night, I recorded in my log that

> The main patch of nebulosity around the pair of stars is visible, but subtle. Not easy. Requires averted vision in the 22-mm Panoptic eyepiece. A 12-mm Nagler makes it even less obvious tonight.

In other words, the nebula was singularly unimpressive. Normally, I would simply have moved on to something else. Instead, I screwed a UHC narrowband light-pollution filter onto the eyepiece. Why did I do that? Don't ask me. As noted in the

accessories section, light-pollution filters *shouldn't* do a darned thing for a reflection nebula. They dim the light of stars, and since reflection nebula "shine" because of reflected starlight, they should be made invisible by a UHC filter. Nevertheless:

> M78 is much improved by a UHC light-pollution filter on the 22-mm eyepiece! It is significantly more visible with the filter than without. Without the filter, it is a round or slightly elongated glow; with the UHC it is an irregular, lobed, and relatively large structure.

Why? As is the case with many reflection nebulae, there is at least a minor emission component to the nebula; M78 is apparently a mixture of emission and reflection nebulosity. There is enough emission nebulosity involved in M78 to make an LPR filter like the UHC fairly effective. The main point of this story? That even after decades of observing, you shouldn't become too complacent about what you can or cannot do with a telescope or how you should use one. If somebody tells you that you can't use your telescope "that way," go right ahead and try. You may be surprised at the results.

Really *study* M78. Just don't find it, glance at it, and move on to your next challenge. Spend some time with this object. Make a drawing. Push yourself to see just that single additional bit of detail. I guarantee, the more you look, the more you'll see. If the main nebula is easy, can you make out an additional object in this field?

NGC 2071

NGC 2071 is a smaller, "detached" portion of the M78 nebula 15′ NNE of the main cloud and visible in the same medium-power field as the main nebula. It's dimmer than the main patch, and only about half its size at 4′ in diameter. Like M78, it surrounds two stars, both, like M78's stars, of 10th magnitude. In larger apertures, in fact, NGC 2071 looks just like M78 does in a 6-inch telescope. I've seen NGC 2071 in 10-inch and larger instruments on *very* good nights in the city, but it is challenging. Very challenging. Which doesn't mean *you* might not be able to bring it back with a 6-inch or 8-inch telescope.

M78 was discovered by Charles Messier's contemporary, Pierre Mechain, in 1780. Despite its somewhat pedestrian appearance in our telescopes, in reality it is a huge and wondrous thing. M78 is believed to be about 1500–1600 light years away and is thus about 2–3 light years across. In other words, this "little" DSO is much, much larger than the main part of our Solar System. While our eyes usually only see one or two dim comet-like objects here, long exposure photographs reveal a much more extensive area of nebulosity as seen in Plate 50.

Color images are especially interesting because they show subtle tinges of pinkish red in addition to M78's overall reflection-nebula blue. That is because there is an obvious emission component here, as I discovered when I attached my UHC filter to the eyepiece. There are enough energetic photons from the stars buried in M78 to encourage at least some atoms to fluoresce. This combination is seen in much more dramatic form in Summer's Trifid nebula, which is so bright that it's often possible to see subtle hints of color difference in it's reflection and emission parts visually with the aid of a medium-large scope.

This whole area is filled with subtle patches of nebulosity. Most, like the recently discovered or rediscovered spot, "McNeil's Nebula," found by U.S. amateur Jay McNeil on one of his CCD images of M78, are very difficult. McNeil's nebula has been referred to as a "visual object," but only from dark skies with sizeable aperture.

After half an hour or more of searching for and observing M78 and its dimmer kin, I'm ready for a break. Time for a sip of coffee, a stretch, and a glance at my star charts to reacquaint myself with the next stop on our night-journey.

Where to next? Given Orion's spectacular appearance and location alongside the Winter Milky Way, you'd think that it would just be brimming with luscious deep sky delights. It is, but only if you're out in the dark countryside with a very large telescope. Open one of those pretty, full-color coffee-table astronomy books and Orion's tantalizing and legendary diffuse nebulae spill off the pages: the Flame, the Horsehead, the Running Man. Beautiful images that fire my imagination and my appreciation for the deep sky. Unfortunately, as stimulating as they are in pictures, these nebulae are dim and subdued visually even with large apertures from the darkest sites. In the city, they are just plain *not there*.

What about star clusters? Orion has scads of these, but most are dim and unimpressive in medium-sized telescopes in light-polluted skies. There are no Messiers among them, and Orion's star nests pale beside those of nearby Gemini and Auriga. Planetary nebulae? One or two. But nothing as good as the Ring. Not hardly. Or even as good as M97, Ursa Major's dim Owl. Galaxies? Surprisingly, given Orion's Milky Way location, yes, but none that are anything more than the dimmest of smudges under gray skies. Is there *anything* else "good" to see other than the Great Nebula and M78? From town? Not as much as you'd expect, no, but there are a few detours the diligent observer can make on the way to M42 and the wonderland of the sword. All these objects are identified in *Sky Atlas 2000*.

NGC 2186

NGC 2186 is a fine, small open cluster 4′ across, shining weakly at magnitude 8.7. In the 11-inch Schmidt Cassegrain, I saw as many as 20 tiny stars arranged in a crescent shape. This group probably requires an 8-inch telescope to see well, though it's no doubt detectable in much smaller instruments as a small hazy patch. Look for it northeast of Betelgeuse. Start at Phi Orionis, 4° 35′ west of Betelgeuse, draw a line from Phi and through Betelgeuse and on into space for the same distance, 4° 35′, and you'll find NGC 2186 nestled in a medium rich star field.

NGC 2174, NGC 2175, and NGC 2022

NGC 2175, another open cluster, is large and sparse—I identified 10 stars that appeared to be cluster members scattered across 20′ of sky. The real attraction here isn't these dim pinpoints, though, it's the large emission nebula, NGC 2174, located to the southwest of the cluster. This nebula *may* be just barely visible in urban skies with a 10-inch

telescope equipped with a UHC filter on an *excellent* night. It is much easier to see in the city with a 12-inch telescope, but is not a routine catch. For that matter, it's not overly easy even with large scopes, 15 inches and above.

In the C11, I was able to detect a *very* faint haze extending outward from a magnitude 7.5 star. The nebula, like the star cluster, seemed to be about 20′ in size. The cluster is easy to locate in almost any scope, as it is comparatively bright at magnitude 6.8 and lies only 1° 22′ northeast of the bright star Chi2 Orionis. As for the nebula, you're on your own. Use a wide-field eyepiece equipped with a narrowband nebula filter, scan the area to the south and west of the cluster, and keep coming back to this spot on superior nights.

NGC 2022, a small planetary nebula, is located 2° east of magnitude 3.54 Lambda Orionis, an attractive double star and one of the three suns that form the small triangular asterism representing Orion's "head." I'd never observed this planetary until recently because its small size (19″) and its dim magnitude (12.4) didn't seemed to make it worth bothering with—even from dark sites. When I finally got around to having a look at this nebula, I was surprised by how nice it looked. It *is* small, but even at 100× it was easily identifiable as a planetary nebula. It also seemed much brighter in an 8-inch telescope than the magnitude figure would indicate. At 200×, it was rather impressive in the 11-inch SCT, appearing as a small gray ball. Some detail in its tiny disk seemed just on the edge of visibility. I didn't see a central star, however, and it was really just a featureless fuzzy. How much scope do you need for it in the city? This planetary was challenging in an 8-inch scope, but I have no doubt that it *could* be doable in a 6-inch scope. I tried an OIII filter, but noted little improvement in visibility or detail.

M42

Are you ready? You won't need a chart to find the evening's final object. M42, the Great Orion Nebula, is easily located by anyone who can see Orion's Sword. The middle, "fuzzy" star is the Great Nebula blazing across the light years, penetrating even the worst light pollution with ridiculous ease. I won't bore you with a long discussion M42, but I will make a few suggestions that may enhance your pleasure in viewing this marvel.

OK, so you've seen this object a million times before. Why not just take a quick look at M42 and move on to other things? Everybody with a telescope knows just what it looks like, right? Not necessarily. How long has it been since you've made a *detailed* examination of this huge cloud? Do you at least *try* to make drawings of this object (see my impression of this monster nebula in Figure 9.3)? Do you view it with a wide range of magnifications? Every time I look—*really* look—at M42 I seem to find something new. It looks great in tiny telescopes, and bigger instruments only enhance my feeling of wonder. Don't neglect the rest of the Sword, either. While you probably won't see the fascinating complex of reflection nebulosity, NGC 1973/1975/1977, the Running Man Nebula, there are many pretty stars and clusters scattered all up and down the Sword.

If there's a deep sky object (DSO) that's as impressive in the city as it is in the country, it's M42. Sure, you lose some of the outlying wisps of nebulosity in urban skies, but a light-pollution filter can bring much of that back. It's hard to suggest the best telescope to use on this marvel. It looks just as good, frankly, in a Short Tube 80-mm refractor as it does in a big Schmidt Cassegrain or Dobsonian. The big scopes

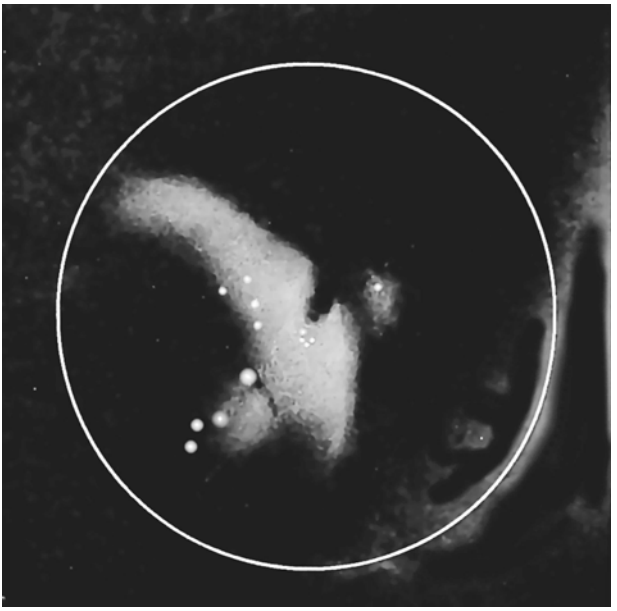

Figure 9.3. The Great Nebula.

allow me to zoom in on the details of the nebula's interior, but the small one allows me to see the whole cloud set in the wonderful sword. Aside from a light-pollution filter, the one thing that will add more to your joy in viewing M42 than anything else is a wide-field eyepiece. This is one time when the City Lights astronomer wants low magnification. Even in the city, the nebula stretches all the way across the field of a 35-mm Panoptic eyepiece and beyond in my C11.

In addition to the dark intrusion in the nebula's Northern side, the "Fish Mouth," and the bright multiple star system, the Trapezium, Theta 2 Orionis, look for the "wings," the streamers of nebulosity that flow east and west. On the northern edge of the nebula, surrounding a magnitude 7 star, is the small, detached cloud, M43. In the city a 10–12-inch scopes reveals that M43 is comma-shaped and, on the very best evenings, hints that it's crossed by dark dust lanes. However big or small a telescope you own, turn it to M42 frequently. Don't be embarrassed to keep coming back to this easy object at every opportunity. It's a mind-blowing sight, always.

Tonight's Double Star: Meissa, Lambda Orionis

Lambda, one of my favorite double stars, is challenging without being trying, and is one of the first double stars I show my university astronomy students. It looks like a double "should": two close yet distinct points of light. The primary is a bright

magnitude 3.6, and lying 4.4″ away is a dimmer secondary star shining at magnitude 5.5. The primary is blue–white, and the secondary is just plain white, though some observers report a trace of "olive green" in it, an illusion caused by the presence of the much brighter main star. Though usually split by a 6-inch telescope, poor conditions can make larger aperture necessary for success with Meissa. Lambda is easy to locate, being, as mentioned earlier, one of the three stars in Orion's triangular head, just to the northwest of Betelgeuse and Bellatrix.

> Don't ever discount the value of your most wonderful optical instrument—your unaided eyes. I think one of my most memorable views of Orion's blazing suns was with my unhindered eyes. One unseasonably warm night in the late 1960s or early 1970s, I sat in a country field with a thoughtful young woman and drank-in the majesty of the Celestial Hunter. Ever after, Orion has been associated in my mind with the scent of patchouli and the sound of folk guitar, music favored by a generation now growing old, but forever young in the contemplation of the distant stars.

Tour 2

Challenges for Deep Winter Nights

What shall we look at tonight? As always, a *variety* of deep sky denizens if that's possible. After observing for a few years, most deep sky fans tend to focus on a single type of object, often to the exclusion of all else. No self-respecting galaxy hunter, for example, would be caught dead wasting his/her time on mere open star clusters. But this narrow concentration means you miss some wondrous views. I'm the original astronomy dilettante; I'll look at *anything*. In part, it's the contrast between the very different animals in the deep sky zoo that makes my nights so interesting.

With this in mind, I decided to select several radically different destinations for tonight's expedition. Perseus is a natural hunting ground if you're after contrasts. This is one constellation that has it all: numerous star clusters, elusive diffuse nebulae, intriguing planetary nebulae, beautiful and mysterious double and variable stars, and even a challenging galaxy or two. I eventually selected three very diverse and lovely stops for tonight's itinerary: open cluster M34, planetary nebula M76, and galaxy NGC 1023.

M76

Our first destination, M76, the Little Dumbbell Nebula in Perseus, is not overly hard to find, though it is, at magnitude 11, one of the dimmest of the Messiers. Its 3.0′ × 2.0′ size makes its surface brightness fairly high, but I won't call it "easy." It's time for *challenges* after spending most of the winter in the house or stumbling across easy open clusters. Figure 9.4 should lead you to the Little Dumbbell without too much hassle, however. Look for the nebula slightly less than a degree northwest of Phi Persei. This star is not very bright at magnitude 4.07, but it should be easy enough to land on if you hop there from bright Gamma Andromedae (magnitude 2.36) and 51 Persei, which shines at magnitude 3.57, and which is only 2° 15′ from Phi.

Center Phi Persei in a low-power, wide-field eyepiece and slowly sweep one eyepiece field's distance toward Delta Cassiopeiae—very slowly. You'll be looking for a small puffball. There is a 6th magnitude star 12′ east-southeast of the nebula, the only even marginally prominent star in the immediate area. If you have difficulty finding the M76, stop for a moment, get your bearings, take a deep breath, and try again. Remember to examine each field carefully since this planetary may be quite hard to see in a small scope under really poor conditions.

When M76 finally appears in your eyepiece, you may or may not be able to make out its dumbbell shape. In small scopes, you'll probably find it appearing as a slightly elongated or rectangular patch rather than as two distinct lobes. Even on the darker nights when M76 shows off some detail, don't look for it to resemble the big Dumbbell, M27, in Vulpecula. M27 looks more like an apple core than a dumbbell, while M76

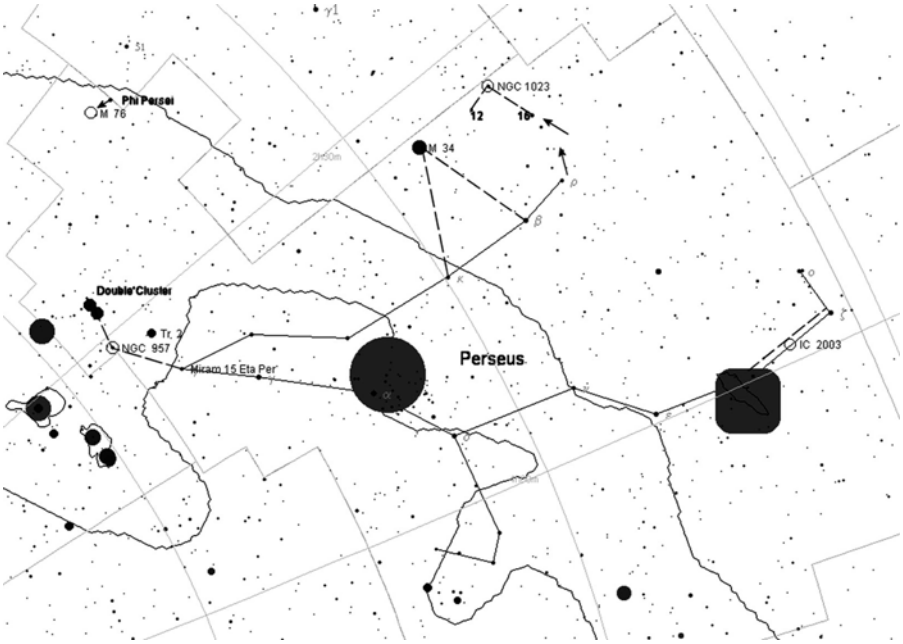

Figure 9.4. The star fields of Perseus.

is composed of two round lobes that are in contact, actually making it look more like a piece of exercise gear (in a medium-sized scope) than the big Dumbbell does. How hard is this double-lobed shape to see in the city? Not terribly hard in 8-inch and larger instruments equipped with OIII filters—which help considerably with this planetary. The challenge at 12 inches of aperture and above is not to see the dumbbell shape, but to be able to detect that one lobe is brighter than the other and, beyond that, to see vague hints of the outlying haze of faint nebulosity that surrounds this object.

Viewing with a very small telescope? Don't automatically assume M76 will be invisible. I have been amazed at how easy this dim planetary nebula can be on the right night. On a good post-cold-front evening, I had no problem observing it with my OIII equipped 60-mm ETX 60:

> I was surprised and pleased to be able to see the Little Dumbbell from in-town with 60-mm of telescope aperture. Required the OIII filter to see well. Removing the filter, I found I could still see the nebula, but just barely. Could not resolve it into two lobes, but it was otherwise easy in this scope, appearing as a uniform and elongated oval of nebulosity at 75×.

On poorer nights, it could be difficult even with the larger aperture of the 4.25″ Newtonian:

> Interesting, but really just at the limit of visibility in this aperture under these skies. Diffuse and round looking.

The long focal length and medium aperture of my Nexstar 11 SCT proved to be a good combination for M76:

> The Little Dumbbell. Exquisite in a 26-mm Plossl, even without a filter. Lovely field. Both lobes easy at low power. Some suggestion of faint streamers of nebulosity wrapping around one of these lobes.

Even on frustrating nights, I found M76 to be more than worthwhile. Especially if I stuck with it rather than quickly moving on. Extended observation with higher powers would almost always reveal at least a hint of it in my smallest scopes under the worst skies (including high humidity and incipient fog). It has occasionally been invisible in my Short Tube 80 and ETX 60, but I have never failed to bag it with a 6-inch scope with the OIII filter installed.

M76 is a Vorontsov–Velyaminov type 3(6) planetary nebula (irregular disk/anomalous form), which is located about 1700–3000 light years from Earth. Like almost all planetary nebulae, M76's distance is not well known. Photographs taken of this object by very large telescopes show that in addition to its curious non-disc structure, M76 is wreathed in many faint streamers and tendrils of nebulosity. These streamers are rather difficult to see visually, but are readily apparent in CCD exposures with amateur telescopes like the 8-inch SCT that took the photo in Plate 51.

M34

The little Dumbbell *was* hard to find in sodium-pink skies tonight. But the next stop, M34, is much easier. After M76 you should almost be able to find M34 with your eyes shut. Using a detailed chart, search for this object 5° west-northwest of the famous eclipsing variable star Algol, Beta Persei. This magnitude 5.2 open cluster should be at least barely visible in your finder even in pretty heavy sky glow. Under really dark skies, M34 is obvious to the naked eye. At 35′, it just fills the field of a low-power eyepiece, so stick with your longest focal length ocular for the most pleasing look at this sprawling star-nest. You may want to try higher power to see if you can pick up some of the cluster's less prominent stars, but be forewarned that they are at magnitude 13 and dimmer.

I enjoyed viewing M34, though I must agree with the late Walter Scott (Scotty) Houston who thought the cluster was "sparse." Looking through my log, I see that on the same night I viewed M76 with the ETX, I also took a quick look at M34.

> Easily seen, fills a half degree field. M34 isn't super-spectacular, but is easily seen, found, and is rather attractive. Concentrated toward the center, basically oval in shape, though I sometimes have an impression of an almost "spiral" shape being formed by the brighter stars. No nebulosity seen. About 40 stars seen at 45×.

Under the Trumpler classification scheme for open clusters, M34 is class II 3 m (detached with weak concentration toward center, large range in brightness, moderately rich). At a distance of 1500 light years, it is approximately 20 light years in extent. This group's age of 100 million years or so makes it somewhat elderly as open clusters go, being senior to both the nearby Double Cluster and the Pleiades.

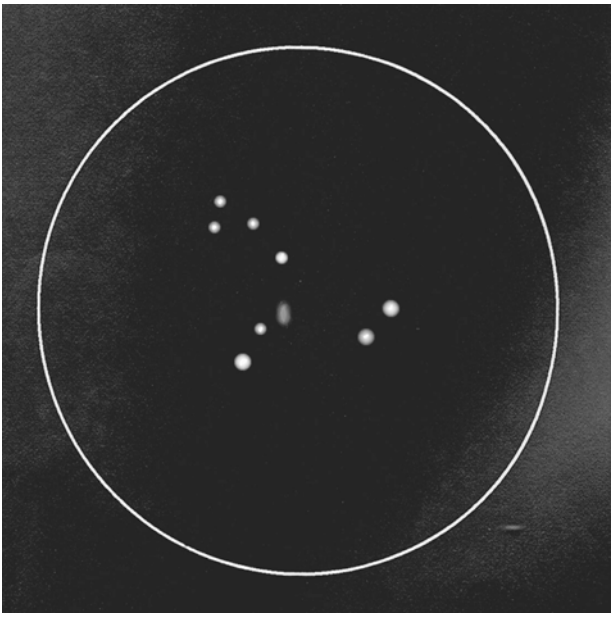

Figure 9.5. NGC 1023, the Little Spindle.

NGC 1023

Our final featured deep sky tour stop for this evening, galaxy NGC 1023, the Spindle Galaxy, seems out of place here in the midst of the winter Milky Way, but some galaxies do manage to make their presence known not far from the "zone of avoidance" created by our galaxy's huge, dust-swollen body. NGC 1023 isn't overly difficult to see most of the time, though you should try to wait for a good night if your scope is small or your skies are very bad. It is, in fact, rather spectacular as small NGC galaxies go. I recall that the first time I hunted down this object from light-polluted skies I surprised myself by finding this 11th magnitude marvel in less than 5 minutes. Maybe because the bright stars 12 and 16 Persei (magnitudes 4.9 and 4.2, respectively) form a little triangle with NGC 1023, making it trivial to pin down.

To find this galaxy, star hop your way up from Algol's neighbor, Rho Persei. Hop from Rho, to 20 to 16 and stop. Looking at your star atlas, observe that NGC 1023 is 2° 7′ to the west from 16 Persei, and forms a triangle with it and 12 Persei. 20, 16, and 12 are all in the magnitude 4–5 range, and should be easy for your finder. The first time I hunted NGC 1023, I did have to pay strict attention to what I was doing since, under my heavily light-polluted skies, all I could really see of the galaxy was its small, elongated core, which is visible in my 4.25-inch scope drawing in Figure 9.5. Even this "bright" central area was best seen with averted vision.

On a decidedly average night of seeing and transparency, my notes recall that NGC 1023 was:

> Visible in the 4.25-inch scope, with averted vision. Seems elongated E/W at 90×. No sign of a stellar core or outer envelope. It disappears completely when I look directly at it, and higher powers don't seem to help much at all.

In scopes of 8 inches of aperture and above, NGC 1023 can be distinctly variable. One night it'll look "ho-hum," as above. At other times it will begin to give up some detail to the methodical observer. In particular, the elongated saucer shape of its main body, which is responsible for its "spindle" nickname, becomes obvious.

> In the C8 at f/10 with the 12-mm Nagler and TeleVue 2× Big Barlow, NGC 1023 is fairly obvious and surprisingly large at 300×. In addition to the bright, oval core, a fairly large and strongly elongated expanse of nebulosity is visible tonight along with a bright, sub-stellar nucleus.

NGC 1023 (Plate 52), which astronomers have classified variously as a Hubble E7p galaxy or an S0, appears to be a lenticular galaxy with a disturbed-appearing nucleus—it is included in Halton Arp's catalog of "peculiar" galaxies. This part of the constellation contains quite a few dim galaxies, a number of which lie just to the east of NGC 1023, and most of which are beyond the range of any but the largest urban scopes.

Stimulating Side Trips

NGC 957

NGC 957 is a better-than-average open cluster that's easy to find 1.5° east of NGC 884, the easternmost of the famous Double Cluster "twins." To find it, scan east and just a little north of the Double Cluster, and be on the lookout for a fairly conspicuous triangle of 7th magnitude stars. You may want to use a detailed, small-scale chart to track it down, as this is a rich area, and there are many "cluster-like" clumps of stars everywhere that can deceive you. While NGC 957 is a *good* cluster, it's big, a sprawling 11.0′ in extent, and it may not be immediately obvious against a rich background. At an integrated magnitude of 7.6, the 20 or so stars you see here, arranged in a shapeless pattern elongated east–west, are not a challenge once you're in the right spot and know what you're looking for.

IC 2003

This is far from the easiest DSO we've run down tonight, but this tour *is* about challenging objects. This planetary nebula is faint at magnitude 12, but that's not the problem. The trouble is that it's *small*, with various sources giving it a diameter of from 4″ to 8″. Due to this minute size, it's bright, at least, and is certainly more prominent than NGC 1023. It's not a challenge for your finding skills, either, being located almost exactly equidistant between the bright stars Xi and Zeta Persei. It is situated in the same area as the well-known—if notoriously dim—California Nebula. The problem is distinguishing it from an anonymous field star. How do you pick it

out? As with other small planetaries, two things are critical, high power, and an OIII filter. I found I could detect it—barely—as a slightly fuzzy star at 166× in the 8-inch *f*/5 Newtonian, but required an OIII filter to be sure. The OIII dimmed the other field stars while making the nebula *slightly* more prominent. Identification can be easier at higher magnification on nights when the air is still and you can pour on the power. The nebula became quite obviously nonstellar at 350× and above in the C11 SCT.

Tonight's Double Star: Miram, Eta Persei

Miram is a very good-looking pair of stars color-wise, with its supergiant primary star being an intense orange-red, and the secondary a cool blue. The blue companion star is much dimmer at magnitude 8.5 than the magnitude 3.8 primary, but their wide separation, 28.3″, means resolving them, observing them as two separate stars, is not as difficult as you'd think, and quite possible in small apertures if the seeing is steady. Eta is rather trivial to locate since it's a part of Perseus' stick figure constellation pattern. It forms a triangle with Tau and Gamma Persei. These three stars are often used as a "pointer" when searching for the Double Cluster.

> Feeling a bit of a strain from locating and viewing yet another faint fuzzy, I pull my eye away from the eyepiece and for a moment just look up at the skies. Overhead, the distant, alien stars of the Perseus OB-3 association blaze away. After a while, my gaze settles on the spot where I know galaxy NGC 1023 is located. Though I can't hope to see this dim and distant creature with my unaided eyes, I can see it with my mind's eye, and suddenly, with a rush of something that almost feels like vertigo, I sense the true three-dimensional reality of the cosmos. Perseus' bright stars are my close neighbors, nearby friends, no more alien than my Earthly acquaintances when compared to the really distant and peculiar NGC 1023.
>
> We are all of us—the residents of the Milky Way—huddled together for comfort against this immense darkness. Even NGC 1023 is amazingly nearby when we consider the inhuman distance that lies between us and the quasars. One of the most rewarding tools of the amateur astronomer is imagination. Our little telescopes give a sometimes dim outline of the truth of things, but our minds can fill in the details of the realities of our universe.

Tour 3

A Surprise Planetary

"The Moon will be rising soon and it's cold out here. How about something a little easier than M76 and NGC 1023 for this outing?" I *was* thinking we should catch Pisces' M74, which is beginning its descent into the west, but that dim, face-on Sc spiral, while doable from urban areas—I've seen it with the 4.25-inch scope with major effort—is tortuously difficult. More than once, even on the best nights for City Lights astronomers, I've come away from my telescope scratching my head and wondering whether I've *really* seen M74 or not. OK, I'll give you a break. Here's a set of easy, quick prizes, a trio of beautiful Messier objects, which, due to their southerly location in an out-of-the-way constellation, few casual observers ever visit. And one holds a delicious surprise!

M46

Although M46 resides within the borders of the somewhat obscure southern star pattern, Puppis, the Poop Deck of the obsolete giant constellation *Argo Navi*s, the ship of Jason, it is easy to find. Don't use the horizon-dimmed dim stars of Puppis as your guides, though. Puppis is populated by numerous bright stars, including four brighter than magnitude 3, but for most Northern Hemisphere observers they don't look very bright at all due to their low altitudes. Instead, find your way by the brilliant beacon of the Dog Star.

This open cluster resides 13° 45′ east of Sirius, Alpha Canis Majoris. The only complication is the possibility of mistaking M47 for M46, M47 is *another* nice open cluster that lies only 1° 30′ to the west of M46. Look at Figure 9.6, and you'll see that M46 (and M47) form a near equilateral triangle with bright Sirius and mag 2.2 Rho Puppis, one of the more distinct of Puppis' stars. Minimal optical aid, finder or binoculars, should easily show both M46 and M47. Just remember that M46 is on the east and M47 is on the west and take into account the probably inverted image of your finder, and you can't fail.

Once you have the cluster centered in an eyepiece, you'll be pleased at how pretty it is. Consisting of at least 150 stars between magnitudes 10 and 13, this manageably small beauty is less than 30′ in extent and puts on a nice show in any telescope. Imagine, though, how wonderful a sight it is under dark skies in the Southern Hemisphere, since it is situated right in the heart of the marvelous Puppis Milky Way. Even on a very poor night in a Northern Hemisphere city, however, I recorded in my log entry (and my drawing in Figure 9.7) for the 4.25-inch Newtonian that M46 was:

> Amazingly lovely and compact. Scattered clouds and haziness tonight, so this cluster is a little dim. Outstanding nevertheless, with at least 30 stars visible in the field of a 25-mm Kellner eyepiece at 48×. The basic shape of the cluster is round or slightly elliptical , and I can detect a faint background glow of unresolved stars.

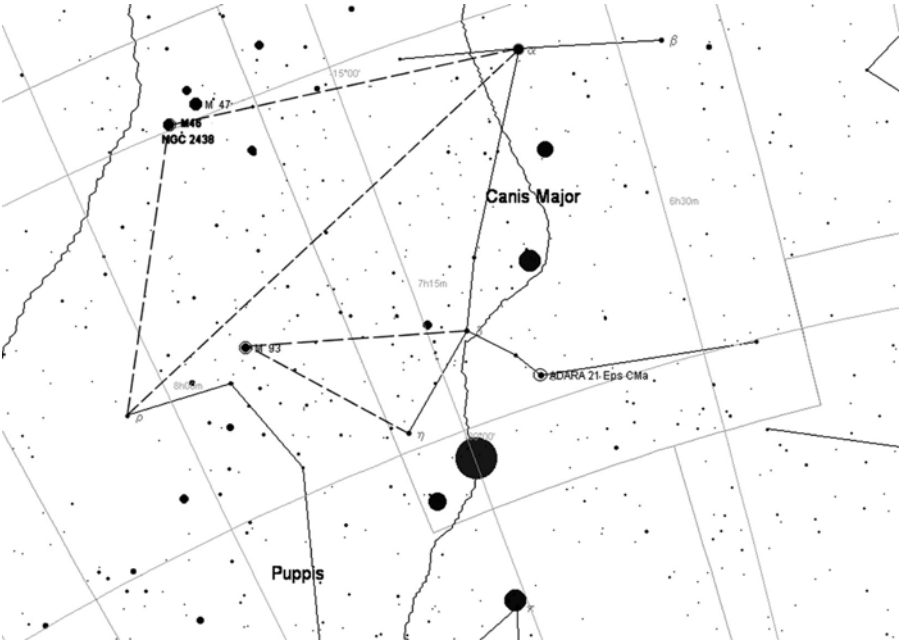

Figure 9.6. Puppis and the Big Dog.

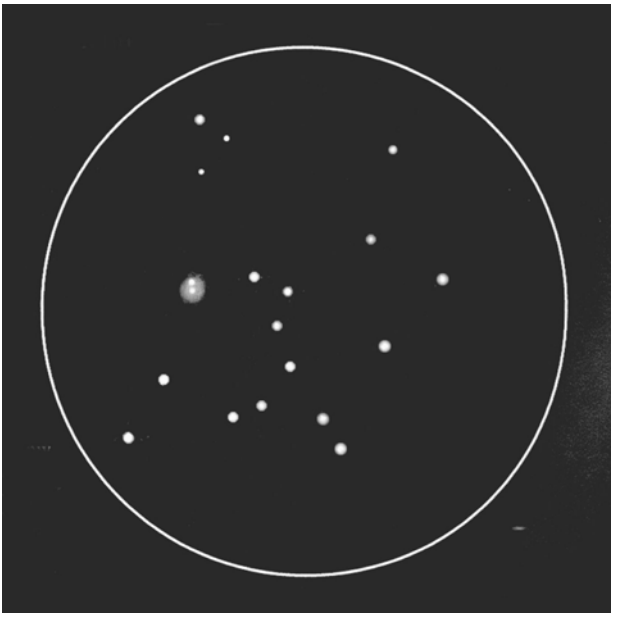

Figure 9.7. M46 and its hidden prize.

Open clusters are nice, but there is a certain undeniable ho-hum factor to *another* half-degree group of semi-dim stars. However, a patch of bright stars is not the *only* attraction here. Once you've formed a general impression of this cluster, look closer. About 7′ north of the center of this cloud of stars, you'll find M46's "surprise," the planetary nebula NGC 2438

NGC 2438

The magnitude of this small planetary, 11.0, sounds forbidding, but its small size, $1' \times 1'$, makes it nice and bright. The problem is not its magnitude, really, but as when we searched for IC 2003, its small size. Once again, apply enough magnification so that it's distinguishable from cluster stars without dimming it so much that it becomes invisible in your scope from your skies. If it isn't immediately obvious, search the field carefully for a "star" that seems a *little* fuzzy with averted vision. If you still can't see it, increase your magnification further. While this makes the view of the cluster much less attractive, magnifications above 150× begin to make the nebula more obviously nonstellar. If NGC 2438 is *still* not seen, check to make sure you're not *really* looking at *M47* rather than M46, a mistake I've made a time or two. If you have an OIII filter available, use it, as this nebula responds well to one.

I would classify NGC 2438 as a "moderately difficult" object from the city with a 4-inch or smaller telescope (it's barely visible as a small blob in my drawing), but it's definitely possible on the right night, so keep after it. In this aperture range, you'll see a tiny gray disk superimposed on a pair of close, bright cluster stars. Averting your vision makes the nebula easier to see, and you'll note that even this small object displays the "blinking" effect typical of planetary nebulae in smaller telescopes.

The key to enjoying this nebula is going after it on the right night. On poor evenings, NGC 2438 can be surprisingly hard to detect in an 8-inch scope. On all but the worst nights, however, this planetary is easy in 10–12-inch telescopes and sometimes even lets go of a few details:

> In light pollution and fairly heavy haze, M46 is easy, but, even in the C11 equipped with an OIII filter, the planetary, NGC 2438 is not immediately obvious. I am finally able to pick it up by waiting for Puppis to rise a little higher in the sky. As the evening wears on, the haze seems to clear off a little, making things even easier. I still can't seem to make out the nebula's disk easily with the 22-mm Panoptic, though. Going to the 12-mm Nagler at 220× makes the nebula stand out like a slightly greenish traffic light amid the yellow headlights of the cluster stars. At this magnification (again with the OIII filter), NGC 2438 is a fairly large gray–green disk abutting a pair of bright stars. Averted vision reveals a ring shape, like a miniature M57, with a surprisingly dark center.

M46, which is shown pretty well in the Digital Sky Survey image in Plate 53, is located 5,000 light years away, or so we're told, and is therefore 30 light years across. When researching this object, I was a little disappointed to find that NGC 2438 is most *probably* a foreground object, being, perhaps, 3,000–3,500 light years from dear, old Earth, and not actually involved in the star cluster.

M47

While you're in the neighborhood of M46, you might as well hot-foot it over to M47, just 1° 18′ away, maybe just on the western edge of your eyepiece field if your scope can deliver a degree of field with a low-power eyepiece. M47 is not quite the cluster that M46 is, I'm afraid. It's sparser and doesn't contain any added attractions like M46's planetary. But it's a nice enough DSO in its own right and deserves a few minutes of your telescope time. This 29′ diameter magnitude 4.3 cluster is easy to distinguish from the background even in the busy Puppis star fields.

When you've got M47 in the main scope's eyepiece, crank *down* the power as much as you can. Even for me at a latitude of 30° north, M47 and Puppis are always near to the horizon and in some pretty fierce sodium-arc light pollution and haze, so there's a limit to how low I can go before the brightening eyepiece field at lower power devours a good portion of this cluster's stars. The 35-mm Panoptic was guilty of this, with a 22-mm Pan or a 26-mm Plossl providing a decidedly better look at M47:

> An attractive enough field in the 22-mm Panoptic and Nexstar 11. M47 appears sparser by far than M46. The cluster is defined by about 10 attractively bright stars. Maybe about that many or a few more dimmer stars are also seen. One nice double is involved in the cluster. M47 is shapeless and scattered, but still makes a nice stop-over in this rich area.

M47 was discovered by Charles Messier in February of 1771. While there's no doubt that he independently discovered it, there is some evidence that it may have been recorded as much as a century earlier by other observers. Unfortunately, Messier wrote M47's coordinates down incorrectly, so this was a "lost" M object until NGC 2422, the cluster's original catalog designation, was convincingly identified with Messier's M47 in the 1930s. M47 is assumed to be 1600 light years away, and about 10–12 light years in size.

M93

Embedded as Puppis is in the Milky Way, it shouldn't be surprising that there's another outstanding galactic star cluster to be found in this constellation, M93, which is considerably more attractive than either M46 or M47. No, it doesn't harbor a planetary nebula, but it does possess an attractive compact core that makes it another open cluster that's reminiscent of Sagitta's loose globular, M71. In fact, I keep running across open clusters that look like very loose globulars so often that I've concluded M71 is not nearly as unique as I used to think. There is no question about M93's true object type; it is a young cluster, "only" about 100 million years old—a positive infant compared to even the youngest globulars.

With a magnitude of 6.5, M93 is dimmer than either of its companion clusters in Puppis, but it's also smaller at 22′, and is quite impressive though it's considerably farther south than either M46 or M47 at a –23° 51′ declination. To locate it, you can hop from Xi Puppis. This magnitude 3.34 star *may* be fairly distinct in your skies, and if so, finding M93 is easy. The cluster is a mere degree and a half to the southwest. If Xi is invisible from your site, use the bright feet of the dog, magnitude 2.45 Eta Canis

Majoris and magnitude 1.84 Delta Canis Majoris. M93 forms a near 90° triangle with Eta and Delta.

In the eyepiece, M93 is remarkable, yielding as many as 50 "easy" stars to a city bound 4-inch telescope at high power. The most attractive aspect of the cluster, without doubt, is its small, compact core:

> In the 4.25-inch f/10 reflector this is a very good cluster at 48× with the 25-mm Kellner. Remarkable, in fact, despite being way down in the thick air to the south. There's a triangular core composed of a sprinkling of many, many tiny stars that show up well despite my observing site, which is located near the site of a large shopping mall. Many medium-bright to dim outlying stars visible, too, surrounding the cluster's distinct arrowhead-shaped center.

M93 is one of Charles Messier's personal discoveries, having been observed and catalogued by him in March of 1781. This cluster's Trumpler classification is normally given as I, 3, r, making it "detached, strong concentration toward center; large range in star brightness, rich."

The Other Side of the Sky

If you've waited long enough for Puppis to rise, or if it's late enough in the Winter for the Poop Deck to be over the horizon at a reasonable hour, a look over your shoulder to the South and West will reveal that Orion and company are skittering surprisingly far into the West. Orion is still well placed for observing, but why not trip on over to the obscure if colorfully named constellation, Monoceros, instead? The Unicorn resides just to Orion's east.

NGC 2237

"Colorfully named" is one way to describe the Unicorn. "Subdued to the point of near invisibility in the city" is another. Monoceros is composed of a vague "W" pattern of dim stars scattered across a fairly large patch of sky—481.6 square degrees lie within the borders of this constellation. Within these precincts, hidden among the dim suns, you'll find some marvelous clusters and nebulae. In fact, it's nebulae that most observers associate with the Unicorn. The Rosette Nebula, NGC 2237 (Plate 54) in particular, a gigantic $80' \times 60'$ wreath-shaped cloud of nebulosity (appropriate for the time of year when this area of the sky becomes prominent), is a legendary object. It resembles the Helix planetary nebula in Aquarius visually, but the Rosette is not a planetary. It's an emission nebula, with the center having been "hollowed out" by the stellar winds of the hot young stars being born in its donut hole.

The Rosette can be difficult to find despite its large size. If you don't have go-to scope, the most expeditious way to locate it is to draw a line from Gamma Orionis, Bellatrix, through Alpha, Betelgeuse, and on for another 8°. This may seem to be a leap into the dark, since you'll see few stars in your target area, but your finder will easily show the open cluster, NGC 2244, the group of brilliant young stars in the center of the Rosette, as a fuzzy patch, so finding will be easier than your star atlas made it look. Not only will the cluster be detectable in your finder, this $24'$ across beauty may

even be resolved. In the main scope, you'll see a little dipper-like asterism of bright blue–white stars.

The Rosette Nebula itself is often considered a seriously difficult object by visual observers, even those blessed with dark skies. But it's really not, not even in the city, if you remember that it requires two "Fs"—field and filters. Its very large size (it's so big that, in addition to NGC 2237, sections of it also bear the NGC numbers 2238, 2239, and 2246) means long focal length scopes can't help but spread out its light so much that it merges with the sky background. At the proper focal length and magnification it becomes visible in amazingly small instruments. I've even seen the Rosette in my (filtered) 60-mm ETX at 12×.

Of course, going to very low magnifications and wide fields in the city makes the sky background insanely bright. Solution? In this case, an OIII filter. An OIII does an amazing job on this object, and is really required if you are to have a prayer of seeing it in the city. Optimum scope for the Rosette? For me, my 12.5" *f*/4.8 Dobsonian equipped with a long focal length wide-field 38-mm Plossl and, of course, an OIII. This delivered sufficient light gathering power along with a nice wide-field. Actually, my 8-inch *f*/5 can do almost as well, delivering enough light, but also able to reach even lower powers with my long-focal-length eyepieces.

What can you expect to see when you find the Rosette? Dim traces of nebulosity scattered across your field, some brighter, some dimmer. The central hole is hard to discern, and, even with the OIII in place, you may find that putting the cluster outside the field of view makes the nebulosity easier to see.

NGC 2264

Talk about "legendary!" The area around the bright variable star S Monocerotis, is that, in spades. Not so much because of the beautiful open cluster, NGC 2264, The Christmas Tree Cluster, but because of the delicate veils of light and dark nebulosity that enwrap this whole area. Foremost among these clouds is the dark Cone Nebula. In the city? Forget it. Even in the country the Cone is an object for very large scopes and talented, experienced observers. But you *will* see the Christmas Tree, a group of bright stars stretching 20′ from S Monocerotis. S also makes the cluster a snap to find. S Monocerotis and its cluster lie 5° north and slightly east of the Rosette. The cluster and S (a variable star that ranges from magnitude 4.2–4.6) are easily apparent in your finder if you just slew north from the Rosette area. Why "Christmas Tree?" That's just what the cluster looks like, the outline of a squat Christmas tree with S Monocerotis forming the "base."

NGC 2261

There *is* another nebula in Monoceros that you can see from the city, one that's considerably less of a challenge than the Rosette. It's small at 2′×1.7′ and bright at magnitude 4 (usually). If not exactly *discovered* by the famous American astronomer, Edwin Hubble, it was at least given considerable study by him and now bears his name. Hubble's Variable Nebula, NGC 2261, is, like M78, a spot of reflection nebulosity—but with a difference. The basic shape of this cloud is triangular or comet shaped,

with a star buried in what would be the comet's "head." This star, R Monocerotis, is engaged in blowing off its outer layers, and it is these layers and the interaction between them and the dust and gas already in the area that make the nebula variable. The presence of dark clouds of gas moving from the star and through the clouds, casting obscuring shadows and occasionally blocking some of the star's light cause the nebula to vary fairly dramatically in brightness—sometimes over mere days.

Hubble's Variable Nebula is conveniently located 2° southwest of the Rosette, and is easy to pick up in a medium-power eyepiece if you're careful with your sweeping. A detailed chart of the Rosette area will be a big help. You're looking for a "hazy" star, that, when examined at high power, reveals a trailing, triangular wisp of nebulosity.

Once you've found this nebula, consider making a detailed drawing of it in hopes of detecting changes in it later. Using high magnification and coming back to Hubble frequently over the months it's visible can reveal subtle changes in the nebula to patient observers, even those observing from urban areas—it's that bright. Since this is a reflection nebula, if one composed mainly of gas being thrown off by a sickly star rather than of dust and gas in a star-forming region, light-pollution filters don't seem to help. You'll have to rely on higher magnification and waiting for this object to culminate to provide the best view under city lights.

Tonight's Double: Adhara, Epsilon Canis Majoris

Way down south of Sirius, the brilliant Dog Star in Canis Major, is the southernmost of the two "rear feet" of the big dog, Adhara. This bright magnitude 1.5 beacon is an outstanding double. The white primary and blue secondary are unequal in brightness at magnitudes 1.5 and 7.4, and are somewhat close to each other at 7.5″, so an 8-inch telescope is helpful for an easy split, and a 6-inch scope is often the lower limit if you want to see two completely separate suns under less than perfect seeing conditions. Naturally, the far southern declination of Epsilon, −28° 58′, can cause problems for some Northern Hemisphere observers, but this lovely star should be resolvable from most mid northern latitudes if you wait for culmination.

> It is shiveringly cold and I'm as chilled as it's only possible to be when standing nearly stock-still for hours out in the middle of an observing field (or backyard). The north wind that brought this evening's sparkling clear look at the Milky Way is having its revenge on me. But I'm hooked on the winter Milky Way and the multitudinous clusters and nebulae stretching all the way from Canis Major and Puppis to Orion and Auriga. So it goes, night after night, season after season, year after year. The skies are comfortingly unchanging, but they are also forever full of new wonders for me to discover. Even those objects I've seen a hundred times before are still capable of delighting me with their well-remembered but always fresh beauty. On nights like this, I laugh at the city lights as I lift off for the great and wondrous beyond.

Tour 4

Winter's Eskimo

If you were weary of open clusters after finishing the Cassiopeia expedition in the last chapter, I hope you've recovered. In the city, especially in the winter, open star clusters are *the* prime object for the City Lights astronomer. In December the summer stars are gone by the time it's good and dark, and even the constellations of fall are beginning to move to the west by the mid evening. The summer sky was full of globular clusters, and our trek through the autumn heavens also turned up a few. But in deep winter, they are *gone*, with only pale and puny M79 in Lepus present to represent their class. Galaxies? There are a few visible in the winter constellations, but not the endless fuzzballs of autumn and spring.

Forget galaxies and globs for a while. The winter and the Milky Way are a place of open star clusters and nebulae. Revel in them. We can observe these clusters with ease in the worst sky glow. The problem is sifting through long object lists to identify those that are worth a hoot. Too many paltry clumpings barely distinguishable from background star fields can turn off even the most committed galactic cluster fan. Look for rich small-to-medium-sized groups. Learn to decode the Dreyer descriptions, and rely on references like *The Night Sky Observer's Guide* and *Burnham's Celestial Handbook* to help you pick through the winter constellations in search of rewarding destinations.

We'll make stops at some open clusters tonight that can put anything in the summer sky to shame, but, as I've said again and again, the way to deep sky enjoyment is variety and contrast. "Variety" where winter urban observing is concerned leaves you with nebulae in addition to galactic clusters, but most of the season's emission nebulae, once you get beyond the Great Nebula and M78, are frustrating beyond belief for urban observers. Don't spend night after night, as I did as a teenager, searching for the Horsehead Nebula, IC 434, with a 4-inch telescope. Like me, you'll learn a lot about the sky in the Orion area, but you certainly won't see even a trace of old Horsey! What you should do is turn your focus from diffuse emission and reflection nebulae to planetaries. But you will only find one truly outstanding winter planetary (for urban sky watchers) on the Messier list, M76, the Little Dumbbell in Perseus, which we've already visited. What to do? *Get over* the Messier list.

As a young astronomer, I longed for the dark skies of winter, but usually found myself puzzled and feeling a little let down once the first couple of weeks with Orion had passed. What next? The Messier clusters in Auriga, M36, M37, and M38 are delightful, but even they become a little old if they're *all* you look at night after night. What it took for me to break out of the observing doldrums was resolving to sit down with a star atlas and some reference books to find a way to break the Messier habit.

With some study and some exploratory observing, I soon realized that there is a tremendous wealth of winter clusters and planetary nebulae in the NGC catalog, and that many of these are bright and beautiful even in small city scopes. I could go on and on about the forgotten wonders I discovered. "Forgotten" in that many visual observers ignore all but the most well-known examples of these types of objects in the NGC. The whole area from Perseus to Orion holds an abundance of interesting

attractions for the traveler willing to stray off the well-beaten path. Tonight, to get you started, we'll visit a series of objects that are so impressive you'll be forever puzzled as to why old Chuck Messier missed them.

NGC 869 and 884

Since Perseus is well positioned for observing at an early hour at this time of the year, we'll begin within its borders with the famous Double Cluster, NGC 869 and 884. Though not in the Messier, this object is, admittedly, not among the "forgotten" clusters of the NGC. All reasonably experienced deep sky observers know about the Double Cluster, and it is not to be passed by on any winters evening.

A large part of enjoying the Double Cluster lies in knowing *how* to observe it. As the name indicates, this is two star clusters, open star clusters, NGC 869 and 884, magnitudes 4.3 and 4.4, respectively, the centers of which are separated by only 30′. Each is beautiful on its own, but put both in the same eyepiece field, and you have one of the most amazing objects in the sky. For full enjoyment, you'll need to use an instrument that will accommodate both and leave a little space around them. This can be a problem—your average *f*/10 SCT won't give you the at least 2° expanse you need to take in all of the scattered cluster members. However, you do it—focal reducer, long focal length eyepiece, short tube refractor, or binoculars—I urge you to view this pair the way they were meant to be seen, in one field, like the sprawling lights of two huge adjoining cities set on a dark plain. For me they looked amazingly like Dallas and Fort Worth, Texas as seen from a red-eye flight.

Finding the Double Cluster is easy enough. One way to locate the pair is to put Magnitude 3.76 Eta Persei in the finder crosshairs and scan 4° northwest in the direction of magnitude 2.68 Delta Cassiopeiae. An elongated haze patch will jump right out of your finder at you when the Double Cluster comes into view. When the clusters are nearing culmination, you may even be able to catch them with the naked eye; certainly they are easily visible as a double misty patch without optical aid from medium-dark suburban sites. When you have the two in the field of the main scope, spend some time absorbing their majesty. Then start comparing them and picking out details.

I found my best views came with my 8-inch *f*/5 Chinese reflector and a 38-mm Plossl eyepiece with a 60° apparent field. This provided a 75′ wide expanse of sky, and while not *quite* enough to take in every straggling star, it framed the pair nicely. Going lower in power would've tended to amplify the sky glow beyond what can be tolerated. A more expensive wide-field eyepiece would, of course, go even further toward hitting the magic 2° field size perfect for the Double Cluster. I could have also gone to a smaller, shorter focal length refractor, but the 8-inch *f*/5 seemed made for this object, easily taking in the rich centers of both clusters and providing plenty of light gathering power. In the 38-mm eyepiece, the westernmost cluster, NGC 869 was considerably richer, more condensed and generally flashier than its companion, but both were outright spectacles:

> The Double Cluster fits easily into the field of my inexpensive 38-mm medium wide-field 2-inch format Plossl eyepiece (26×) in my 8-inch f/5 Synta Newtonian. The eyepiece field is somewhat gray at this low power, but both clusters are very lovely and extremely

> rich. Going to higher power with another imported eyepiece, a 26-mm wide-field design, improves the view somewhat, even if some of the cluster members are placed outside the field, since the background sky is considerably darker at higher power. I quickly went back to the 38-mm eyepiece, however, as this object just has to have wide field to be really enjoyed. The grayness of the background is not that noticeable due to the brilliance of the cluster stars. They almost seem to be bright enough to make me lose my dark adaptation!

In the deep sky game, you get used to attractive illusions. *That* planetary nebula is not *really* a member of *that* star cluster, and *that* cluster is not *really* involved in *that* nebula. They are merely along the same line of sight, put together in the eyepiece by our unique perspective. In this case, though, the two clusters of the Double Cluster are actually almost as intertwined as they appear to be in our telescopes. They are fairly close in space, only a few hundred light years apart. Both are roughly 7,000 light years distant from Earth, and are part of the great Perseus OB-1 association of young stars.

NGC 1528

Everybody's heard of the Double Cluster, but who knows NGC 1528? It's a shame that reciting its catalog number will result in blank stares from most amateur astronomers. It's a remarkably beautiful open star cluster. I didn't have any difficulty at all in locating this object, either, since it lies only $1^\circ\ 37'$ east of the prominent star Lambda Persei in northeastern Perseus. NGC 1528 forms a near-right triangle with Lambda and nearby Mu. Lambda and Mu are not terrifically bright (both are about magnitude 4.5), but they may even be naked eye visible when Perseus is high in the sky on dark winter nights. Using these two stars as your guideposts, sweep carefully, and you will soon have this cluster centered. NGC 1528 has a combined magnitude of 6.4 and is $24'$ across, so a lower power is demanded both when searching for and when observing this object.

I think you'll be as surprised as I was at how nice this cluster turns out to be. Since the NGC galaxies are *usually* much dimmer than the Messier galaxies, as a new observer I was prepared for the NGC open clusters to also be inferior to their Messier counterparts. But that is not always the case, and certainly not this time. This object seems superior to such famous Messier clusters as M29 and M39 in Cygnus. Owing to its medium size, NGC 1528 will fit nicely in the field of a medium-power eyepiece, making a very pretty picture. While it contains about 165 stars photographically, if your conditions are similar to mine, you'll probably be able to make out, at most, about 20–25 suns. But this is still a remarkable object. An extract from my observer's log for NGC 1528 reads:

> Quite a little gem in the 8-inch f/5 Newtonian . Fairly rich, and dominated by a 'U' shaped asterism. Around 30 cluster members are seen along with quite a bit of haze suggesting more unresolved stars. Best seen in the 22-mm Panoptic, though it would probably do well with higher magnification. I'm very impressed by this cluster.

NGC 1528 is located 2,600 light years from Earth, and in the Trumpler classification scheme for open clusters, it is a "detached, medium-rich cluster with a medium range of star brightness."

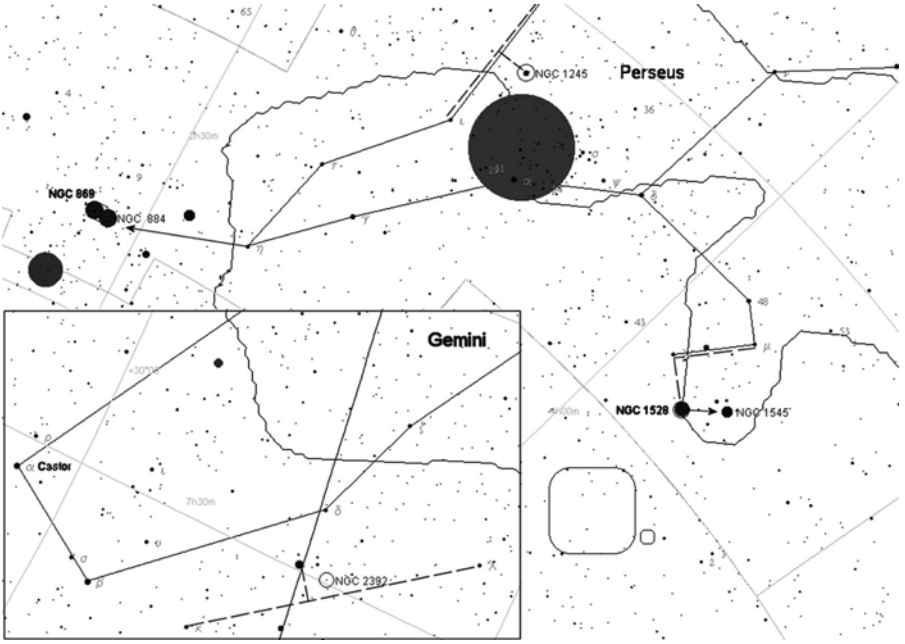

Figure 9.8. Gemini and Perseus.

The Eskimo Nebula, NGC 2392

Much as I love the Double Cluster and enjoy nice surprises like NGC 1528, there's no doubt that the evening's final *feature* stop is the "best" of the night—in my opinion, anyway. Let's turn to the celestial twins, Gemini. NGC 2392, a real deep sky wonder if ever there was one, is another amazing showpiece that Messier missed. This is the famous Eskimo Nebula.

NGC 2392 is even easier to find than NGC 1528. It lies almost exactly at the center of a line drawn between Lambda and Kappa Geminorum, and about 2° east of Delta. Since this a small object (40″ in diameter), you may want to use a higher power than usual when searching for it. Work slowly, keeping the chart in Figure 9.8 oriented to match the view in your finder. Its magnitude 10.0 disk is obviously nonstellar even at low magnifications.

Once you've located the Eskimo, the first thing you'll notice is its surprisingly obvious blue–gray color. You'll probably also be amazed at just how bright it seems. This object will definitely take high magnification, so use all the power your telescope and sky will permit. The 10th magnitude central star of NGC 2392 is readily visible, and in a small-to-medium-sized telescope the nebulosity winks in and out as you avert your vision, just like Cygnus' Blinking Planetary. Although the nebulous disk surrounding the central star is bright, there were only the very *faintest* hints of detail in a 4″ scope. I didn't really see *much* more with the 12.5-inch scope in the

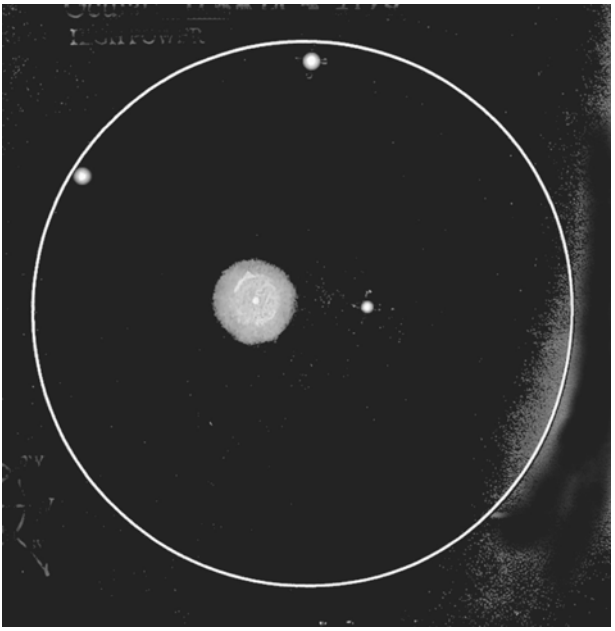

Figure 9.9. The Eskimo shows hints of detail in a 12-inch scope.

city, just enough faint indications of internal structure to tantalize me; just enough to record in the drawing in Figure 9.5. Why is this planetary called the "Eskimo"? Look at a long-exposure photograph of it and you'll see that the combination of an inner, mottled, ring of nebulosity with a fuzzy outer ring looks amazingly like a human face in a hooded parka (see Plate 55). This detail doesn't come easy for visual observers, but some of these features are visible in large amateur scopes under dark skies using very high magnifications.

> I have a very nice view of the Eskimo in the 12.5-inch Dobsonian. In moments of good seeing, detail seems to flash into view at about 300×. But it's gone before I can decide exactly what I've seen. I can definitely make out that there is an inner and an outer ring of nebulosity. This is one of those times when drawing is the best way of "seeing" an object. When I spot a detail, I immediately record it. It vanishes, I wait for the next flash of detail, record that, and so on until I have a nice "time exposure" sketch.

In the drawing, in Figure 9.9, it's easy to see that, despite all my work, I couldn't coax a lot out of the Eskimo. Can I do better? Maybe. Steadier skies than are usually present in winter are often a huge help with small deep sky objects (DSOs) at high magnification. I'll come back to this planetary nebula with sketchbook and determination on a "planetary seeing" night when I'd normally be after Jupiter or Saturn.

NGC 2392 is *thought* to be *about* 3,000 light years away. Given its rate of expansion, this star-corpse is *believed* to be one of the youngest of the planetary nebulae, with a tentative age of less than 2,000 years. The Eskimo was first observed by William Herschel in 1787.

More? Thanks to my usually balmy wintertime temperatures, I can often go all night, cruising up and down the Milky Way's downtown strip. If you want more, look to these standouts.

NGC 1245

This is one of Perseus' better DSOs, and that is obviously saying a lot. A 10' in diameter open cluster, it is fairly rich, showing off at least 15–20 suns at medium power in the 8-inch *f*/5. At a magnitude of 8.4, it's dimmer than Perseus' other standouts, so catch it when it's near culmination, and use medium magnifications to pull out as many dim members as you can. As noted earlier, the Perseus area is so littered with clusters and asterisms that *look* like clusters that it can be difficult to find exactly the group you're looking for. For once, though, I didn't have to slew around wondering where my cluster was. I positioned the scope halfway along a line drawn between Iota and Kappa Persei, and then moved the scope just under a degree—51'—to the East. I couldn't pick up NGC 1245 in the finder, but when I moved to the main scope, it was awaiting me in a medium-low power eyepiece, showing a distinctive "W" shaped asterism formed by its brightest stars.

NGC 1545

Another interesting open cluster, this is a scattered but interesting group 18′ diameter, glowing at magnitude 4.6 at the feet of Perseus. Like NGC 1245, it is easy to locate, since it forms an equilateral triangle with easily seen Lambda and 48 Persei. Another pointer to the group is a pair of magnitude 5 stars 2° East of Lambda. The cluster is 26′, one medium-power field, further to the east. While not as eye-catching as some of the area's agglomerations, this is a good "meat and potatoes" object. Three bright stars form a small triangle at the group's heart, and are surrounded by perhaps 20–25 obvious cluster members.

Tonight's Double Star: Castor, Alpha Geminorum

The most novice of sky watchers is familiar with Castor, Pollux's twin in the classical constellation, Gemini. But fewer amateurs than you'd think are aware that the bright Alpha star is a good, if close, double. Yes, Castor is actually two stars, a magnitude 1.9 primary and a magnitude 2.2 companion. The two are at a frighteningly close separation of 2.2″, but their similar magnitudes make them easy in small scopes. I've routinely split this pair of pure white stars with my 80-mm *f*/5 refractor at high magnification under good conditions. If you find it difficult to split Castor, make sure you're not really looking at Pollux. Castor is the *westernmost* of the two bright stars. If

you know this area of the sky, a good way to remember which star is which is, "Castor is close to Capella, Pollux is in proximity to Procyon."

> When you finish packing-up your beloved telescope and head-in from a late winter night's cold, stop for a moment and ponder what we've seen tonight. These open clusters and the planetary nebula represent the Alpha and Omega in the lives of the stars—birth and death. Our clusters are maternity wards full of young stars. The nebula is an aged sun on its deathbed and has thrown off its outer layers and begun a long, long decline. Even the stars do not forever endure. But for ephemeral creatures like us they remain as unchanged and beautifully new as on the night we took that first wondering look up.

Tour 5

One for the Road

As winter grows old, a constellation begins to dominate the heavens even more strongly than spectacular Orion. Obviously, the main reason for Canis Major's prominence is magnitude −1.5 Sirius, the brightest star in Earth's sky. The basic stick-figure shape of the Big Dog, an inverted "Y," is easily identifiable, but unmemorable. It's the blazingly bright blue–white sapphire of Sirius that makes up for the lack-luster shape of its home constellation. Sirius is so bright that when it's near the horizon, flashing every color of the rainbow due to the thick atmosphere there, it often results in frantic UFO reports from the naïve and gullible.

You'd think a mid-sized constellation—it covers 380 square degrees of sky—lying near the winter Milky Way would be loaded with deep sky wonders. Sadly this is not the case if your definition of "wonder" is "a bright Messier object." There's only one Messier within Canis Major's border, the large but outstanding open cluster M41. There are a couple of other galactic clusters, M46 and M47, which we've already visited, in nearby Puppis, but not much else of the showpiece class is to be found in the vicinity of the Big Dog. A little digging in the star atlas did turn up some additional objects of interesting types in the area—including a two diffuse nebulae and a galaxy for us to visit—but these are subtle objects, so be prepared to do some real work.

M41

M41 seems more than deserving of its inclusion in the Messier catalog. It's bright at magnitude 4.6 and very easy to find in the relatively barren star fields near the western end of Canis Major. Unfortunately, it is large, 38′ across its major axis, and a little thin star-wise when compared to the glorious clusters in Auriga, for example. It *is* magnificent in binoculars, with my inexpensive Chinese 15×70s providing an unforgettable view. In these glasses, it's easily resolved into myriad stars, and appears as a compact and elongated object reminiscent of a globular cluster in a telescope. It looks so fantastic in binoculars or my Short Tube 80 refractor at low power that I'm always disappointed when switching to the main scope, and seeing this cluster revealed as a nice but rather pedestrian assemblage. Bottom line? For best effect, keep the magnification down and the field wide.

It can be a little difficult to find the right magnification and the right field diameter to show this M object to best advantage. But finding this object couldn't be easier. The chart in Figure 9.10 shows it sitting pretty 4° almost due south of Sirius, forming a right angle with Sirius and Beta Canis Majoris, magnitude 1.98 Murzim.

In the eyepiece of the 8-inch *f*/5 Newtonian telescope, M41 is revealed as a medium rich and somewhat shapeless group. In the city, expect to see about 30–40 stars with ease (under dark skies even a 3-inch scope will reveal 50 or more stars here). This elongated, flattened pattern of bright stars is supplemented and enhanced by scads of dimmer suns spangled across the field in random fashion that begin to show themselves

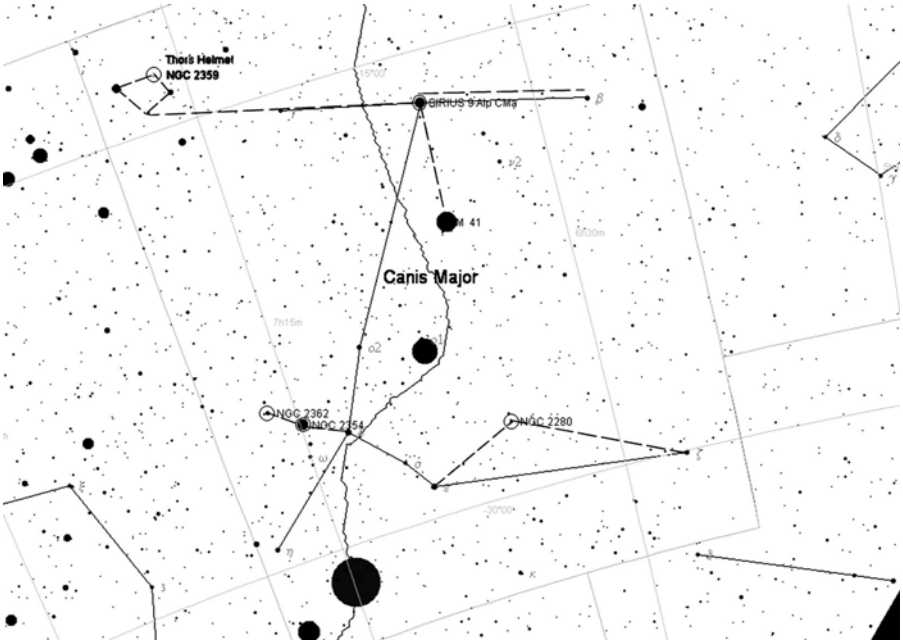

Figure 9.10. Canis Major chart.

with increased magnification. Upping the power does cause the cluster to lose impact by eliminating the dark sky around it that frames it at low power. But increasing the magnification reveals many stars that were invisible at lower power. I always try to examine open clusters at a variety of magnifications, even if the smaller fields of short focal length oculars "destroy" the beauty of the larger groups. You'll see several bright stars involved in M41, with 12 Canis Majoris, which lies just 20′ to the southeast of the cluster's heart, being most impressive at magnitude 6.0.

Yes, I was happiest with M41 in large-aperture binoculars or a wide-field refractor, but I did enjoy viewing it in the 8-inch *f*/5:

> This outstanding Messier cluster shows off at least 25 members in the 8-inch with a 35-mm Panoptic at 28×. The Short Tube 80-mm refractor shows off almost as many of stars, but provides a much more impressive view at 20×. The most distinguishing characteristic of the cluster is a shockingly orange–red magnitude 9 star near the center of the group. This is made even more impressive by its contrast with its sister cluster stars, most of which are blue–white in color. A longer look at the cluster reveals numerous oddly curving chains of stars and hints of a background haze of unresolved suns.

Under dark skies, M41 can be a naked eye object, appearing to be almost the size of the Full Moon, at least if you live far south enough in latitude to get it out of the trashy air at the horizon. M41 was first catalogued in the 17th century, well before Messier laid eyes on it, but this cluster may have been seen by the ancient Greeks long before that, and, if so, was one of the few DSOs known to them (M44, the Beehive, being

another). Current thinking places M41 at 2,300 light years, making it approximately 25 light years in size.

Thor's Helmet, NGC 2359

With NGC 2359, we go from easy and obvious and pedestrian to hard, challenging, and interesting. Canis Major, trotting along beside his master, Orion, and splashing his paws in the edge of the Milky Way's stream, is not as rich in emission nebulae as you'd expect; certainly he's not as blessed with these objects as the Hunter. There is at least one nice example of this class of DSO in Canis Major, NGC 2359, The Thor's Helmet Nebula (also occasionally referred to as the "Florida" Nebula).

Thor is an unusual and attractive object that definitely deserves a look-see if you're up to his challenge. Be prepared to throw as much aperture as you can muster at it. In my skies it took the Nexstar C11 to pull it out. In part, this is due to the southerly declination of this object, $-13^\circ\ 14'$, but also because of its intrinsic dimness. NGC 2359 is $10'$ in extent, fairly large, and its surface brightness is resultantly low. On typically hazy (for my location) late winter nights, it definitely required a UHC filter for detection. On an outstanding evening, this object *should* be visible in an 8-inch scope—I've thought I've seen it, barely, in my UHC filtered 8-inch *f*/5 on fair nights—but in the city it is most often a nebula for 10-inch telescopes and above. In addition to aperture, an OIII or UHC filter is mandatory.

While not overly difficult to locate, there aren't any bright nearby stars to direct you to Thor, so search carefully using a low-power, wide-field ocular with a UHC or OIII filter in place. Start at Sirius, and draw a line through Gamma Canis Majoris, a distance of $4^\circ\ 35'$. Extend this line an equal distance out into the empty space and stop. The nebula lies approximately $45'$ northwest of your stopping place.

I knew that if I used my computerized, go-to-equipped Nexstar 11, finding Thor's Helmet obviously wouldn't be a problem, but I was skeptical as to whether I'd see anything once the telescope landed me on the correct field. Even under dark skies, this is not always an easy nebula in a 10–12-inch SCT. I was very pleased, then, to be able to see Thor's Helmet with direct vision without even trying very hard on an average evening:

> Thor's Helmet is surprisingly visible under relatively poor, hazy conditions. Despite the light pollution, it was easy in a 35-mm Panoptic at 80× when I used a UHC filter in conjunction with the eyepiece. Without the filter, the nebula is seemingly invisible—I didn't think I could detect it, anyway. It does appear that I'm seeing almost the full $10'$ swath of nebulosity, but the "helmet wings" seen under dark skies are not visible, or at least only barely. Most of the time, this is just a dim, elongated patch slightly brighter than the sky background, but I occasionally convince myself that I can detect one curving, elongated swath of nebulosity after long observation with a dark hood over my head.

The Thor's Helmet Nebula (Plate 56) is a type of nebula completely different from those we've visited most of in this series of tours. It's not an emission nebula or a reflection nebula, nor is it the remains of a supernova or a Solar mass star. Thor's Helmet is a type of nebula associated with Wolf-Rayet stars. Wolf-Rayet stars are very hot (up to 50,000 kelvin) and very large (up to 20 Solar masses) stars that are well down

the evolutionary path to supernovae-hood and are expelling their outer layers. The nebula is the remains of the stellar atmosphere blown off by a nondescript-looking "central star." At some point in the distant future, Thor's associated star is likely to burst into supernova glory in the star fields of Canis Major. Another example of this phenomenon is the (in)famous Bubble Nebula in Cassiopeia, which is far more difficult to detect in city or country than Thor's magnificent Helmet.

Tonight's Double Star: Sirius, Alpha Canis Majoris

We can hardly leave Canis Major without taking a look at his stellar attraction, the brightest star of them all. Normally, looking at a bright star in a telescope is not a very interesting experience. In a scope, a brilliant star is just that, a bright point of light, maybe dancing around as seeing changes. Children do seem fascinated by the appearance of Sirius or any bright star in the eyepiece, but there's not much here for amateur astronomers. Not until recently. As of this writing, 2005, the Pup has come into view.

Sirius is possessed of a companion star, Sirus B, the "Pup," that's fairly easily visible at certain times. On average, the Pup lies at a distance from its parent star similar to the planet Uranus' distance from our Sun. The orbit of Sirius is quite a bit more eccentric—elliptical—than that of Uranus, however. From our perspective the Pup can be up to 11″ from Sirius, but this can dwindle down to 3″ at the other "side" of the Pup's orbit. Certainly, 3″ is not terribly tight as close double stars go, so the Pup should be easy to resolve, right? No. Not hardly. The problem is the huge difference in magnitudes. The Pup is at magnitude 8.5, while Sirius is blazing away at magnitude *minus* 1.5.

This immense difference in brightness makes the companion star hard to see, even at maximum separation (the Pup will reach its greatest distance from Sirius in 2005 and will begin to slowly move closer thereafter). At or close to the Pup's greatest "elongation," the careful observer should be able to resolve it with a 10-inch scope at high power—300× and above. Sirius B can probably be detected in considerably smaller telescopes, but I'm finding that the extra aperture makes detection much more certain. With the C11 at 350×, the Pup is unmistakable as a little spark of light barely separate from gaudy Sirius' "rays." To be positive I wasn't fooling myself, I printed a finder chart for the Pup oriented to match the view produced by my scope (*Skytools 2* allowed me to produce a chart for mid-2005, Figure 9.11, in just a couple of minutes). Frankly, if you're not a double star fan, the Pup isn't overly impressive. Not unless you know the fascinating and slightly silly story surrounding it.

The *discovery* of Sirius B is straightforward. Famous American telescope maker Alvan Clark spotted it as he was testing a brand new telescope, an 18.5-inch refractor he was installing at Dearborn Observatory in Michigan in the U.S. on January 31, 1862. That it took until the mid 19th century to discover the Pup is a little surprising, but not astonishing. While large scopes had been in use since the time of William Herschel in the 18th century, the *quality* of telescope optics didn't begin to catch up until the 19th century, when quality was dramatically exemplified by Clark's exquisite refractor objectives.

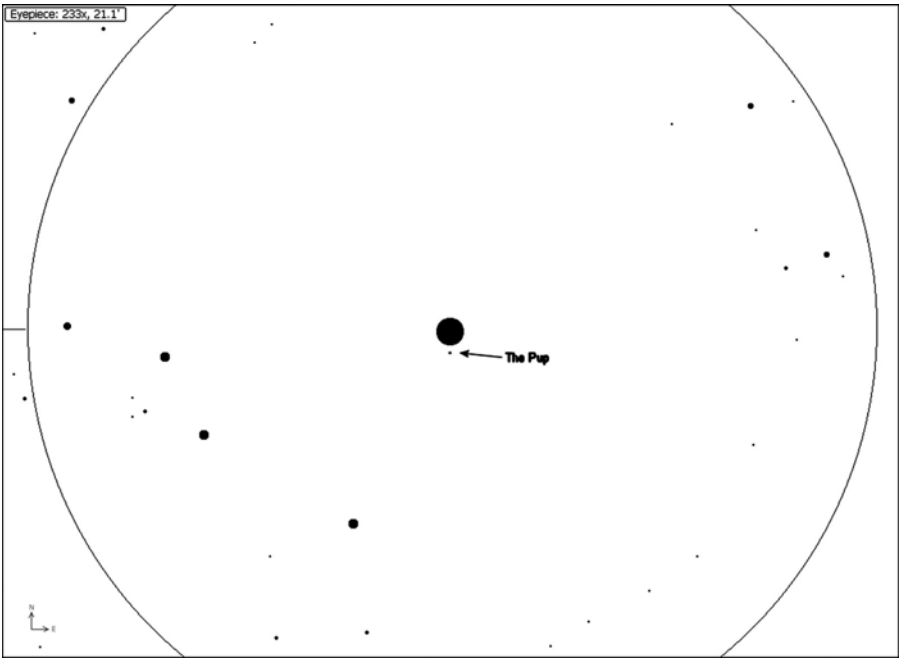

Figure 9.11. *Skytools 2* finder chart for Sirius and his Pup.

The interesting part of the story didn't begin until nearly a century later, in the 1940s. At that time, two French anthropologists were studying a West African tribe, the Dogon, which supposedly had little contact with westerners. These people, who lived in what is now Mali, fascinated the scientists with folklore stories that seemed to indicate that they had long been aware of the existence of a dim companion to Sirius. Not only that. They also claimed to know that Sirius B is a very dense white, dwarf star, something that was fresh knowledge to astronomers of the late 1940s. *And* the Dogon appeared to know that the Pup orbited Sirius over a period of 50 years. How did they know these things? How could they *possibly* know? The Dogon claimed to have been visited by extraterrestrial voyagers some 10,000 years previously, who gifted them with their knowledge of the Pup.

What a story. It's easy to see why the tale of the Dogon and the Pup has become beloved of UFO buffs and *X Files* fans. But what's the ground truth? How to explain the tribe's apparent knowledge of advanced astronomical data? The first theory to be offered was bandied about by people in the anthropology community who didn't have much knowledge of observational astronomy. Maybe, they theorized, the dark skies of West Africa enabled the Dogon to see Sirius B without optical aid. This "explanation" seems laughable. Even under the darkest skies it's unlikely that *any* human will see down to magnitude 8.5, and even if someone could, the close proximity of Sirius would make detection totally impossible, even at greatest elongation of B from the main star.

Another possibility is *cultural contamination*. During the 1920s and 1930s there was a great deal of travel to West Africa by westerners of all types, not just scientists, at a time when there was much speculation in the European press about the nature of Sirius B as a dwarf star. It's not clear that the anthropologists were really the first Europeans to have encountered the Dogon. It's entirely possible that other western visitors sitting outside with their hosts at night might have related the news of Sirius' strange nature to impress the tribesmen. This cultural contamination mixed with preexisting folklore beliefs of the Dogon seems the best explanation for the mystery. The Dog Star/Dogon tale *does* make a good story though, and is not completely and convincingly explained to my satisfaction yet.

Sirius, Alpha Canis Majoris, is a blue–white A1 spectral class star located 8.6 light years from Earth. It has a mass about 1.5 times that of the Sun, but its brilliance is due to its relative closeness, as it is not a giant star. It is famous in history due to its association with the flooding of the Nile (in ancient Egypt, Sirius rising with the Sun meant it was time for the Nile to leave its banks), important to early Egyptian agriculture. Its moniker, "Dog Star," also comes from the Egyptians and their association of it with their dog-headed god, Osirus.

Elsewhere in the Kennel

There's no question that Canis Major is the land of open clusters. A look at a detailed star chart will reveal hordes of them. Most of these NGC objects are fairly lackluster, but there are a couple of nice exceptions.

NGC 2354

A magnitude 8.9, 20′ diameter open cluster located 1° 29′ northeast of Delta Canis Majoris. NGC 2354 is not overly rich, but its interesting shape makes it worth a look. The center of the cluster is marked by a relatively bright magnitude 9 star that is surrounded by an almost complete ring of medium-bright cluster stars. This strange asterism almost looks artificial.

NGC 2362

Slewing the telescope 1° 14′ farther to the northeast from NGC 2354 brings us to NGC 2362. Finding this one is as easy as falling off a log, since it's involved with bright magnitude 4.39 Tau Canis Majoris. There are as many as 60 stars visible here, though I see less than half that many from my light-polluted stomping grounds. Roughly triangular in shape, most of the cluster is composed of dim stars. This contrast between Tau and the rest of the group can produce an interesting effect. Tau is known as the "Jumping Spider Star" because a tap on the scope's tube will cause the star to jiggle in a pattern seemingly *different* from the rest of the cluster stars. This strange

optical illusion is due, no doubt, to the large brightness difference between Tau and its companions.

NGC 2280

There are a few other types of objects in addition star clusters to be seen in Big Dog's den, Thor's Helmet being one example. If you comb the star fields you can even turn up a number of galaxies. Unfortunately, most of them are *insanely* dim for the City Lights astronomer. You do have a shot at NGC 2280 (Plate 57). At magnitude 11 and $7.0' \times 3.0'$, it is often doable on very good city nights by medium-to-large aperture scopes. Wait for its field to get as high in the sky as it will, and examine the area carefully at medium-high magnification. Don't expect much more than a faint, perhaps vaguely elongated (northwest–southeast) smudge, however. The spot where this shy galaxy lurks is easy to get to, since the bright foot of the dog, Epsilon, and magnitude 3.02 Zeta Canis Majoris (see Figure 9.6) form a flat triangle with the galaxy.

> Sirius, light of the South! His brilliant blue beacon seems to overwhelm the dull glow of sodium arc streetlights. Whether hunting the elusive Pup or searching for the sometimes maddeningly difficult Thor's Helmet Nebula, I've again forgotten I'm observing under "impossible" city skies, and have just had a wonderful time out under my stars.

Canis Major marks the end of our starry road. I hope you've enjoyed this series of deep sky hikes and will go on to plan and take many more on your own. I'm always interested in the urban adventures of my brother and sister amateur astronomers, and would enjoy hearing from you on the "Rod's City Lights" computer mailing list (see Appendix 1 for the URL).

> Happy deep sky hunting from city lights!