CHAPTER SEVEN

Summer

Tour 1

The Friendly Stars

One summer, I found myself living alone in the urban home of some friends, "house-sitting" for them while they were on vacation. I was recently divorced and hadn't yet readjusted to the single life. The empty house seemed strange and spooky, and the nights promised to be long. Luckily, I'd brought my 6-inch Dobsonian telescope with me, and when the skies cooperated I had no lack of friends to visit on these summer evenings. Looking out at the darkening sky on one surprisingly clear if substantially light-polluted evening, my gaze ran across the southeastern horizon and I found myself drawn to one of these friends, mysterious Ophiuchus, the Serpent Bearer and First Physician (in the guise of Aesclepius). His stars, glowing with burnished majesty in the still summer air, beckoned and I was soon setting up the telescope.

It had been some time since I'd visited this most-unfamiliar of the summer constellations (for nonastronomers, anyway) and I was anxious to see how his multitudinous globular star clusters would hold up in sodium-pink city skies. Sure, I'd visit Hercules—how can you pass up M13 on any evening when it's over the horizon? But, as I've said before, desert-only does not a nutritious meal make. My main target area for the evening would be Ophiuchus, with a side trip into neighboring Serpens Caput for a look at a star cluster I think is actually *better* than M13.

Let's get started. Before you can begin to sample the deep sky pleasures of Ophiuchus, you must to be able to find the constellation. That may not be easy if you are a new

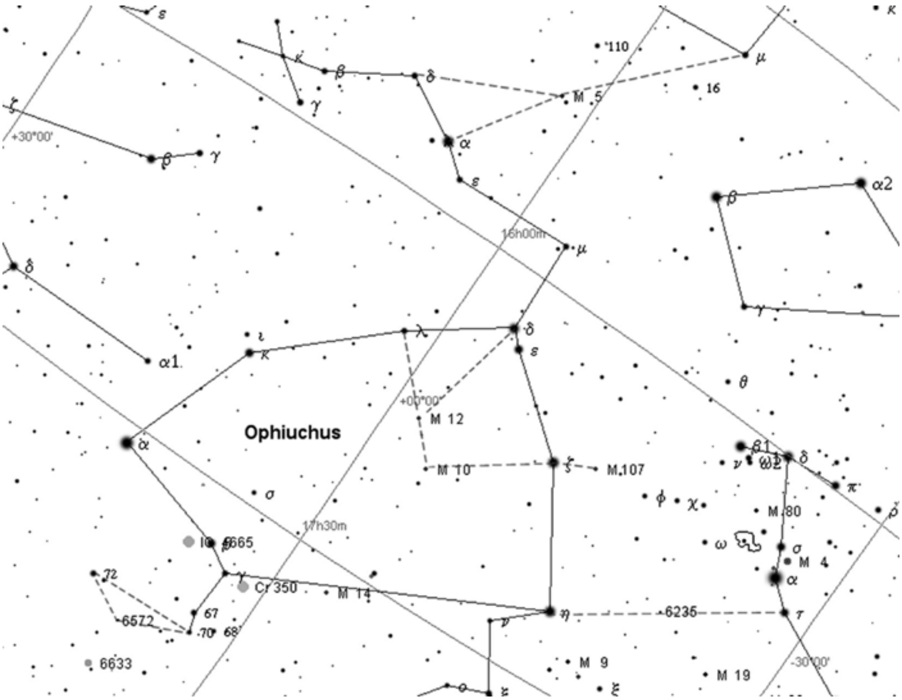

Figure 7.1. The Ophiuchus neighborhood.

visitor to this out of the way part of the summer sky. Ophiuchus is composed of subdued stars that are spread across a large expanse of sky in a somewhat shapeless pattern. He's big and dim and it's difficult to trace his form in bright and humid urban skies, but to become a productive explorer of the summertime sky you need to extend your knowledge beyond well-known constellations like Hercules, Scorpius, and Sagittarius and start poking around in out of-the-way corners. You must stray off the beaten path and wander among the strange constellations you never hear mentioned on *Star Trek*, constellations like Scutum, Lupus, and *Ophiuchus*.

Many of Ophiuchus' stars are readily visible under the streetlights, but, no, his form does not jump out at you as that of nearby Hercules does—and Hercules, despite his fame, is not blessed with any bright stars. The basic pattern of the constellation is that of a house shape, a square with a triangle attached (see Figure 7.1). Ophiuchus' "house" is lying on its side, and the peak of the slightly distorted "roof" is pointing north. Don't even try to visualize the pattern as a human figure holding a snake Ophiuchus looks no more like a physician than Sagittarius looks like an archer or a centaur.

The easiest way for the new explorer to land in Ophiuchus is to follow the stars of Hercules. Start from the Keystone, the central pattern of stars that forms the Hero's body, move up his Eastern "arm" from the Keystone to Delta Herculis, and from there move to Alpha Herculis. Exactly 5° 15′ almost due east of Alpha you'll find one of Ophiuchus' few memorable stars, lustrous magnitude 2.08 Alpha Ophiuchi (Rasalhague), which forms the peak of Ophiuchus roof.

When you've identified the constellation and can pick out its shape with ease, look for the star Delta Ophiuchi (Yed Prior), in the southwestern area of the constellation figure—it forms the southwest corner of the house. Once you've got this magnitude 2.74 sun in the in your finder, look just 1° 24′ East for Epsilon. Pass this bright one by and keep going for another 7° 30′ and you'll happen on magnitude 2.56 Zeta Ophiuchi. Zeta and Delta, along with a dimmer star, magnitude 3.82 Lambda Ophiuchi, Marfik, which lies to Delta's north, will make it easy to find our first target, M12. Move your scope slowly and methodically, though, as there are no overly bright stars in the immediate area of the star cluster to help you find your way.

M12

M12, which lies 1° 39′ southeast of Lambda Ophiuchi, forms a near-right triangle with Lambda and Delta. If you position your scope with reasonable care, I wouldn't be surprised if you hit this cluster on the first try. If you miss it, a quick search should be all it takes, as, at magnitude 6.1, this Shapley–Sawyer Class IX (9) cluster stands out prominently, even in the bright and humid skies of city summertime. Its classification as a "9" means it is fairly loosely concentrated, without a prominent core, but it's far easier to run down than most of the galaxies of spring were.

What does M12 look like in a 6-inch aperture telescope? It can be disappointing. You'd think the "loose" nature of this globular would mean even a small telescope would deliver lots of resolution; cluster stars shouldn't be so closely packed together as to prevent a 4 or 6-inch from plucking individuals out of the milky glow. Unfortunately, this loose structure actually makes M12 a difficult subject for a small urban scope under gray summer skies if your goal is the resolution of individual cluster stars. Far from spectacular, M12 reminds me of a slightly brighter twin of spring's M53. Yes, M12's stars are well separated, but they are dim. While a few of this glob's suns approach magnitude 12, most are at a forbidding magnitude 14 or dimmer. The cluster's light is spread out across a fairly large area of sky, too, 16′, making it even less impressive under poor conditions. As I found out during my house-sitting observing runs and documented in Figure 7.2 and in a log entry:

> I had great hopes for M12 based on what it looks like from the country, where it's a spectacular (if not overly bright) ball of stars in the 6-inch Newtonian. But it's not nearly as good from this urban site as I'd expected. It's a vague and ghostly glow 3′ or 4′ in size at most in my scope. There is only a little central condensation. Mainly it's just a small gray disk that dims smoothly to its edges. Despite increasing my magnification to 250×, and using averted vision on the cluster's periphery, I can't resolve any stars tonight. Most of the Messier globulars will give up a star or two if only briefly and with averted vision, but not this one.

Keep your eye on this cluster throughout the summer, of course, as you never can tell when a night of improved observing conditions will make it look *radically* better in smaller telescopes. The easiest cure for the can't-resolve-the-glob blues, though, is to pour-on the aperture, as I did recently with my Nexstar11 SCT:

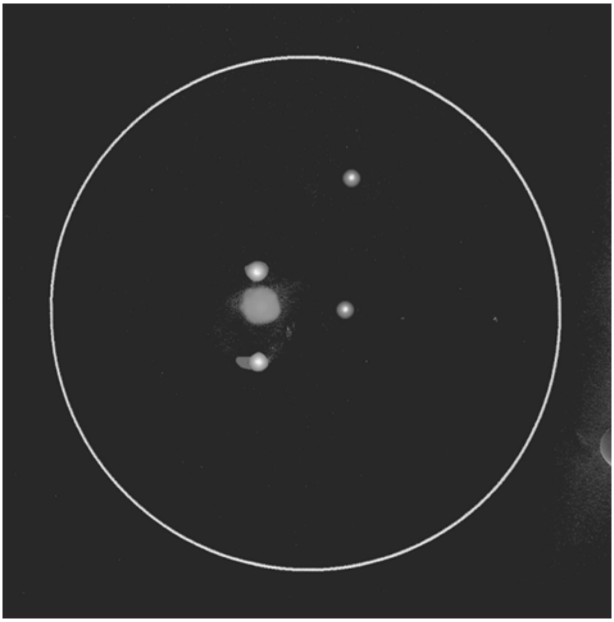

Figure 7.2. M12, one of the twin globulars of Ophiuchus.

> M12 is excellent despite the haze-amplified light pollution I'm dealing with tonight. Much resolution at both 220× and 127×. The loose core is not completely resolved, but numerous stars, both around the edges and closer in toward the center, are easily visible with direct vision. Looks vaguely irregular, with an almost "square" appearance. It's large, and I wish I could use my 35-mm eyepiece on this one, but it makes the background sky way too bright.

M12, like the constellation Sagitta's famous M71, is so loose in structure that astronomers have wondered whether it might really be an open cluster rather than a globular. Spectroscopic studies, however, reveal its stars as elderly rather than youthful—open cluster stars are always young compared to those that compose globulars. M12, which lies an estimated 16,000 light years from our planet, is an ancient globular star cluster. If it is indeed 16,000 light years away, it is about 75 light years in diameter. Like other globs, it is composed of old stars, both evolved ones that are in the red giant stages of their lives, and small, low mass stars that can continue to shine dimly for countless eons.

M10

There are two ways to find the nearby (to M12) globular, M10. If you're an experienced observer comfortable with your scope, just eyepiece-hop 3° 16′ east from

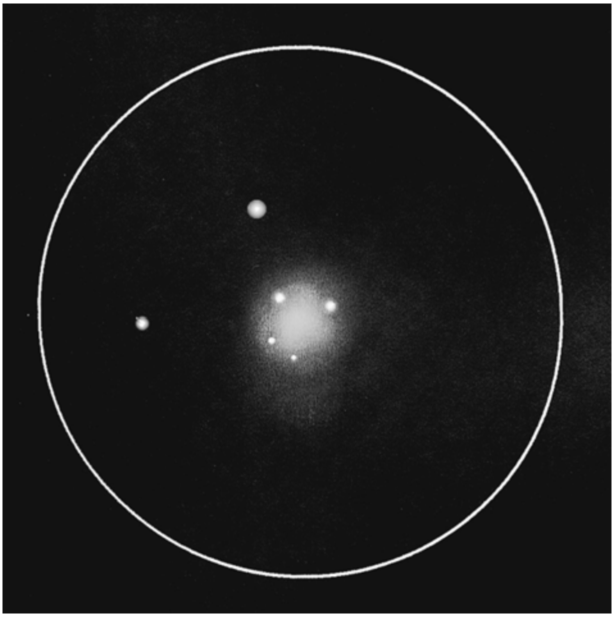

Figure 7.3. M10, Ophiuchus' other twin.

the previous object, M12. If you're *not* so experienced, or, like me, don't visit Ophiuchus as often as you should, use the stars Delta and Lambda again, but also include nearby Zeta Ophiuchi in your pattern making. As seen in Figure 7.1, M10 forms an almost perfect rectangle with these four stars. If you have trouble hitting the right spot this way, look for magnitude 4.8 30 Ophiuchi in the area of the cluster. It shows up well in finderscopes, and M10 is only about a degree away from this star. At magnitude 6.6, M10 is a little dimmer than M12, but this is more than made up for by its Shapley–Sawyer Class of VII (7). Its more compact form gives it a brighter central region, making it stand out better from the gray sky background in your eyepiece.

Since M12 and M10 are so close together in the sky, it's inevitable that they'll be lumped together as "two of a kind." You'll often hear them referred to as the "Twin Globulars of Ophiuchus." But that's ridiculous. They *do* have similar sizes and magnitudes, but they look *nothing* alike in an eyepiece. M10 (Figure 7.3) is *worlds* better than M12 from the city. Or in the country, if you ask me. M10 is bigger and dimmer than M12, and logically should look worse, but its more compressed structure makes a huge difference. In the 6-inch scope I found that:

> M10 is much more impressive than M12. In the 6-inch scope at 150×, even with the cluster lower in the sky, numerous member stars are resolved around its periphery and can be held steady in my gaze with averted vision and high power. A few even wink in and out of view when I stare straight at the cluster.

Naturally, going to a bigger scope makes the good even better:

> Lots and lots of resolution with the 12.5-inch Dobsonian at 125×. I can see cluster stars right across the globular's core with direct vision. This core almost looks "transparent"—as if I'm seeing through it, past its multitudes of stars to empty space beyond. Streams of stars branch off from the cluster's center and almost seem to assume a spiral pattern.

It doesn't take a 12.5-inch telescope to make M10 look good. This is a truly remarkable object in my inexpensive 8-inch *f*/5 equatorial Newtonian as well. At 167× with an imported 6-mm wide field eyepiece, M10 just looks *amazingly* wonderful. In the heaviest light pollution, many small stars spill across the cluster core and occupy almost the entire width of the eyepiece's 60° apparent field. I believe I actually preferred the view in the 8-inch scope to that in the larger Dobsonian. The 8 inch's driven mount made it easier to study the cluster and to see all the stars it could deliver—continually nudging the Dobsonian along to track the cluster was distracting. The 8-inch *f*/5 was a significant improvement over the 6-inch scope for very little penalty portability-wise.

Unlike M12, there has never been any doubt about the nature of M10 (Plate 35). A glob is a glob is a glob in this case—the aged stars revealed in its HR diagram and its appearance in any telescope make that clear. It's a little closer to us than M12 at 14,300 light years, which makes it a little smaller than its brother at 63 light years in diameter.

M5

I've gotten into *arguments* about this Messier globular cluster. If you live in the Northern Hemisphere, all you hear is, "M13, M13, M13." Hercules' Great Globular Cluster, is good. OK, *very* good. But is it the best globular cluster for observers at northern latitudes? Not in my opinion. There's, for example, M22 in Sagittarius. It's much bigger, looser, and easier to resolve than M13 in small scopes. Too bad it's so low in the sky for many Northern Hemisphere observers. But there's another globular, one that, to my eyes, looks considerably better than M22 *or* M13, M5 in Serpens Caput (Plate 36).

If you thought Ophiuchus was an obscure constellation, I'm betting Serpens is completely unknown territory for you. Serpens is actually two constellations: *Caput* and *Cauda*. As the Latin words indicate, one is the Head of the Snake and one the Tail. Visualize the figure of Ophiuchus/Aesclepius with his familiar snake draped across his back, head on one shoulder and tail on the other. The star-pattern of Ophiuchus doesn't look much like a man, but the constellation figure of Serpens Caput does look something like a serpent's head. We can forget about the Cauda, the Tail, for now, as M5 is within the borders of Caput.

Serpens Caput is easy to find if you know the basic form of Ophiuchus. It's connected to the main figure of the constellation at the star Delta Ophiuchi, which we used to find M10 and M12, and extends through four medium bright stars that lead you to Serpens Caput's most distinguishing feature, the head of the snake formed by Rho, Iota, Beta, Gamma, and Kappa Serpentis. While it might be argued that Serpens looks more like a snake than Ophiuchus looks like person, forget that this asterism is supposed to represent a snake's head; the five stars form a nice letter "X" in the sky southwest of Ophiuchus. Always look for this X, as it's usually quicker to locate Serpens by means of this prominent pattern than by wending your way up from the east from Ophiuchus.

With your eyes fastened on the "X," note magnitude 3.67 Beta Serpentis, the southeastern member of the asterism. From there, jump down to the next prominent star along the snake's back, mag 3.80 Delta. The snake's body jogs back North after Delta, and you'll next run into Alpha (magnitude 2.65), and Epsilon (magnitude 3.71) fairly close to each other. M5 is 9° 21′ Southeast of Delta, Alpha, and Epsilon, forming the apex of a slightly lopsided triangle in combination with their slightly tilted base. Another way to find the cluster is by using magnitude 3.88 Mu Virginis, which is 11° 46′ to the southwest. M5 is a little over halfway along a line drawn from Mu to Alpha Serpentis, and is a little closer to Alpha than Mu. M5 is not difficult. At magnitude 5.6, you can safely use a low-power wide-angle eyepiece while hunting for it. This star cluster burns through light-pollution with ease despite its large size of 22′.

It didn't take me long to center M5 in the field of the 6-inch scope, even using my way-too-small 30-mm finder. When I went to the eyepiece, I liked what I saw:

> Lovely, with a very compact core. It appears slightly elliptical , and is elongated east/west. Raising my magnification to 200× reveals plenty of outlying stars away from the tightly packed nucleus—which doesn't show any resolution in the 6-inch scope. Other than its elliptical shape, there's no real form or pattern to its stars. The stars surrounding its core congregate in random patterns, nearly filling the field of my eyepiece. I hate to leave M5 , but there's so much else to wonder at in Ophiuchus and the rest of the summer constellations—I've got to move on.

Like spring's M3, M5 often looks blue in color to me. You'd think a globular, made up of old yellow and red stars, ought to have an overall golden hue, but this one glows an amazing sapphire.While I used a 6-inch scope to view M5's minute stars, they should be visible in 4-inch telescopes at high power, since the brightest cluster members shine at magnitude 12.

M5, a Class V (5) globular, is one of those Messier objects that Messier himself didn't originally discover. It was first seen in 1702 by German comet hunter Gottfried Kirch and his wife Maria during one of their "sweeps" for comets. Charles Messier did discover it independently in 1764, and recorded it as a "nebulous star." M5 is one of seven globulars on Messier's list that lie inside the borders of Ophiuchus. This enormous ball of suns, 126,000 light years away from our cozy rock, is incredibly ancient. It is believed to be one of the most elderly of the Milky Way's globulars, old enough that it may have been witness to the titanic events surrounding the birth of our galaxy.

Other Globs and a Sweet Surprise

M107

Lurking near the center of the galaxy, which is found in the nearby constellation Sagittarius, the Ophiuchus area claims more than its fair share of globulars, most of which are at least *visible* in small telescopes. If you want to see more than the three showpieces in this region, M10, M12, and M5—and you should—M107 is a good place to start, as it's even easier to find than M10 or M12. It's dimmer and smaller than the other two at magnitude 7.9 and 10′ in diameter (in pictures—you'll be lucky to see less than half that much), but its location near prominent Zeta Ophiuchi, means that finding it is simplicity itself. Position your finder on Zeta and slew 2° 43′ south. Just before you hit the cluster, you'll cross a lopsided triangle of 7th magnitude stars half a degree across. Since M107 is going to be small, kick up your magnification as much as you dare. Even though it's very loose, M107 is small and high power will help you pick it out from the background.

What M107 will look like in your telescope depends, as it does with every other DSO, on you, your skies and your scope, but it was at least worthy of a few minutes with my 6-inch:

> Surprisingly dim in the 6-inch Dobsonian, even at 150×. I can see it, but can't resolve a single star. It's fairly identifiable (at 96×), nevertheless, and I believe a better evening and higher power will improve it.

Coming back to it later with the C11, it was better, certainly, but admittedly the bigger telescope still didn't make it spectacular on a poor night:

> M107 is there this evening—barely. At 220× with direct vision I can make it out with some difficulty. Even though it's fairly high in the sky, it just doesn't look like much. It's a small, gray, fuzzy ball with only occasional resolution of a few stars around its edges at 300× and higher magnifications. At lower powers, it is completely unresolved. I'm gratified to be able to see any stars at all in this small cluster.

NGC 6235

Want *more* of a challenge? A globular cluster that's not a Messier? Trot over to the far southeastern corner of Ophiuchus for NGC 6235, another very loose cluster with a Shapley–Sawyer Class of X (10). Not only is it loose, it's dim at magnitude 10.2, and small at 5′.

NGC 6235 lies almost exactly at the midpoint of an imaginary line drawn between two easy to see stars, magnitude 2.43 Eta Ophiuchi, and magnitude 2.82 Tau Scorpii, which is 14° 49′ south of Eta. This position close to two prominent stars would ordinarily make the cluster easy to find, but this globular is faint, so keep your eyes open. As you move south toward Tau, you'll run across magnitude 6.26 29 Ophiuchi, the only marginally luminous star close to the cluster. It is almost exactly halfway between Eta Ophiuchi and the glob. Just before you reach the star cluster, you'll see two 7th magnitude stars aligned almost perfectly with the line you've "drawn" from Eta. They are approximately 22′ apart, and the second star is only 25′ from the NGC 6235.

Even in the country, this distant cluster doesn't give up its secrets easily. It may take a 20-inch class telescope to reveal a handful of stars under dark skies. Knowing this to be a very real challenge, I didn't even try for it with the 6-inch scope during my house-sitting stint—I came back to it later with the 12.5-inch Dobsonian:

> NGC 6235 is low on the horizon, skimming the trees, and in some of the worst horizon garbage. I wasn't sure whether I'd be able to see this cluster at all, even with the 12.5-inch scope. It is detectable, but only barely, as a small, 1′ or so diameter smudge at 127×. Can't always hold it with direct vision; it pops in and out. It looks more like a dim Virgo galaxy than a globular cluster. Higher magnifications don't help either; 220× makes it disappear completely.

M62

M62 is a much more practical cluster for small scopes and bright skies than NGC 6235. It's at magnitude 6.5 and is a Class IV (4), so it is rarely a challenge to see. The only challenge, in fact, is trying to achieve resolution in smaller telescopes, but even in that regard M62 is a kindly and forgiving old cluster.

M62 is a little over 7° from NGC 6235, and is more a part of Scorpius, really, than Ophiuchus. It straddles the Ophichus—Scorpius border and is less than 4° from Epsilon Scorpii, one of the Scorpion's "backbone" stars. It forms a near isosceles triangle with Epsilon and Tau Scorpii. Both of these stars are very bright, but proceed slowly. Unless your observing site is close to the equator, you'll be working down near the horizon, and the stars and the cluster will be dimmer than you think they should be, even in a large aperture finder. Once you've got the cluster in the field of the main telescope, pour on all the power that it, your scope and your skies will support if you want to pick out a few of this glob's distant stars. I worked hard on this one, spending over an hour with it and using a wide variety of magnifications with my 6-inch *f*/8. This diligence rewarded me with at least a brief glimpse of its true form:

> This is more than just another faint fuzzy. At 180×, averted vision picks up a few cluster stars every now and then. To achieve this modest triumph, though, I had to cover my head with a dark hood and spend a lot of time looking. In addition to averted vision, I found that lightly tapping on the telescope tube, making the image of the cluster vibrate slightly, was necessary to make the few visible stars easy to see.

NGC 6572

I mentioned a surprise, didn't I? In addition to globular clusters, Ophiuchus, as you'd expect from his close proximity to the Milky Way, holds many of those other typical galactic-plane type objects: nebulae, open clusters, and planetary nebulae. A look at a detailed chart reveals them scattered all across his form. The Ophiuchus pages in a good star atlas look hopelessly jumbled from DSO symbols piled on top of DSO symbols. Despite the density of objects in this area, though, there's really only one other object of interest to the urban observer in addition to the prominent globs. But it's a wonder.

At a brightness of 9th magnitude, NGC 6572, "The Blue Racquetball Planetary," sounds discouragingly dim, but its tiny size of 11″ means this is no Owl Nebula. It's bright, standing out like the proverbial sore thumb in almost any telescope. To find it, head back to the northern part of Ophiuchus, in the direction of Hercules, and locate Alpha and Beta Ophiuchi. Moving Southeast from Beta, hit magnitude 3.75 Gamma and make a hard turn to the east and down to two fairly prominent magnitude 4.0 stars, 67 and 70 Ophiuchi. Now, turn north and go 5° 15′ and you'll encounter 71 Ophiuchi at magnitude 4.64. It's easy to spot since it has a companion, magnitude 4.0 72 Ophiuchi, just 49′ farther north. The nebula lies 1° south of the middle of a line drawn between 70 and 72. This sounds complicated, and I'll admit that a go-to telescope would be nice when hunting this sucker, but keep after him with a good atlas and you'll bag him—eventually!

Your biggest challenge won't actually be finding the nebula, but distinguishing the Blue Racquetball from a field star in a small telescope. At 11″ in diameter, this VV type 2a planetary is only one-fourth as large as Jupiter is at his largest. That means magnification, magnification, magnification. You should be able to identify a "star" in the field that looks slightly peculiar even at lower finding powers, however. Center this, run the power up to 200×, and you will get a nice surprise:

> No wonder they call this thing blue! If you want color in a DSO, this is the place to go. The Blue Racquetball is almost startling in the richness of its color. The blue of this planetary is more noticeable in the 6-inch scope than is the color of Andromeda's more famous Blue Snowball. The shape also lives up to its name. It is a featureless disk, just a little round racquetball.

If you mention your experiences with the Blue Racquetball at an astronomy club gathering, you'll probably get a lot of blank stares, as the word doesn't seem to have gotten out on this magnificent nebula. This is a tremendous DSO, so spread the word far and wide about this odd little ball bouncing through dim southern stars.

Tonight's Double Star: Marfak, Kappa Herculis

Marfak is an easy to split double star that shows off an interesting color contrast. With a separation of 28″, it is even practical for binocular observing. The magnitude 5.0 primary is a pure looking yellow, but the secondary, shining at magnitude 6.5, is best described as "bronze" or "copper." While Kappa is not part of the main Hercules stick figure, it's pretty easy to find. It lies a little more than halfway along a line drawn between Gamma Herculis, the "last" star in the Hercules, pattern before you reach the Serpens Caput border, and Gamma Serpentis, one of the stars of Caput's "X", which lies 7° to the west of Gamma Herculis.

> That's it for tonight's guided tour. Now, go your own way, wandering through the bewildering treasures of the south. That's what I did on this lonely summer's evening. I traveled from wonder to mystery to marvel as the night grew old and the dawn of another lovely summer morn crept up on me and my wonderful telescope. Lonely? By the end of the night I didn't feel a bit lonely. After soaking in so much beauty, the night and the universe didn't seem mysterious or forbidding at all. Even the distant, enigmatic globular clusters seemed no stranger than friendly bees buzzing around the hive of the Milky Way's center.

Tour 2

Arkenstone in the Stars

When darkness finally arrives after another long midsummer's day, amateur astronomers are witness to an incredible spectacle: the rising of the center of our home galaxy. Look to the south, and, in dark skies, you'll see the Milky Way's nucleus blooming like some monstrous fiery flower. The entire area of the southern Milky Way is literally packed with treasures for the deep sky observer. While the full beauty of this region is denied to the urban astronomer, there are still some lovely views to be had for even the smallest urban telescopes.

Of particular interest in the summer Milky Way is the area of an ancient zodiacal star figure, Sagittarius the Archer. This constellation, which represents the noble centaur Chiron, the teacher of Hercules of Greek myth, is prominent in the south even from fairly high northern latitudes. Don't look for archers or centaurs, though. Look for a heavenly tea service. As shown in Figure 7.4, the stars of Sagittarius form a perfect representation of a teapot.

What makes Sagittarius interesting for us deep sky trekkers is the fact that it is smack-dab in the middle of the summer Milky Way—the center of our home galaxy lies within Sagittarius' borders near M24, a rather subdued (in the city) open cluster/star cloud. This means the area is literally bursting with star clusters, both open and globular, and many wispy emission nebulae. The same goes for nearby Scorpius. It may not be quite as rich as the Archer, but it has some wonderful globular star clusters, and a few open clusters that beat anything of their type in Sagittarius. Scorpius, by the way, is one of the few constellations that beautifully portray what they're supposed to represent; in this case, the scorpion of myth that stung Orion to death.

The urban observer does have to be a bit discriminating when hunting objects in this region, since some types of DSOs show up better in light-polluted skies than others. Depending on how bad your site is, the southern nebulae may be practically exterminated by the sky glow. We can pull some of their beauty out of the light pollution with light-pollution reduction filters, magnification, and skill, but there is no denying that they are better seen from the country. Many of Sagittarius' open and globular star clusters, though, hold up well even from the worst sites.

For many of us, our options are further complicated by the nature of summertime weather. Like most observers, I have a love/hate relationship with the summer skies. On one hand, the coming of this season brings a large increase in the number of bright DSOs that are visible. On the other hand, crystal-clear skies are rarer now. Even the most beautiful days segue into hazy, muggy nights. These less than ideal skies become even worse when coupled with light pollution. Winter skies look darker whether you're in the city or the country because, as was mentioned in the first part of this book, they are *drier*. Less light is scattered by moisture in the air. If you live in an area with high summertime humidity, and have trouble with any of these objects, wait for one of those rare dry—or at least drier—summer nights and try your luck again.

Actually, it's unlikely any of tonight's DSOs will prove challenging, no matter how high your humidity level. All are bright. Amazingly bright. In fact, I had a difficult time

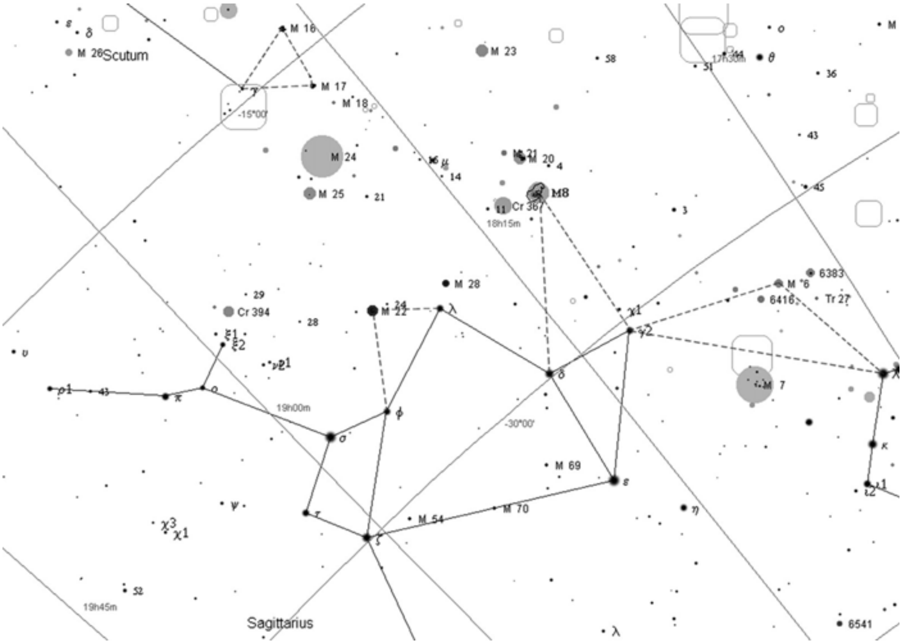

Figure 7.4. The Sagittarius Teapot.

putting this tour together. Not because of any lack of inspiration. My problem was that even when the less than optimum summer observing conditions of my backyard were taken into account I was still faced with the task of choosing a few objects from a multitude of beautiful sights. I really wrestled with which objects to keep and which to throw out, and finally came up with a selection that I think represents the very *essence* of the summer deep sky.

M80

Tonight's cosmic journey inward toward the center of the galaxy begins with the beautiful globular cluster M80 in Scorpius. Besides being a striking sight in fairly small telescopes, M80 also has the advantage of being simple to find. A quick look at an atlas locates this cluster 4° 27′ northwest of Scorpius' brightest star, the impressive red supergiant, Antares. An easy way to snare it is by using magnitude 2.89 Sigma Scorpii, which is just northwest of Antares. Draw a line from Sigma and through magnitude 4.55 Omicron Scorpii. Now, extend this line the same distance again and stop. M80 lies 1° 15′ to the southwest.

Once you have M80 centered in the field of your main scope, your first impressions will be *small* and *bright*. Less than 10′ in diameter and with a brightness of magnitude 7.2, M80 appears stellar in small scopes at low powers. Higher powers will definitely increase the details you can see in many globular clusters, and will usually resolve a few peripheral stars for medium-aperture instruments, but that's not the case with M80. Unfortunately for the city-bound small-scope observer, while higher powers will make M80 look more like a globular and less like a fuzzy star, they will not come close to allowing resolution of the cluster's elusive suns.

M80 is composed of dim stars, 14th magnitude and dimmer, and is highly concentrated, being rated a Shapley–Sawyer Class II (2). It can be hard for smaller instruments to resolve stars in loose globular clusters, but a little scope often has even more trouble picking stars out of the really tight ones. The combination of very small size and dim stars make it impossible to resolve M80 in the city with much less than an 8-inch telescope—and a 10-inch scope makes the task much easier.

This trouble with resolution, though, is offset in my mind by M80's incredible brightness and the beauty of the star field in which it is set. This area of the southern sky is filled with intertwining dark nebulae (William Herschel's famous "hole in the heavens" is nearby). And bright M80, shining like a beacon amid misty star clouds and obscuring nebulae makes for an unforgettable sight. An entry in my observing log for the 4.25-inch *f*/11 Newtonian records M80's appearance on a below average evening as:

> A nice cluster, though now near the horizon. Round, very concentrated, somewhat stellar, appearing at low power. No hint of resolution or graininess. It's a round, star-like object in a rich star field.

Nice, but, as always, I want *stars*. I enjoy observing globulars in their unresolved state in small telescopes and binoculars, but nothing beats seeing them break apart into myriad suns. With that goal in mind, I came back to M80 with the C11:

> At 220× in the 11-inch scope, my impression of M80 is "small and grainy" rather than the usual "small and bright" of smaller telescopes. It is really not much different from what I could see in the 4-inch scope, just brighter. I was able to make out a small number of stars around the edges, but even at 466×, as high a magnification as I usually dare to apply to this glob, M80 is difficult to resolve.

M80 is located nearly 30,000 light years from Earth. A note of historical interest is that the nova *T Scorpii* burst from invisibility to 7th magnitude amid M80's dim stars in 1860, changing the cluster's appearance radically, and briefly making it into the most observed globular star cluster in the sky.

M22

If you found the inability of a small telescope to resolve M80 into stars frustrating, our next destination, the awesome deep sky wonder M22, will more than make up for that frustration. As I mentioned when discussing M5 in the preceding Tour 1, M22 easily "beats" M13 in my opinion, and is especially rewarding for the urban observer with a smaller telescope. In fairly severe light pollution, a little scope—even a 3-inch scope—will resolve *some* of M22's stars at high magnification if you're far south enough in latitude to get the cluster out of the worst horizon-haze and light pollution. In this same 3 incher, M13 remains a fuzzy, if bright, *blob*. M22 really is the archetypal globular cluster for small telescope users.

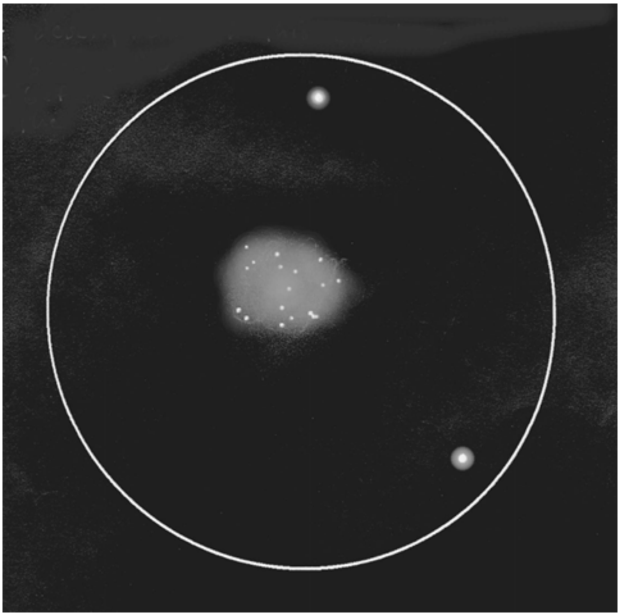

Figure 7.5. M22, Arkenstone in the stars.

M22 is also one of the easiest globulars to locate; it's 2.5° northeast of magnitude 2.8 Lambda Sagittarii, the "top" star in the teapot's lid. The cluster forms an isosceles triangle with Lambda and bright, magnitude 3.1 Phi Sagittarii, which marks the spot where "handle" joins the "pot" (Figure 7.4). Pop in a low-power eyepiece, move your scope into the general vicinity, and you should almost immediately locate the huge magnitude 5.1 glow that is M22. This thing extends a full 32′ across in photographs, making it slightly larger than the full Moon.

When you've got it in your sights, *gaze steadily at this "blob"* and you'll soon see *tiny* stars winking in and out of view around the edges, and will maybe even detect a few sprinkled across the cluster's center in a 4-inch telescope. A higher power eyepiece (100× in a 4-inch scope) should increase the number of cluster stars you can see. As always, diligent, prolonged observation of a DSO will reward the observer with many details that were invisible at first glance. In my modest Short Tube 80 refractor, this big thing was a delight, and I recorded its appearance in the drawing in Figure 7.5 as well in as in a text log entry:

> Fantastic! This huge glob was getting awfully low by the time I finally pointed the ST 80 its way, but it still looked just, plain wonderful. M22 was bright in the field of a 15-mm TeleVue Plossl at 26×, but at that power there was not a hint of resolution. Boosting the magnification to a bit over 100× with a 7-mm Orthoscopic and a 2× barlow, however, did bring out at least a few cluster stars, and showed its strongly elliptical shape well.

In the C11, "good" became "oh-so-much-better":

> M22 is low on the horizon on this average night and well into hazy, streetlight-pink skies, but it is simply incredible at 120×. It's a large, distended oval of tiny stars, and looks

> incredibly resolved. Very flattened. The core is a milky globe with many stars sprinkled across it. Averted vision brings out more there and on the periphery of the cluster. Nearly fills the field of a 22-mm Panoptic eyepiece. I don't notice any color in this glob; its overall hue is a silvery gray.

The technical details of M22 are as amazing as its appearance. Like most globular star clusters, it is mainly composed of Population II stars, the ancestors of the much younger Population I stars (like our Sun). This cluster contains, at a *conservative* estimate, at least 500,000 stars, many of which have gotten old enough to leave the main sequence, confirming this globular's advanced age. It is quite possible that M22 and its stars formed at about the same time as the Milky Way itself, 10–12 billion years ago. The diameter of M22's central region is 50 light years, and the cluster has been given a Shapley–Sawyer Classification of VII (7) (loosely concentrated). At an estimated distance of 10–12,000 light years, M22 is definitely one of the closest of these conglomerations of aged stars, being nearer to us than famed M13.

M17

Yes, light pollution takes quite a toll on the nebulae of the Southern Milky Way. Not only are these glowing clouds of hydrogen gas far more vulnerable to the ravages of sky glow than star clusters, the *good stuff* is down in Sagittarius and close to the horizon for almost all Northern Hemisphere observers. M17, the Swan or Omega Nebula, however, is always a pleasant surprise. At a medium size of 11′ × 11′ and a magnitude of 6.0, even small instruments can reveal its presence from some pretty awful observing locations, and medium-aperture scopes can make it look almost as good as it does from the country if you can use an OIII or UHC filter to restore a little contrast.

The Swan is situated in the northwestern area of Sagittarius near the Serpens Cauda border, and is relatively easy to find. "Relatively" because, while this is obviously a star-rich area, there are no bright ones close to M17. The best path is probably from magnitude 4.7 Gamma Scuti. M17 is 2° 35′ southwest of this star. There is a magnitude 5.3 star 23′ west of the nebula if you need more guidance, but it's hard to miss M17 if you just move southwest from Gamma with a low-power eyepiece in the telescope.

Once you have M17 centered, you'll see why generations of observers have visualized this glowing cloud as a Swan, a Greek letter omega, or a Horseshoe, especially if you're using a 10–12-inch telescope and add a UHC or OIII to the eyepiece. The nebula (Plate 37) is composed of a bar that's 11′ long in photos, and is terminated with a hook shape on its western end. Since there's not a bar on the western side of the hook, the nebula always looks more like a Swan than a horseshoe or omega to me. No matter which shape you see here (some people even see this as the *Lobster* Nebula), it looks marvelous:

> M17 is far better than nearby M8 or M20 in the C11 on this below average night. A rich field with the Swan shape floating among the many stars. Best seen at 100X with a UHC -type filter. I can't detect the dark lane that cuts through the bar of nebulosity that forms the Swan's body, but I can make out the swan's neck without trouble, though this crook of nebulosity is considerably shorter than it is from the country.

The Great Swan, which is a beautiful shade of pinkish-red in photos (it's gray to our less color-sensitive eyes), is a huge cloud of hydrogen 6,000 light years from us. If this distance is correct, it's 15 light years across—one big bird! It is estimated that the

Swan contains enough mass to make nearly 1000 Suns. M17 glows across the light years because its atoms have been "excited"—made to give off light—by the high-energy photons emitted by hot young stars hidden within its folds of nebulosity.

Interesting Side Trips in Sagittarius and Scorpius

M16

There are few nebulae more identifiable by the public than M16, the Star Queen or Eagle nebula. This is due to the famous Hubble Space Telescope image, the "Finger of God." In amateur scopes and images, however, it appears more like—though certainly not nearly as good—as it does in Plate 38. The Eagle is dim and difficult compared to the Swan, and even under dark country skies a UHC-filtered 8-inch telescope is *required* to easily reveal the nebula. In the city, seeing it is harder still, even with the aid of OIII and UHC filters. The nebula has a listed visual magnitude of 6, but, as with all extended objects, this is not a good indicator of how hard it is. In my experience, it's *far* more difficult than even its large 15′ size and surface brightness of magnitude 12 would indicate.

If you found M17, you shouldn't have any trouble getting the Eagle in your eyepiece. He's just 2° 27′ west, maybe two or three low-power eyepiece fields. Once you've got the bird centered in a medium-power eyepiece, don't be too disappointed if the nebula frustrates you. You'll at least be rewarded with the beautiful open cluster that has formed from the nebula's gas clouds:

> The famous Eagle is not an easy object in the C11. The rich open cluster is nice enough, of course, but even on this good night there is only the barest suggestion of the Eagle's nebulous body. Its "wings," which extend from the main body of the nebulosity, are invisible at high or low power and with all my nebula filters. The UHC seems to bring out what little nebulosity there is the best. I have never seen any trace of the Eagle with any scope smaller than 10 inches in the city.

M8

I always have high hopes for M8, the famous Lagoon Nebula. In the country, or even from decent suburban skies, this is a wonder. You have two patches of nebulosity cut by a dark lane, the "Lagoon", and a wondrous open cluster is superimposed on the nebula (this star cluster is not involved in the nebula, it is merely along our line of sight to it). Like M42, getting to M8 is like shooting fish in a barrel. Even under poor conditions, it should show up in your finder as a fuzzy star, 6° west of Delta and Gamma, Sagittarius' "spout stars."

Easy to find like M42, yes, but don't get the idea that this will *look* as good as Orion does in light pollution. M8 is badly hurt for us northerners by its closeness to the horizon. It's got a high integrated magnitude of 5.0, but this is spread out over an object 30′ × 45′ in size, so the surface brightness is rather low at 13.0. An OIII filter can help with the Lagoon, but there's no use mincing words: M8 is usually a huge disappointment if you're familiar with its appearance from dark sites:

> With a UHC or OIII filter only a small—maybe 10′ across—patch of nebulosity is visible, in the 8-inch f/5, and that patch is faint. Other than this nebulous knot, which is clumped around the bright star 9 Sagitarii, the main attraction here is the fine open cluster, NGC 6530 just to the East of 9. Averted vision did seem to show up a little extra nebulosity, and I thought I occasionally caught hints of the dark lane that splits this object in two, but the Lagoon is a subdued and difficult object in the city.

M4

While not exactly easy in the city, either, globular cluster M4, back over in Scorpius, is certainly easier to observe than the Lagoon in light pollution. This big, 26′ across glob is a bright magnitude 5.9, but the large size and its extremely loose form [Class IX (9)] make it slightly trying for smaller apertures.

It's located just 1° 18′ southwest of Scorpius' brilliant Antares, so finding is assured. But go slowly if you're using a smaller instrument or if you've got a particularly bad night—this one is easy to run right over. Despite its slightly forbidding stats, I went after M4 with the 4.25-inch reflector on a good evening and was not disappointed:

> This is an impressive object in the 4-inch scope tonight, even though it's into some fairly bad sky glow. No sign of resolution, but I can make out that it's much flattened, and that has a loose, grainy appearance. It "wants" to resolve into stars.

As with M80 on the other end of the compactness scale, I went to larger aperture to see stars:

> Easily visible with direct vision in the C11. It looks very much like a dim, scattered open cluster, though, until I use averted vision. When I do "look away," its globular nature is more obvious, with a dimly glowing core area a few arc minutes in diameter. Many dim suns are resolved across its central region. All in all, I can see about 20′ of cluster at 200×. There is a curious line of resolved stars that crosses the core, looking like the iris of a cat's eye, lending it its occasionally heard nickname, "The Cat's Eye Cluster."

If you get an outstandingly good night in the city and have a larger telescope at your disposal, you can also look a mere 57′ northwest of M4 for a little "extra" globular, NGC 6144. This magnitude 9.1 object can be challenging in urban southern skies, but it is achievable. In most urban scopes it will appear as a small, round, dim, and utterly unresolved glow.

M6

Let's finish this jaunt with the bright, easy, and beautiful Butterfly open cluster. Magnitude 4.2 M6, the Butterfly Cluster, is 20′ in extent along its major axis. It takes its name from the fact that it's composed of two roughly rectangular lobes of stars joined together.

To find M6, we travel down into the region of the Scorpion's Stinger, which is an area fairly far south in declination, meaning that if you're at higher northern latitudes you'll want to wait for culmination to view M6 if at all possible. The cluster lies to the west of a line drawn between Sagittarius' Spout Star, Gamma, and Scorpius' Stinger Stars, Lambda and Upsilon Scorpii. Move your scope into position scope midway along this imaginary line and then slew 2° to the west. You can't miss it in a 50-mm finder. This galactic cluster shines out unbelievably well from the rich background of Milky Way stars.

I liked this cluster in my C11, but this was one time when I much preferred my little Short Tube 80 refractor. A short focal length telescope can provide some wonderful wide-field views in this area, even for the urban observer.

> Relatively small and rich. Best seen in the Short Tube 80 with a 17-mm Plossl at 23×. The two butterfly-wing lobes blend into each other tonight in this scope, and it looks a little more like a rectangular patch of stars than a butterfly, but it is very nice in this instrument. I don't detect any haziness that would indicate unresolved stars, even at higher powers. Twenty stars are easily seen.

Tonight's Double Star: Antares, Alpha Scorpii

You won't need any instructions to help you find Antares. This 0.96 magnitude red supergiant is Scorpius' brightest sun, and the 16th brightest star in the sky. Antares, "Rival of Mars" and "Heart of the Scorpion," is interesting for double star fans because of its little magnitude 5.4 companion 2.6″ away. 2.6 seconds of arc is not overly tight when it comes to doubles, but the large magnitude difference between the primary star and its companion makes this a difficult observation for telescopes smaller than 6 inches. The secondary star is usually obliterated by the glare of the bright primary. Use as much aperture and magnification as you can on an evening of steady seeing, though, and you'll be rewarded by a fine sight. The strongly orange primary makes the secondary star look an outrageous shade of green, though it's actually white. I find about 11–12 inches of aperture splits Antares easily from my fairly southerly latitude of 30° north.

> It's almost time to pack it in, with the eastern sky beginning to brighten and the stars of summer diving into the west, but I can't resist slewing back to M22 for one last look. As I gaze into the deep summer night, looking long and lovingly at this cosmic relic, I keep coming back to the words of J.R.R. Tolkien, which the late Robert Burnham quoted in his Celestial Handbook as a description of this magnificent cluster: "It was as if a globe had been filled with moonlight and hung before them in a net woven of frosty stars. . . ."

Tour 3

Star Nests in Cygnus

I know when summer comes. It's obvious when I look east and see the great swan, Cygnus, winging along the horizon. This giant swan completely dominates the early/mid summer eastern sky—the other star figures in the area are dim or small. Hercules' subdued Keystone can be surprisingly hard to trace from damp and hazy city skies. The same goes for Ophiuchus; as we saw, his mostly unimpressive stars are not only hard to see in the city, their stick-figure pattern is almost shapeless. Cygnus' neighbor, Aquila the Eagle, is prominent enough, but includes little in the way of bright, deep sky wonders for urban astronomers. The rest, Lyra, Sagitta, Vulpecula, and Delphinus are tiny if identifiable and can't begin to approach the majesty of the Great Bird of the Galaxy.

What's a huge swan doing flying through the night sky, anyway? Apparently this constellation has been identified as a long-necked bird since classical times. The question is *which* swan. Some say the Bird is the pet of Queen Cassiopeia. He's also been associated with the son of the great sea-god Neptune, changed to a swan to save him from being murdered by the mighty Greek warrior Achilles. The most popular myth concerning Cygnus says that he is master musician Orpheus, torn to pieces at the hands of a band of wild maenads, female followers of the strange god Dionysus. The Olympian deities were not wholly without mercy and, it's said, placed Orpheus, wondrously changed to a magnificent bird, in heaven near his beloved harp Lyra.

But what matters to astronomers is how the real swan, the constellation stick-figure, looks and how difficult it is to find. It is remarkably easy. While this constellation's shape does somewhat resemble a winging swan if you squint your eyes and hold your mouth just right, the novice should really look for Cygnus' other guise, the Northern Cross. Cygnus, shown in the chart in Figure 7.6, forms a luminous cross stretching 22° 17′ from Deneb, the head of the cross to the beautiful double star, Albireo, at the foot. Cygnus is big, but also bright, containing stars like the remarkable Deneb, a giant A2 star burning at magnitude 1.29. In fact, all the stars that form the cross shape are easy to see from the most light-polluted urban locations, with the dimmest being magnitude 2.87 Delta, the tip of the western cross arm. The Northern Cross is arranged so that its head points north-northwest.

What's to be found in Cygnus? Hard core deep sky observers, those with semi-dark skies, anyway, tend to think of the Bird as the home of many fascinating emission nebulae. Within Cygnus' borders are the North America Nebula, the Bridal Veil Nebula, the Crescent Nebula, and many others. In bright urban skies, though, most of these tantalizing objects are invisible. They are either big and dim, or small and dim, or just plain dim. All is not lost, though. Sitting astride the Milky Way, the Cygnus region is the home of numerous open star clusters. These clusters tend not to be the best in anybody's list (though two Cygnus clusters are included in the Messier), but their sheer numbers make a visit to the Swan, a must for urban observers. And, as the telemarketers say, "That's not all!" We'll also visit a passable globular cluster lying just over the Cygnus border.

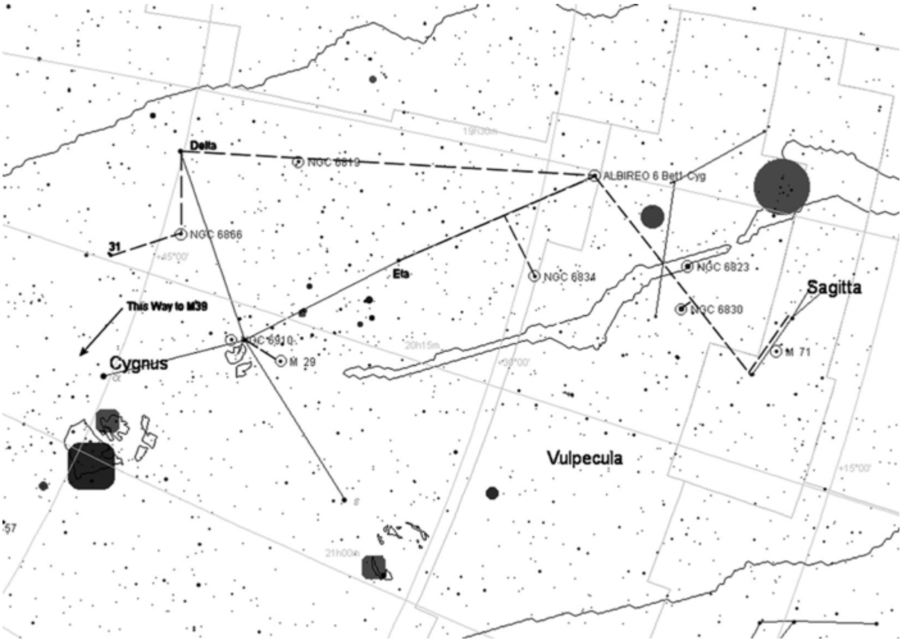

Figure 7.6. Chart of the Northern Cross.

M39

Cygnus is just *full* of open clusters and it's easy to get confused and lose your bearings. So, rather than hopping around, let's start at one end of the Swan and work our way along carefully and methodically. For our first stop, we'll begin at the head of the cross (or the tail of the swan if you prefer). M39 actually lies well away from the stick-figure pattern of Cygnus, being 9° 13′ from bright Deneb. It's in Cygnus, but just barely, lying closer to the border of the small constellation Lacerta the Lizard than to the magnificent cross. Cygnus is also adjacent to the familiar and distinctive constellation Cepheus the King, so a good way of locating M39 is by starting in that constellation rather than messing around with the dim stars of the lizard.

Our jumping-off point for M39 is magnitude 3.35 Zeta Cephei. Cepheus is not the brightest constellation in the summer sky, but his large "house" shape shows up well in fairly poor conditions. You may want to use binoculars to help orient yourself at first if he is hard to make out. Using binoculars as a navigation tool is a trick far too few deep sky observers—city or country based—know. If you're unfamiliar with an area of the sky, the bright, right-side up, wide-angle images of a pair of 7 × 50 or 10 × 50 binoculars can be a tremendous help. Once you're acquainted with the Cepheus—Cygnus border region, draw an imaginary line from Zeta Cephei to bright Deneb. Then, backtrack until you're at the halfway point of this line Zeta. Position your scope there. Then, move it 3° to the east-southeast. M39 should be readily visible as a hazy, little spot in your finder. If you need more help, the magnitude 4.23 star Pi Cygni is just over 2° 30′ northeast of the cluster.

Arriving at M39, you may or may not be disappointed depending on your perspective. It's certainly bright at an integrated magnitude of 4.6 (its brightest individual stars are at magnitude 7). Unfortunately, it's also large at 32′ and not overly rich, with 30 stars being verified as cluster members. There's no denying that what makes an open cluster interesting most of the time is small size and rich makeup. M39 is saved from total obscurity by being set in a lovely field and by having an interesting shape.

In the eyepiece, M39 is a triangle of three bright stars filled-in with quite a few dimmer cluster members. At its over half degree size, this object will challenge narrow field scopes, and it looks far better if you can put some eyepiece field around it. In other words, this is a perfect object for a short focal length rich-field refractor or reflector. Not that it doesn't look OK in longer focal length instruments:

> M39 is low in the sky and in some heavy light pollution, but it looks remarkably nice in the Nexstar 11. This large, star-spangled beauty fills the field of a 22-mm eyepiece. It gets even better in a 35-mm, though I lose some of the dimmer cluster-members to sky glow with that eyepiece. At medium magnification I can easily pick out at least 20 stars in addition to the three brightest members. These three bright luminaries are arranged in the shape of a near equilateral triangle, with the dimmer stars in this triangle's center.

But this is really a cluster for wide-field scopes:

> In the Short Tube 80 refractor at 16×, M39 comes alive and is much more interesting and attractive than it is in a narrow field instrument. The three bright "triangle" stars are readily visible, as are many of the other members. No, I can't count as many stars as I can with higher magnifications and larger scopes, but the cluster just looks much better, set in a wide and distinctive field.

Even in small-aperture binoculars, M39 is obviously composed of stars, so I assume Charles Messier, knew this was not one of his pseudo-comets when he included it in his list in 1764.

M39, as the title of this section implies is, like all open clusters, a place where stars have recently begun to shine. This particular assemblage is middle aged for an open cluster, at 270 million years. This seems ancient to us short-lived humans, but as things go in the wider universe this cluster is almost a newborn. Especially when compared to the globular clusters. Its distance of 800 light years means the triangle of M39 covers an immense 7 light years of space.

M29

The other Messier object in Cygnus is—big surprise—an open cluster. M29 is both smaller and easier to find than M39. To locate it, you start at Cygnus' "middle" star, Gamma Cygni. From there, move a mere 1° 45′ to south-southeast. This is a fairly rich region, but you should be able to identify magnitude 7.5 M29, a small fuzz-spot in your finder scope, without much difficulty. Remember, as always, to rotate Figure 7.6 (or your star atlas) so the view matches what you see in your finder.

When I look at M29, what I see is a small dipper-shaped asterism (Figure 7.7) formed by the cluster's 8 bright stars and supplemented by a number of dimmer ones. This small cluster covers about 11.0′ of eyepiece field. I used to think this cluster was uninteresting, but, like M39, it has such a distinctive shape that I keep coming back

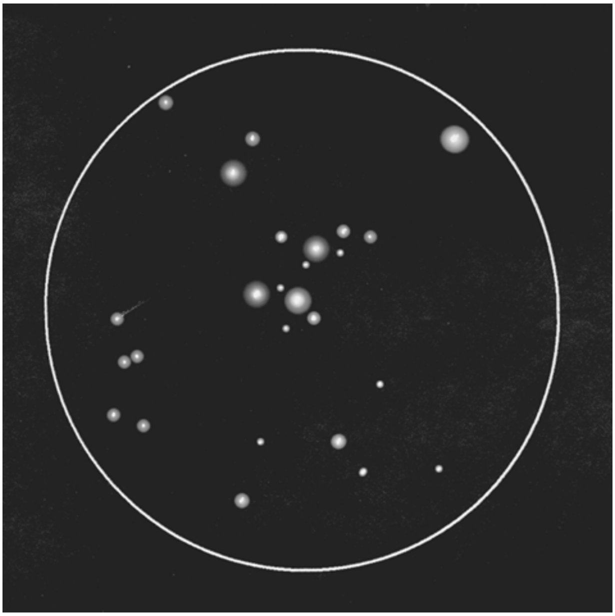

Figure 7.7. M29, open cluster in Cygnus.

to it. It has become an old friend. You can throw as much aperture at it as you want, but my observation is that it doesn't get much better after about 6 inches. Certainly, I had a good view of it even with the 4.25-inch Newtonian:

> Four bright stars stand out extremely well at 48× in the 4.25-inch scope. In addition to these four, I can see 7 other cluster members with averted vision despite scattered clouds and fairly heavy haze.

Unlike M39, this is an object for a telescope. Binoculars will reveal it as a hazy patch near Gamma, but without real resolution. When the comet-hunting Mr. Messier ran across this one in 1764, it probably did look nebulous to him in his modest telescope.

Poor M29. It has the misfortune of being set in the midst of clouds of interstellar matter that dim it considerably. Were out it in open space, this cluster would be a real standout, like a miniature Pleiades. As is, its integrated magnitude figure is at around 7.5, and its brightest stars hover at 8.5. This dimming, "extinction," means that M29, which is fairly distant from us at 7,000 light years, remains an interesting also-ran in the open cluster beauty contest.

M71

I said we weren't going to jump around. But let us do just that for a moment before resuming our survey of the Cygnus open clusters. M71 is not the area's only globular, but it is far more interesting in light-polluted skies than dim and bland M56 that lies nearby in Lyra. Situated close to Cygnus in the small constellation Sagitta the Arrow, M71 is more attractive than M56, and is both a challenge and a puzzle.

If you're patient and wait for it to rise out of the horizon murk, Sagitta becomes laughably easy to identify in most urban settings. It really does look like a small arrow, and is what I'd call "prominent" despite its brightest member being Gamma (no, not Alpha), a modest magnitude 3.47 yellowish star. Locating M71 is not at all troublesome if you can see Sagitta. M71 is positioned halfway along a line drawn between Gamma and magnitude 3.82 Delta. Actually, it's 15′ Southeast of this line, but a medium-wide eyepiece should show it up as long as you *precisely* position the scope midway between Gamma and Delta.

When you think you are in the correct area, look very carefully—examine the field obsessively—and you'll notice the *small* glowing knot that is the relatively dim M71 shining at an integrated magnitude of 8.30. It is small at 6′, but that won't help much. This is a *very* loose globular, so it *won't* be bright, far from it, and you'll want all the aperture you can muster for easy identification and to get a decent view of this weak and scattered cluster. I found my 11 or 12.5-inch scopes just about *required* on a poorer-than-average night. In the 12.5-inch scope it was visible if unremarkable:

> M71 looks more like a small barely resolved open cluster than a globular star cluster . I catch quite a few cluster members flicking on and off around the edges, but the core is tough. It is insanely loose and very dim. At first glance, M71 seems rather shapeless, but extended observation seems to reveal that it is triangle shaped. The field it's set in, which is beautiful and rich with stars from dark skies, is very much subdued from my light-polluted backyard.

Like most of the tougher globulars, M71 (Plate 39) is difficult because it is loose. *Incredibly* loose with a Shapley–Sawyer class of XI (11). In fact, astronomers still debate whether this group should be classified as an open or globular cluster. A check of the cluster's HR or Color Magnitude Diagram (plots of cluster stars' spectral types against their magnitudes) is ambiguous, with M71 appearing to be similar in age to older *open* clusters. It's also small for a globular. 13,000 light years of distance from us makes it only about 25 light years in diameter, a real miniature as far as these usually gigantic star balls go. These days, the consensus of opinion among professional astronomers seems to be that this *is* a globular despite appearances, though that does not appear set in stone.

More Star Nests

NGC 6910

To begin a quick tour of what's only a taste of the bright non-Messier Cygnus clusters available to urban observers, move back north to the area of Gamma Cygni where you'll find little 7′ diameter magnitude 7.3 NGC 6910. Often open cluster fans run into problems when negotiating rich areas like the Cygnus star fields. The area is so crowded with stars that almost every field contains clumps of stars that *might* be the cluster being sought. NGC 6910 doesn't present that problem. In almost any scope, it's instantly identifiable and is very distinct from the background clutter.

NGC 6910 can be found peeping out only 32′ north of Gamma. There aren't any other bright stars in the area, but you shouldn't need them. Put Gamma on the Southern edge of an eyepiece yielding a half degree true field, and you'll find the cluster on or just outside the Northern edge of the eyepiece. This is a small group, and medium power will make it stand out much better than it will in the gray background of a low-power ocular. In the 8-inch Newtonian at 100×, NGC 6910 was much better than I had expected (deep sky observers have a tendency to expect NGC open clusters to be dim and/or bland, but they are not always so lackluster):

> A real surprise in the 8-inch f/5! Very nice indeed for a non-Messier. Not very rich, with about 10–15 stars visible from this site, but compact and interesting. The brightest stars form an elongated "Y" shape.

NGC 6866

Next up is NGC 6866, which is nearly the same distance down the cross as NGC 6910, but in the western section of the constellation halfway along the cross-arm toward magnitude 2.87 Delta. A magnitude of 9.0 and a major axis 6′ across mean NGC 6866 is both dimmer and smaller than NGC 6910, and it really needs a medium-sized telescope to show up well in my skies.

To find this one, use Delta and a dimmer star, magnitude 3.79 31 Cygni. 31 is 3° 19′ to the north of the cluster. Delta, on the west and a little to the south, is almost the same distance from NGC 6866 as 31 Cygni, 3° 30′. Delta and 31 form a near right triangle with the cluster. In my 12.5-inch scope, this object is lovely from city or country. The better your site, the better it looks. From country or good suburban skies, this one is particularly nice, and is set in a rich and beautiful field. If you are restricted to that good, old city observing location like many of us, don't despair, though, as you get the same effect and almost as good results by waiting for this cluster to climb to culmination:

> Beautiful field with cluster obvious and looking like a miniature M39. At about 5′ across, it is nice in the 12.5-inch scope at 200×, and presents the same effect as the Messier cluster: a triangle of prominent stars filled with dimmer sparklers.

NGC 6819

NGC 6819, another standout, is much more distinctive than the average NGC open cluster. In fact, it looks very similar to M71—a splash of stars with a slightly compressed, hazy core. This object can be a little tough to find, since it doesn't live near any prominent stars. The easiest way to locate it, probably, is to position the scope so that it points to a spot two-third of the way along a line from Beta Cygni, Albireo, to Delta. You'll find it 5° south and east of bright Delta. Another way of looking at the situation is that the cluster forms a tall triangle with Gamma and Delta. The brightest star near NGC 6819 is magnitude 4.89 15 Cygni, which lies back along the line to Albireo, 3° from our target cluster. Search carefully, since it's only magnitude 9.5. Its small 5′ size does help here, as it may even be visible as a little haze spot in a 50-mm or larger finder.

> A very attractive NGC open clusterin the 11-inch Schmidt-Cassegrain. I started out at 127×, which revealed the cluster as a squarish pattern of very tiny stars about 5′ across. At higher power, the cluster grew a bit, as more dim stars were revealed, and it looked more oval than square. Tonight, this one actually looked better than M71.

NGC 6834

This open cluster is in the southern part of Cygnus near Albireo in the foot of the cross area. NGC 6834 is east of a line drawn from magnitude 3.89 Eta to brilliant magnitude 3.08 Beta. Move the scope to a point midway along this line, and then slew 2° 30′ east and slightly south and you should be able to get this somewhat dim 9.7 magnitude 5′ diameter cluster into the field of a medium-powered ocular. If NGC 6866 looked better in medium apertures, this cluster cries out for it, with my best view coming with the Nexstar 11.

> Small and dim. In the 11-inch scope I see a 5′ oval of faint stars—mostly magnitude 10 and dimmer—crossed by a prominent line of brighter stars. Until I increased the magnification to 220×, I had the impression that nebulosity was involved in the cluster. At higher power this is revealed to be many faint stars.

NGC 6830

The neighboring constellation Vulpecula's NGC 6830, at magnitude 8.0 and 12′ in extent, shouldn't be easy to separate from the background star fields. In fact, many observers report that it is invisible against the rich Cygnus Milky Way background. I tend to think that this is really a case of insufficient aperture, however, as this one was impressive and easy to see in 11- and 12.5-inch instruments. If you have access to at least a 10-inch scope, this NGC is certainly worth searching for.

NGC 6830 lurks in Eastern Vulpecula near the border with Sagitta. The best pointer is magnitude 4.58 13 Vulpeculae, which is 1° 7′ north and slightly east of the cluster. While 19 will be visible in a 50-mm finder, you will likely not see it naked eye from the city. If you have trouble positioning the scope correctly, another way to find NGC 6830 is to move the telescope so that it is about 2/3 of the way along a line between Beta Cygni and the "Arrowhead," Gamma Sagittae. For best results here, choose an eyepiece that will encompass the cluster's 12′ size and allow some space around it, while delivering medium-high magnification. I did this and had no trouble finding or observing the cluster:

> NGC 6830 is another good one for medium aperture. Very distinct from the rich, beautiful field it is set in. Rectangular in shape with three brighter stars and many dimmer ones, i.e., 10–12 dimmer stars easy.

NGC 6823

While I've suggested medium aperture for the two preceding clusters, they are no doubt visible—for a persistent observer—with an 8-inch or smaller telescope. They may not be easy, however. That's not the case with NGC 6823, "Scorpius Junior," as I've christened it. It's fairly large at 12′, but its integrated magnitude, 7, is much more "reasonable."

If you were able to locate NGC 6830, this one will be a breeze, as it's only 1° 48′ west of the preceding open cluster. If you have trouble, you can also pin it down by aiming the scope so it's almost exactly halfway along a line that runs from Beta Cygni to magnitude 3.82 Delta Sagittae.

> A nice, medium-sized open cluster in the 8-inch f/5. Looks very much like a miniature Scorpius. Without much imagination, I can visualize the stinger, tail, and head of Scorpius' little brother. Six bright stars stand out and numerous dimmer ones wink in and out of view.

Some observers have reported glimpsing Pleiades-like nebulosity involved with this cluster, but I saw no trace of it at any magnification with or without LPR filters.

Tonight's Double Star: Albireo

Yes, this has been the *barest* sampling of the Cygnus area's open clusters. There are *many* more interesting ones that deserve a visit. But I've had enough for the night. Heavy midsummer dew is falling and a warm bed is calling. I'll make just one more stop before tearing down the scope: Albireo. This wondrous magnitude 3.1 double star, Jewel of the Swan, is a not to be missed sight. Composed of two stars 33″ apart, the primary is a deep golden yellow while the secondary is an incredible azure-blue. Novice or old hand, *nobody* can possibly grow tired of Albireo. This is one time when aperture is not a consideration. I thought Beta looked as good (or better) in my trusty 80-mm *f*/5 refractor as it did in the 12.5-inch Dobsonian.

> The incredible beauty, not just of gem-like Albireo, but of all I've seen on this night and a lifetime of other starlit nights, literally tugs at my heartstrings. How incredibly lucky I am to be an amateur astronomer. To think, if I hadn't stumbled across that dog-eared Patrick Moore book in my elementary school library I'd have missed all this. Maybe that's why I'm so interested in introducing new people to the sky. We amateurs are, by action and example, purveyors of wonder, evangelists of the cosmos—we just can't help ourselves.

Tour 4

Requiem for the Dead Stars

Stars are like people. They are born, live their lives, and die. The courses of their lives are more majestic outwardly than those of humble creatures like us, of course. They are birthed in light-years-spanning clouds of gas, live in thermonuclear fire, and some of them die in supernova glory that can outshine an entire galaxy for a brief time. But like most of us, the majority of stars live sedate lives. The fate of the smaller stars, stars like our own Sun, is less majestic than the fate of the giants who die as immense fireballs. The little suns die with a whimper rather than a bang, but leave behind remains as fascinating as a supernova and its remnant nebula.

The corpses of Sun-class stars are far more common and easier to see than the remnant nebulae of supernovae. These supernova remnants like the diaphanous Bridal Veil Nebula in Cygnus can be dim and difficult in small scopes from dark country and are nearly invisible in the midst of city light pollution.

The little stars, whose lives end as red giants, slowly blow off their outer layers and leave behind planetary nebulae. Planetary nebulae have nothing to do with planets. They are called "planetaries" because Sir William Herschel, who ran across many of these objects in his restless sweeps, his surveys of the night sky, thought their fuzzy disks somewhat resembled "his" planet, distant Uranus.

When a smaller star ends its life, it expands to red-giant size as nuclear fusion in its core shuts down as hydrogen is exhausted. Over the course of millions of years, the huge clouds of gas that once formed the star's atmosphere slowly drift off into space, revealing its slowly cooling core, the leftover body of a once mighty sun ending life as a dimming white dwarf. This core still puts out a great deal of radiation all across the spectrum, however, and excites the drifting clouds of gas to glow brightly. Voila! You have a planetary nebula. These are prime objects for the urban astronomer, since most are small and bright compared to either diffuse nebulae or supernova remnants. There are challenging planetaries, but the wonderful words "small" and "bright" do indeed describe the appearances of the majority of these objects.

Planetary nebulae are especially welcome targets during the summer. Open star clusters are nice, but observing one after another all summer long gets boring—for me anyway. In contrast, planetaries are almost always surprising. The events that take place at the end of a star's life usually leave the white dwarf sitting in something that resembles a tube of gas. The appearance of this gas tube depends on our perspective. If we're viewing it end-on, it will look like a torus, a donut. If it's arranged so we see its side, it may look like a rectangle or box. Depending on a number of factors, planetaries can assume some almost fantastic shapes. The Dumbbell Nebula in Vulpecula actually resembles a half-eaten apple, while Scorpius' Bug Nebula looks like an insect.

Where do you go to find planetary nebulae? They are dead stars, so you go where the stars congregate in their greatest numbers, along the Milky Way. The entire stretch of the summer Milky Way from Cassiopeia in the North to Sagittarius in the South is littered with the bodies of the dead. There are so many planetaries gracing the summer sky that even a brief survey of what's out there would take many, many a summer night, even from urban sites. For our guided tour I've selected those that are both bright and not too small or large.

M57

This is as good as it gets. The famous Ring Nebula, M57, is 1.4′ × 1′ across its major and minor axes, just the right size to stand out well from the bright city sky background. Due to its small size, it is amazingly bright at magnitude 9.4. While this object gets more and more impressive with increasing telescope aperture, it is a fine sight in an 80-mm refractor and easy enough in a 60-mm. To find it, you'll visit the small and distinctive constellation Lyra, a classical star pattern that represents Orpheus' heaven-preserved harp. Lyra would be fairly nondescript were it not for its Alpha star, magnitude .03 Vega, a member, with Deneb and Altair, of the famous "Summer Triangle" of bright stars. Vega is a mighty class A0 star, a blue–white beauty that's one of the gems of the northern sky.

M57 is the easiest of tonight's objects to locate. It's on the opposite side of the lyre stick-figure from Vega, and is found a little less than halfway along a line drawn from Beta Lyrae to Gamma Lyrae. Position the scope 3/4 of a degree, 48′ to be exact, from Beta directly on the line from Beta to Gamma. Magnification doesn't matter too much, but you probably want to be at around 50× or thereabouts.

I found that if I went too low—16× in my Short Tube 80 refractor, for example—the Ring stopped showing up as a ring and looked more like a dim and slightly fuzzy star. Aperture seems important for the best view of the Ring, too. Increasing the power did make M57 distinguishable from a star in the little refractor, but even at higher magnifications it was hard to see the nebula's smoke-ring shape with the 80-mm or with 4-inch class telescopes. I did find that averted vision almost always showed the "donut hole" with my Short Tube 80 at 100×, but it wasn't an easy observation with that scope or with the 4.25-inch Newtonian:

> I remembered M57 as being slightly difficult in heavy light pollution in this small Newtonian, but it's very prominent tonight in far less than perfect skies. Initially appeared as a perfectly round fuzzball, but averted vision and a magnification of 90× showed the ring shape with some difficulty—enough difficulty that I don't think a novice observer would have seen it. Much of the time it looked like an undistinguished, dim gray disk.

At 6 inches of aperture, the nebula's ring aspect becomes easy to see with direct vision. Aside from greater brightness, M57's appearance doesn't change much more with increasing telescope aperture until you get to 10–12 inches. A scope of that size in the city begins to reveal more of the Ring's secrets, like the fact that it isn't a perfectly round donut, but is elongated. It also becomes clear that this is really a "filled" donut. The interior hole is not dark; it is an obvious light gray. What's the holy grail of Ring observers? The central star. The white dwarfs that form the central stars of planetaries are often easily visible in small scopes—but not this one. The Ring's dwarf is exceedingly dim, around magnitude 14 or *dimmer*, and the hazy nature of the ring interior makes it even more difficult to see.

I have never seen M57's central star from the city in any scope, including a 24-inch monster Dobsonian, and have seen it only with *extreme* difficulty in a 12.5-inch scope at very high magnification under very dark and steady skies. That doesn't mean you shouldn't attempt it, however. Use the largest scope possible, and the highest possible magnification—500× and above—to thin out the interior nebulosity and create enough contrast for the star to emerge. You'll also need rock-steady seeing, as unsettled air that makes stars "bloat" and shimmer will completely erase the Ring's central star.

If you thought distances to other DSOs sounded uncertain, you haven't seen anything yet. Like many—if not most—planetaries, the distance determinations for M57 are all over the map, ranging from 1500 to over 5000 light years. Even its shape is a matter of speculation. It used to be thought that the Ring was a sphere, with thicker gas at the limb causing the ring appearance. Today, it's believed that M57 actually *is* a ring, or, perhaps more likely, a tube of nebulosity viewed end-on.

M27

There's no denying the Ring is a real classic of a DSO, but its relatively small size and fairly regular ring shape argue against it being considered the best planetary in the summer sky. There is not a whole lot of detail for the small-medium scope to pick out in M57. Many observers will tell you that the "best" honor should go to another summer treat, M27, the Dumbbell Nebula, located in the unassuming constellation of Vulpecula, The Little Fox, which we visited earlier in search of an open cluster. Magnitude 7.3 M27 is bright and also big at 8′ × 5.7′, making it an interesting target for giant binoculars. While it's large in comparison to the Ring, it's not large enough that its light is so badly spread out as to make it a challenge from the city.

Vulpecula may not be a familiar constellation for novice astronomers, and it's certainly not prominent. Its three brightest stars form a distorted triangle (Figure 7.8) that's hardly eye-catching. The brightest star in the constellation, Alpha Vulpeculae, is a dismal magnitude 4.4. The Dumbbell should be hard to find, then? Not at all. The proximity of Vulpecula to glorious Cygnus and distinctive little Sagitta means it's easy to get your bearings and track down this DSO. Once you're in the general vicinity, you'll find plenty of guide stars, too—here near the Milky Way, many stars show up with only a little optical aid, even in bright skies.

There are several approaches that will land you on M27, but the route I usually take is from magnitude 3.47 Gamma Sagittae, the "Arrowhead". Draw an imaginary line from Gamma to magnitude 4.58 13 Vulpeculae 4° 45′ away. 13 should be easy in most finderscopes. M27 lies 3° 13′ along this line toward 13 and just a bit outside the line to the Northeast. This is an area lacking in bright stars, but magnitude 5.67 14 Vulpeculae, just 23′ Northwest of the nebula, is prominent in finders, and is an almost infallible guide to the Dumbbell.

M27's nickname the, "Dumbbell," goes all the way back to William Herschel's son, John, who likened its double lobed appearance to a barbell. This double-lobe shape will be obvious in the city if you're observing with at least a 6–8-inch telescope. If you're using a 4-inch or smaller instrument, the dumbbell shape is not always easy to detect. You'll probably see something more like the strongly oval fuzzy in Figure 7.9, a drawing I made some years ago from a highly polluted urban site with the 4.25-inch

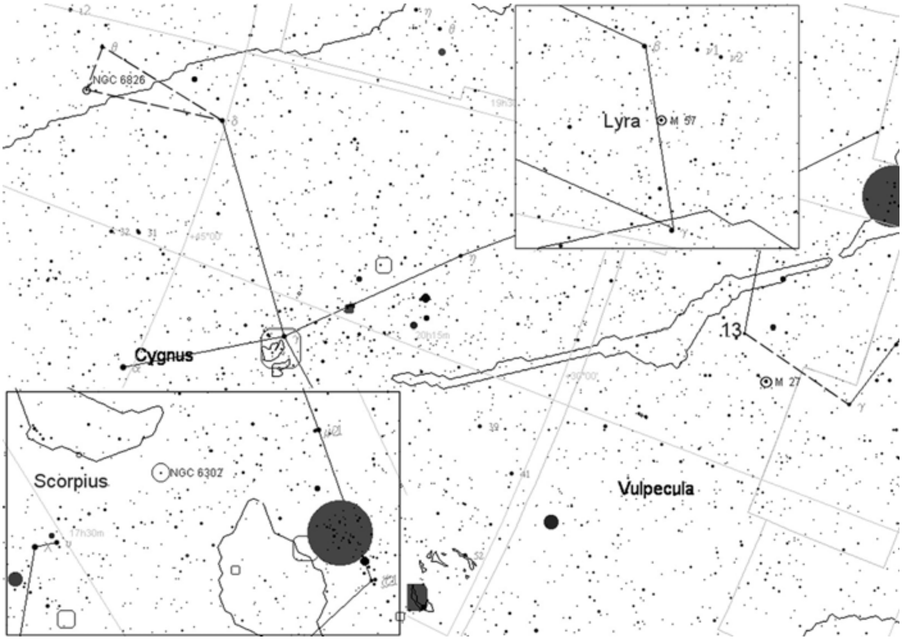

Figure 7.8. Vulpecula and companion constellations.

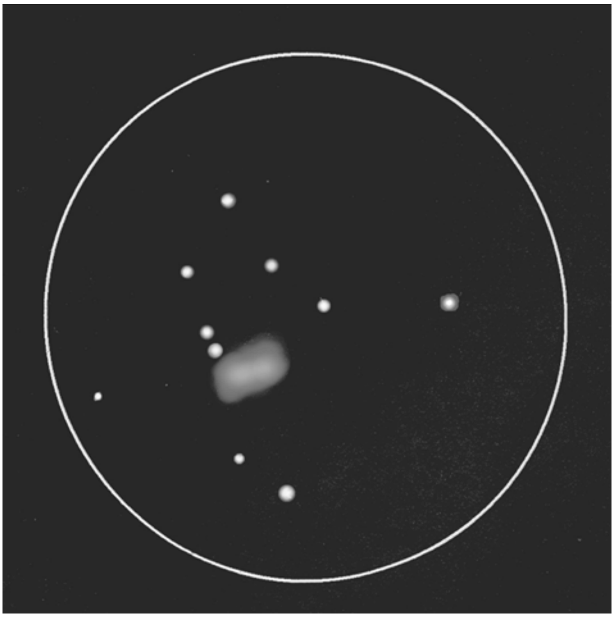

Figure 7.9. The Dumbbell Nebula as seen in a 4-inch scope.

Newtonian. On that evening, the Dumbbell looked a lot like the Crab Nebula does from a dark site with a 6-inch telescope.

In my little 4-inch scope, M27 was:

> Fairly easy to identify, but the dumbbell shape is extremely elusive, being barely perceptible at times. I have to work to see anything other than a round-appearing nebula. Averted vision helps, but higher magnification does not seem to. M27 is a dim gray in color with diffuse edges. This is an easy object in the city with an 8-inch telescope, but I missed it a couple of times with the 4.25 before finding it.

If you're the owner of a UHC or OIII filter, by all means use the filter. The OIII, in particular, will help M27 tremendously. It will make the nebula's apple core shape easier in a small scope and unmistakable in a mid-sized instrument. Paradoxically, when you increase your aperture to about 12 inches and insert an OIII, M27 begins to lose some of its famous shape. More outlying nebulosity comes into view and the Dumbbell begins to morph into another piece of sports gear, an American football. Given M27's medium size, use medium powers. 100× is a good level to begin at when you're hunting details.

And there are many details to be had, at least in 8-inch and larger apertures. One of the easiest to detect is a diagonal bar of brighter nebulosity that runs from lobe to lobe. Careful study of the nebula at higher powers will reveal a number of other bright patches in the central region, too. You'll also notice—if you remove the OIII filter—numerous dim stars scattered across M27's face. If you leave the filter off, you may even have a chance of locating the central star.

Unlike the Ring's dauntingly dim precursor, the central star of the Dumbbell is quite approachable at magnitude 13.5. The secrets to spotting it are using high power to dim down the surrounding nebulosity and using a photograph or chart with the central star labeled to help you pick it out from the many faint stars scattered across the nebula. M27, at a fairly sure distance of 1200 light years, rates as "close" when it comes to planetaries, and that is responsible for the wonderful view we have of this star-corpse from town.

M27 is one of those objects, like Orion's M42, that I never tire of, and come back to summer after summer. I've observed it hundreds of times over the course of my observing career, and imaged it almost as often. It shows up well in CCD pictures taken from the worst light pollution, and I captured it recently (Plate 40) with a Starlight Xpress MX516 camera and my C8 SCT on a night when it was almost "not there" in the eyepiece. This fabulous object may present us with a picture of what the Ring Nebula would look like if viewed side-on rather than from the end.

NGC 6826, The Blinking Planetary

Almost as attractive and interesting as the Dumbbell is a slightly less well-known summer object, the Blinking Planetary, NGC 6826. This is a planetary nebula, like M27, that will reward all scope users in the city or in the country. It is dimmer than

M27 at a magnitude of 8.8, but it's also, like M57, small at 24″, making it very bright. I've had no trouble distinguishing it from a star with a 60-mm ETX at relatively high magnification despite the nebula's small size. Large scopes with OIII filters and high powers begin to reveal some interior detail in the nebula, but what most people remember is the amazing "blinking" effect.

The thing that sets NGC 6826 apart from both the Ring and the Dumbbell is the brilliance of its magnitude 10.6 central star. It's impossible to see the Ring's central star with a small scope, and something of a struggle to pin down M27's dwarf, but the Blinking Planetary's remnant star is often the most obvious feature of this object in a small telescope. The nebulosity is bright, too, but a little harder to see than the star. In fact, for the nebulosity to show up well in 8-inch and smaller scopes in the city, the observer will have to use averted vision. Stare straight at this object, and all you see is the star. Look away and the nebulosity pops into view. Rapidly switch from looking directly at NGC 6826 to looking off to the side *and the nebulosity blinks on and off*.

I think the Blinking planetary is definitely easier to find than the Dumbbell. Being located in Cygnus, there are, as was the case with M27, plenty of guide stars. But it's also well-placed with respect to prominent sparklers, not just nondesript 4th and 5th magnitude suns. My method for locating NGC 6826 is a simple one. The blinking planetary forms an elongated triangle with the magnitude 2.87 Delta Cygni, the tip of the western arm of the cross, and magnitude 4.48 Theta. The nebula forms the base of the triangle with Theta, and is 1° 22′ east of the star. A potential difficulty may be in locating Theta, but it's fairly prominent in a finder, and is exactly 5° 17′ Northwest of Delta Cygni.

When the Blinking Planetary is in the center of your field, increase magnification to 150× or higher for a nice image scale and play around with the "blinking" effect for a while. You may be surprised to find the nebulosity blinks more readily with small scopes than with large ones. Larger than 8-inch instruments begin to pull out more and more nebulosity; so much nebulosity that at least some of it is visible with direct vision, lessening the dramatic blinking effect. This nebula responds well to an OIII filter, but using one will *eliminate* the blinking. The OIII both suppresses the central star and brings the nebulosity into direct-vision range of even smaller telescopes.

I did mention details earlier, and some *are* there in this object for medium and large scope owners. In a 12-inch or larger aperture, two bright nebulous patches, one on either side of the central star, may be seen. At high powers in OIII filtered scopes, an inner ring structure may also be discernable.

What can the small scope owner expect? My log from a hot August night using the 6-inch Newtonian is a pretty accurate depiction of what's in store with 4–8-inch telescopes in the city. The nebulosity will be slightly dimmer in the 4-inch scope and brighter in the 8-inch scope, but I didn't begin to see anything other than the pretty blinking effect—any details—until I got to 12 inches.

> Round with a fairly distinct blue color. The blinking is more prominent at magnifications of 100× and higher, which helps pull the central star out of the light pollution. The disk of nebulosity around the star appears to be smooth and even in this telescope.

More Dear Departed

NGC 6302

Cygnus is not the only area of the Summer Milky Way peppered with planetary nebulae. Aquila and Ophiuchus possess many of these nebulae, though no really outstanding examples. Get down into Sagittarius and Scorpius and things improve dramatically. For my money, one of the strangest looking and most interesting planetary nebula in the sky is Scorpius' odd little Bug, NGC 6302 (Plate 41). It is located almost halfway along a line between one of the Stinger Stars, magnitude 1.58 Lambda Scorpii and magnitude 3 Mu Scorpii. While some references list this as a diffuse nebula, its planetary character is pretty clear to professional astronomers.

The Bug is dim at magnitude 12.8, but its size of $1.2' \times 0.5'$ means high surface brightness. What's most remarkable is that even smaller scopes show this planetary's odd shape. It's composed of two lobes, not unlike a miniature of the Dumbbell Nebula (it's sometimes referred to by the alternate name of "The Bipolar Nebula"), but that's not the overall impression I have of this object, not in my 11-inch and larger telescopes. The bi-lobed structure, combined with barely detectable filaments and a flaring on one end, make this look exactly like a little ant crawling across the eyepiece field. "Bug" indeed!

NGC 6543

Not all planetary nebulae are located in the Southern Milky Way. Stars are everywhere in the sky, so, their remains can also be found anywhere in the sky. Our final stop for this evening, the magnitude 8.3 Cat's Eye Nebula, NGC 6543, is famous due to an incredible Hubble Space Telescope image. In most amateur scopes, however, it looks far blander, more like the image in Plate 42. This object was, by the way, well known among deep sky observers long before the HST was pointed its way. Located in Draco, it's at its best on August nights when it's nearing culmination (assuming you're luckier than I am and actually experience clear weather in August), and is easy to locate near a magnitude 3.17 star, Zeta Draconis and a magnitude 3.0 sun, Delta Draconis. Draw a line from Zeta to Delta. The Cat's Eye's small $24''$ disk will be found $5^\circ\ 6'$ from Zeta in the direction of Delta, and just a hair to the south of the line.

Large amateur scopes, high magnifications, and dark skies can reveal some internal detail in this object. Certainly not anything close to what's in the Hubble shot, but at least some indications of bright patches or streamers near the central star. Me? Beyond a vaguely oval cat-eye shape, an obvious central star (magnitude 9.5), and a noticeable bluish-green coloration, I rarely see anything that could be called "detail" in this nebula in any of my scopes, even from the darkest sites. This is a bright, interesting, and magnificent object at magnitude 11.27 (which, shouldn't deter you—it's small, remember) despite a slightly bland appearance, and deserves a look every summer evening. If you're on a quest for details, good luck. Your best bet is to use large aperture and high magnifications—500× and above—on steady nights. The weird and wonderful filaments and helical structures visible in the HST images are now thought to be the result of the progenitor star having a companion, that is, that the central star is actually a double star system.

Tonight's Double Star: The Double Double, Epsilon Lyrae

Back over in the distinctive little constellation of Lyra, on the opposite end of its stick figure from M57, you'll find a truly marvelous double star system, Epsilon Lyrae, the famous Double Double. It's called the "Double Double" because it is made up of two *pairs* of double stars, Epsilon^1 and Epsilon^2 separated by 208″. Epsilon^1 is composed of a magnitude 5.0 primary and a magnitude 6.0 secondary separated by 2.6″. Epsilon^2, which lies to the south of Epsilon^1, is a magnitude 5.2 primary and a magnitude 5.5 secondary separated by 2.3″. All four stars are white in color.

As you'd expect, it's easy to separate Epsilon^1 and Epsilon^2 in any telescope. Resolving the components of each pair is not so easy, however. You're helped by the fact that there are no huge magnitude differences, but the 2.3″ of the second pair is clearly going to be a challenge for small scopes. Six inches can split all four stars at high power, but good seeing helps, and a larger scope is a good option if you're interested in actually seeing all the components on any given evening.

> Late on an August evening, standing out under open sky with my telescope, I sense the season beginning to die. Summer warmth left my bones hours ago, and the dew and an early morning breeze start me shivering. It's always best to dress warmly and in layers when you're out observing, but on those nights when I visit the stellar graveyards that extend all down the Milky Way, horizon to horizon, even a warm sweater doesn't repress all the shivers.