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Big, Bold, Bright, and Beautiful

An observing list by Jerry Oltion

Introduction:

There are several stages in the average amateur astronomer's development. There's the newcomer phase, where we're just learning our way around the sky (and our equipment). There's the intermediate phase, where we begin hunting for more and more difficult objects in order to stretch our abilities and test our limits. There's the photographic phase, wherein we drop down the rabbit hole of equipment, equipment, and more equipment in order to document every beautiful nook and cranny in the sky (and seldom look through an eyepiece anymore). There's the deep-sky-hunter phase, where we don't just push our limits, but shove them around and bully them into submission. And there's the tourist phase, where we start spending time with the big, bold, bright, and beautiful objects that led us into the hobby in the first place. We call that the "eye candy," the stuff we show off at star parties when we want to make people go "Ooooh!"

The phases aren't necessarily a progression. You can run them in just about any sequence, and even do them simultaneously. I've always been a tourist, visiting many showcase objects in an evening even when I'm on a mission to find a Hickson galaxy group. Lately, however, I've found myself reverting to tourist mode more and more, just kicking back and enjoying the view rather than pushing myself to examine yet another faint fuzzy for detail that's visible only via "averted imagination."

This book is for the tourist. It'll also be useful for beginners who haven't yet learned the objects herein. I'm writing it for the person who either hasn't seen everything that's easily visible yet, or has seen so many objects they can barely remember which ones are easy and which ones are hard. It's a list of my favorites, written partially so I can remember them myself.

This list isn't complete. I'm still learning my way around the sky and still finding Big, Bold, Bright, and Beautiful objects I didn't know about before. But it's pretty inclusive. I count over 400 objects.

It should be a pretty good asset at a star party. Many of the objects described here should be visible through at least moderate light pollution, with modest aperture telescopes (say 6" or greater, with many objects visible in even smaller scopes or even

binoculars). I include some fainter or smaller objects for various reasons, ranging from sentimental to historical to just wanting to err on the side of inclusiveness in borderline cases, but the description will tell you whether or not it's liable to be difficult with small scopes or heavy light pollution.

If you happen to have a 20" monster, though, most of these objects will be jaw-droppingly stunning. Seriously. You haven't lived until you've turned a big scope on the Andromeda Galaxy or the Pleiades. But you don't need a big scope to enjoy most of the objects I list here. They're big, bold, bright, and beautiful on their own.

I include quite a few double stars. That's because there are a lot of them in the sky (it's estimated that half the stars in the galaxy are in double or multiple systems), but also because stars punch through light pollution better than galaxies or nebulae. If you live in a badly light-polluted city, double stars may be some of the few objects you can see. And double stars can be much more interesting than you might think. The difference in brightness between the two components, and their separation, can make for a challenge, plus often they show different colors (some of the few objects in the sky that display any color at all). Even in dark sky I find double stars interesting, and spend quite a bit of my time on them.

I considered drawing finder charts for each object, but that seems redundant in this modern age of planetarium programs that run on our phones. Chances are, about half of you reading this are going to punch the name of each object into your hand controller and the scope will go there for you anyway.

I needed some organizing principle, however, and it finally occurred to me that practically everyone who has been in the hobby for more than a couple months has got a copy of *Sky & Telescope's Pocket Sky Atlas*. It's quite possibly the best sky atlas available for the eye candy tourist, except it doesn't actually distinguish between eye candy and fifteenth-magnitude dust bunnies. It's great for helping you find them, though, once you know which objects to look for, so I've organized my list to match the page order in the *Pocket Sky Atlas*. I've arranged the objects more or less from top to bottom and left to right on each set of opened-up pages, but for various reasons I sometimes go farther south on one page before picking up again farther north on the facing page. Also, many objects can be found on more than one page in the PSA. I generally list them on the first page on which they appear, but sometimes if they're more central on a subsequent page I'll list them there instead.

If you don't have a *Pocket Sky Atlas*, no worries. The PSA is arranged in zones of increasing right ascension, essentially celestial longitude, so practically any star maps or planetarium program (like SkySafari or Stellarium, etc.) will work as well.

I haven't been able to observe from the southern hemisphere yet, so most of the objects I list below -40° declination are by reputation only. I've gathered descriptions from multiple sources in the hope that I don't over-sell anything, but I want to include the southern highlights as well as the northern ones for anyone who has the opportunity to view them. It's my fervent hope that I'll be using this list myself someday from Chile or Australia or somewhere like that.

I've included sketches of some objects to give you an idea of what you're looking for. Ironically, sketches are more realistic than photos at showing what the human eye can detect in a telescope. Photos show more color than the eye can see, and usually show far more stars, too. Some of my sketches are probably a bit optimistic as well, especially in cases where a little study will bring out more detail. But no matter how much or how little of an object you can see, enjoy the view through the eyepiece for what it is: a real-

time view of photons that left the object years ago and are just now hitting your eyeball. The telescope view of the objects I've listed here will be some of the most impressive views you can see in the night sky.

Enjoy.

A note on nomenclature, symbols, etc.:

I list the right ascension and declination of every object so you can find it more easily on the PSA charts or in a planetarium program. Right ascension is the east-west coordinate and is measured in hours. Declination is the north-south coordinate and is measured in degrees. Zero R.A. is on the west (right) side of Cassiopeia and runs along the east (left) side of the Great Square of Pegasus. Zero declination cuts through the belt of Orion, just under the circlet of Pisces, and right through the middle of Ophiuchus and Virgo. Declination is positive in the northern hemisphere and negative in the southern hemisphere. The poles are 90° declination.

R.A. is given in hours, minutes, and seconds, as in: R.A. 02h 31m 45s

Declination is given in degrees, minutes, and seconds, as in: +89° 15' 23"

Note that the minutes and seconds are different size units depending on whether they're R.A. or Dec! That's why I use m and s for R.A. and ' and " for Dec.

When I describe the separation of a double star, I use arc-seconds, which are the same units used for declination, so I write four arc-seconds of separation like this: 4" sep.

Sometimes I use " to mean inches, most often when talking about the aperture of a scope. I hope that's not too confusing, but it seemed better than spelling out "inches" all the time.

In describing the size of clusters and nebulae I often use ' to mean arc-minutes. It may also mean time minutes or feet, but rarely.

Most star magnitudes are listed with just a number and no plus or minus sign. There are only a handful of minus-magnitude stars, so I've elected to leave off the + for the 99% that are plus and just include a minus for the few that are minus.

A lot of stars have Greek letter designations. (Those are the Bayer letters.) I've used the symbols and also spelled them out, but there's also a list of the Greek alphabet in the back.

I think that's about all you need to know about that. On to the listings!

PSA chart 1

Polaris – R.A. 02h 31m 45s, Dec. +89° 15' 23"

Polaris is the North Star, around which all the other stars in the sky revolve. It's a chance alignment with the Earth's rotation axis, and a temporary one as that rotation axis precesses around in a big (47 degree) circle, but for the next several hundred years Polaris will be the brightest star near the north celestial pole. That in itself would make it worth looking at, for the concept if nothing else, but Polaris is intrinsically interesting and would be worth a look no matter where in the sky it might be. Why? Because it's a double star. And it's not just any old double; it's a wildly unequal double, with a primary of magnitude 2.0 and a secondary of magnitude 9.0. Each magnitude of difference is 2.512 times brighter than the next, so that means the primary is 2.512 to the 7th power

(their difference in magnitude) or 630 times brighter than the secondary.

Brightness differences that extreme normally make the secondary star hard to see. (We talk about doubles being “hard to split” if their separate components are difficult to distinguish.) Fortunately Polaris’s companion lies 19" (arc-seconds) away, which is far enough to let the secondary stand out beyond the primary’s glare, yet close enough to make the pair interesting. With Polaris, you’ll see the bright primary (with diffraction spikes if you’re using a Newtonian reflector with straight spider vanes) and the secondary will be a tiny dot tucked in close to it. In keeping with the theme of this book, though, the secondary isn’t all that difficult to see in even a modest scope, and it’s hardly affected at all by light pollution. You should be able to see it from town with a good 3" or larger telescope.

The secondary is an actual companion, albeit a distant one. Its distance has been estimated at 2,400 astronomical units from the primary (1 AU = the radius of Earth’s orbit around the Sun, or 93 million miles) and its period (the time it takes to go around the primary) at 42,000 years. It will be a long time before you notice any movement.

If you can’t spot the secondary, try rotating the scope or coming back in a couple of hours. The secondary may be buried in a diffraction spike, and rotating the scope (or waiting for the sky to rotate) will bring it out into the clear. I’ve found that it takes about 50x to split Polaris cleanly.

NGC 188 – (Caldwell 1) – R.A. 00h 47m 36s, Dec. +85° 14' 35"

NGC 188 isn’t exactly bright, but I include it because it’s one of the very few open clusters near the north celestial pole. The most northerly open cluster of any significance, NGC 188 is also one of the oldest, estimated to be from 5 to 9 billion years old. That’s older than our solar system! Open clusters typically drift apart long before that, but this one is still hanging on.

Its stars are only 12th and 13th magnitude, but they add up to a total visual magnitude of 8.1, which is well within the reach of nearly any telescope, and most binoculars. What you’ll see in the eyepiece is a delicate dusting of very fine stars, maybe three dozen visible in small scopes and twice that many in large scopes, surrounded by brighter but less numerous foreground stars. I find it most pleasing at about 100x.

This is the first item on Sir Patrick (Caldwell) Moore’s list of deep-sky gems.

Collinder 463 – R.A. 01h 45m 45s, Dec. +71° 47' 52"

This is a much larger open cluster than NGC 188. It’s nearly a degree across and speckled with relatively bright (9th magnitude) stars, plus dozens of fainter ones. It contains several nice doubles, a faint but neat triple, and some star clumps that look like mini-clusters within the big one. Use your lowest power to appreciate the entire cluster, then zoom in to play around within it. This cluster is great in binoculars, too.

Iota (ι) Cassiopeiae – R.A. 02h 29m 03s, Dec +67° 24' 02"

Double stars are common, but this is one of the rare triple stars in the sky. It appears to be a true multiple star system rather than just chance alignment. The components are close, just 2.9" and 7.3" away, at right angles to one another. You’ll need magnification and steady seeing to split Iota into three, but when you do it’s a beautiful sight. The primary is white, and the two dimmer companions are yellowish and bluish.

The primary is a spectroscopic binary, meaning that the two stars are too close together to split visually but we can tell there are two stars there by looking at how the

spectrum of their emitted light shifts back and forth as they orbit one another. So there are actually four stars in that tight little space, even if we see only three.

NGC 637 – R.A. 01h 43m 04s, Dec. +64° 01' 52"

This open cluster is a borderline object; not hugely impressive but interesting enough to include. In small scopes at low power it's just half a dozen medium-bright stars, but in larger scopes at higher power you get half a dozen more, including a little double near the center that's kind of interesting.

NGC 559 – (Caldwell 8) – R.A. 01h 29m 35s, Dec. +63° 17' 53"

This is another borderline cluster, but since it's a Caldwell object I include it. Its most prominent members make a string of half a dozen brighter stars, but at higher power and in larger scopes you start to pick out several dozen more 11th and 12th magnitude stars.

NGC 225 – R.A. 00h 43m 39s, Dec. +61° 45' 53"

Cassiopeia is full of open clusters, some showy and some not. This is one of the showy ones, although at 12' diameter it's considerably smaller than Collinder 463 above. It's scattering of 9th and 10th magnitude stars make it stand out well from the background, and its collection of dimmer stars fill it out nicely.

Some observers call this the "Sailboat Cluster," but I've never been able to see a sailboat in it.

NGC 663 – (Caldwell 10) – R.A. 01h 46m 08s, Dec. +61° 13' 52"

This is a big, showy open cluster in Cassiopeia. It's coarse, with a dozen or so relatively bright stars amid several dozen more fainter ones. At 7th magnitude it's bright enough to see in any telescope or binoculars, and at 14' it's big enough to be pleasing even in binoculars.

There are three Struve doubles within the cluster: Struve 151, 152, and 153. (Friedrich Struve and his son, Otto, cataloged many of the double stars in the sky, and most of them have "Struve" designation numbers.)

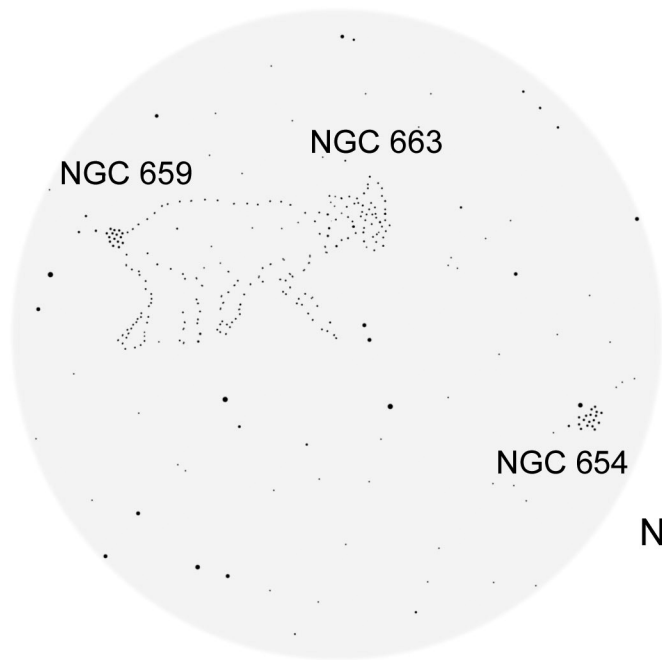
NGC 654 – R.A. 01h 43m 59s, Dec. +61° 52' 52"

NGC 654 is just 2/3 of a degree north of NGC 663, so it's easy to find in a low-power eyepiece. It's smaller and less showy than 663, but it still stands out relatively well with about a dozen 11th-magnitude stars and one bright (7.5 mag) one on the southeast edge.

NGC 659 – R.A. 01h 44m 23s, Dec. +60° 39' 53"

NGC 659 is even smaller and less showy than 663 or 654, but it still stands out nicely against the Milky Way background. There's a distinct pentagon of relatively bright stars within it, and a row of three stars in a straight line.

NGC 659, plus NCC 663 (above) and the intervening stars between them, look like a goat to me. 659 is the tail of the goat, the arch of stars between clusters is the back, and 663 is the head. There are even strings of stars sticking downward to make legs. It's pretty distinctive. Once you see this one, you can't un-see it.



The Star Goat

M103 – R.A. 01h 33m 23s, Dec. +60° 38' 38"

Objects with “M” designations are from Charles Messier’s list of things that turned out not to be comets, but are usually pretty big, bold, bright, and beautiful. So you’d expect M103 to be the brightest and showiest of the clusters in this area of Cassiopeia, but it’s a little behind NGC 663 in brightness and less than half its size. It’s still pretty nice, though, and well worth a look. It has an arrowhead shape, which helps distinguish it from 663.

Struve 131, an easily split (14") double of magnitudes 7.2 and 9.9, lies on the cluster’s northwest edge.

Trumpler 1 – R.A. 01h 35m 42s, Dec. +61° 16' 37"

While you’re in the neighborhood of the above four clusters, you may run across a neat row of four relatively bright stars in a straight line, plus other fainter stars scattered below it and a couple brighter ones above it (Newtonian eyepiece view). It’s not listed in the PSA, but that’s Trumpler 1, a sparse but nonetheless amusing little cluster. It’s a little over a degree to the west of NGC 663 and about 2/3 of a degree to the northeast of M103.

This whole area is great in binoculars. You can see all the clusters at once, plus a rich background of Milky Way.

WZ Cassiopeiae – R.A. 00h 01m 16s, Dec. +60° 21' 13"

WZ Cassiopeiae is a carbon star, one of the reddest types of stars in the sky. This one isn’t all that bright, varying from 9.4 to 11.4 and back over the course of 186 days, but it has a magnitude 8.3 companion about an arc-minute away that turns it into a great optical double. The companion is a white B-type star, and together the pair has the greatest color contrast of any double in the sky. It’s a very nice sight, well worth a look.

The pair aren’t physically related. They just happen to be in the same line of sight.

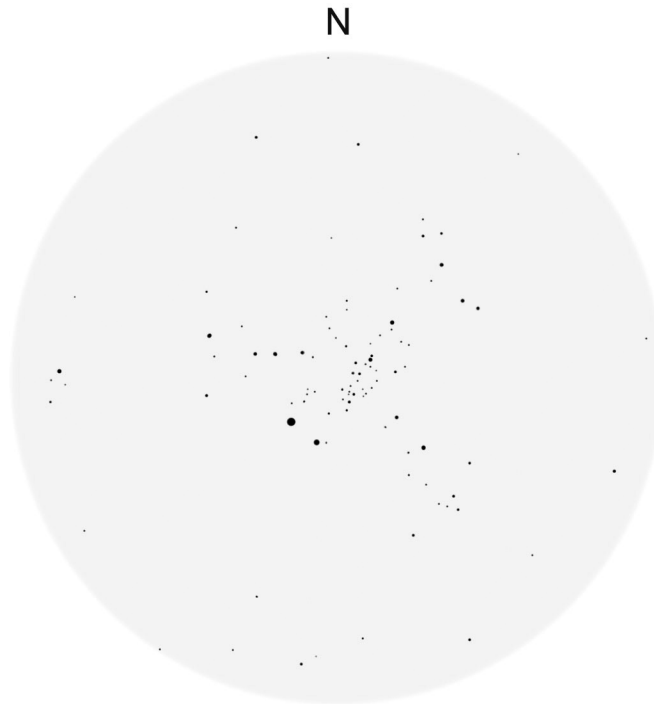
There are two fainter, tighter doubles to the north about 4' and 6', plus another double to the northwest about 8'.

On the Pocket Sky Atlas it's not marked "WZ." It's just "(c)" a smidgen above Beta Cassiopeiae, also labeled "Caph."

NGC 457 – (Caldwell 13) – The Dragonfly Cluster– R.A. 01h 19m 35s, Dec. +58° 16' 38"

Nestled inside the "W" of Cassiopeia, this open cluster fits all four of this book's ideals: It is indeed Big, Bold, Bright, and Beautiful. It's one of those objects that always elicits an "Oh, wow!" at star parties, and it never fails to make me smile when I look at it myself. It's a gorgeous dragonfly fluttering around out there in space, with two big glowing eyes and wide-swept wings that sparkle just like the wings of a dragonfly in bright sunlight.

This cluster is also called the Owl, the E.T., the Kachina, and several other names. Whatever you call it, you won't forget this one.



NGC 457, the Dragonfly Cluster

PSA Charts 2 & 3

Stock 2 – The Muscle Man Cluster – R.A. 02h 14m 42s, Dec. +59° 28' 37"

Stock 2 is a very large (over a degree across), relatively diffuse open cluster on the border between Cassiopeia and Perseus. It's best seen in binoculars or naked eye; in a telescope the stars are too scattered to make out much of a concentration.

In binoculars it does resemble a person holding their arms upward in the pose a

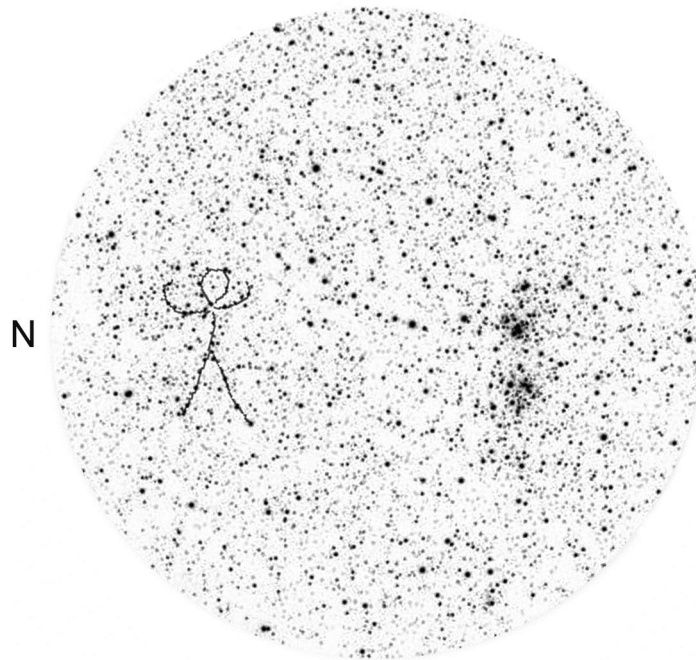
person uses when flexing their biceps. There are even two strings of stars that make up the legs.

Another longer, coarser string of stars leads southward from the Muscle Man to the western half of the Double Cluster.

NGC 884 & 869 – (Caldwell 14) – The Double Cluster – R.A. 02h 20m 35s, Dec. +57° 06' 31" (To a point between the two.)

The Double Cluster is one of those objects you'll go to again and again because it's just so beautiful. Two open clusters close enough together to fit in one low-power field of view, embedded in thousands of Milky Way stars and peppered with red giants — you can spend half an hour just falling into them.

NGC 869 holds what may be my favorite asterism of all: a tiny cat's paw made of half a dozen bright stars, with the brightest forming the heel. Some people see a parachutist; others see a mushroom. Whatever you call it, it's exquisite. You'll find yourself looking for it like an old friend every time you're in the neighborhood.



The Double Cluster and Stock 2, the Muscle Man

Achird – Eta (η) Cassiopeiae – R.A. 00h 49m 09s, Dec. +57° 48' 24"

This star is more often called Eta Cassiopeiae than Achird, which is apparently a relatively new appellation for it. It's a nice double with uneven components of magnitudes 3.4 and 7.6 and a separation of 13". It's splittable in just about any telescope, and people report a significant difference in color between the two stars, but nobody can agree what colors they are. The primary looks yellowish and the secondary reddish to me.

The pair lie only 19.4 light-years away, quite close as stars go, but their orbit is still fairly long: It takes about 500 years to make a complete circuit. The separation varies between 5" and 16" during that time, so it's at near maximum at the moment.

This is one of the first double stars I learned to find, probably because it's so easy in the lower right of the "W" of Cassiopeia. It's an easy find by naked eye, bright enough to stay visible in a Telrad or a red-dot finder and easy to sweep up in the field of view even if you're a little off to start with.

NGC 281 – The Pac Man Nebula – R.A. 00h 52m 48s, Dec. +56° 35' 40"

This is a reasonably bright nebula as far as emission nebulae go. It glows at magnitude 7.4, which would make you think it should be visible in binoculars or just about any telescope. In reality, it requires a medium-sized scope, dark sky, and an OIII or UHC filter in order to make out any detail. (I find the UHC filter slightly better than the OIII for this nebula.) Given those conditions, though, it's a pretty nice nebula, a bright oval patch with a big triangular bite taken out of it. It looks like a Pac Man from the old video game, hence its name.

There's a nice little cluster of stars in its center that adds to the spectacle.

NGC 7789 – Caroline's Rose – R.A. 23h 57m 25s, Dec. +56° 41' 43"

Caroline Herschel discovered this cluster in 1783. I go back to it every time I'm in the area, and I bet Caroline and her brother William did, too. This is one of the most beautiful and delicate clusters in the sky. It can be difficult to pick out if you have too much skyglow, but under a dark sky it's spectacular. There are well over 100 stars visible over an area about 15" wide, and they're all 11th and 12th magnitude so it looks very uniform and almost fuzzy soft.

Then you notice the dark lanes. There are little arcs of darkness all through it, and they seem to define the edges of flower petals...like a rose made of stars!

It's best not to zoom in until the cluster fills the field of view, but to give it some context so you can see the cluster against the darker background. I find that about 90x in an 82° apparent-field eyepiece is ideal.

NGC 7662 – (Caldwell 22) – The Blue Snowball – R.A. 23h 25m 54s, Dec. +42° 31' 54"

The Blue Snowball is a planetary nebula, so named because these often-round nebulae looked like planets in early telescopes. In reality they're the outer envelopes of old, dying stars that have been blown off into space and are being illuminated by the white dwarf core that remains of the original star. The Blue Snowball is one of the brighter ones, easy to find because of good guide stars nearby and because of its inherent brightness. It's bright enough to trigger the color receptors in your dark-adapted eyes, giving it a faint blue/green tinge; hence its name.

While it's fairly bright, it's not huge (about 30"), so you'll want about 100x for this one.

The central star is variable, ranging from 12th to 16th magnitude. When it's near its brightest it can be seen in a modest telescope, but at its dimmest it's very difficult.

M76 – The Little Dumbell – R.A. 01h 42m 21s, Dec. +51° 33' 47"

M76 is a bi-lobed planetary nebula that looks a little like a bow tie, or yes, a dumbbell. It's a small version of its more famous sibling, M27, known simply as "The Dumbbell Nebula." So yeah, this one is a little smaller, but it's still pretty neat. Well worth a look. Try an OIII or UHC or even a Skyglow filter and see if it stands out a little more. (It will.) I like the view at about 140x.

NGC 1245 – R.A. 03h 14m 41s, Dec +47° 13' 52"

NGC 1245 is a nice open cluster in Perseus. It's composed of mostly 12-magnitude and fainter stars, so you might expect it to be fairly difficult to spot, but it stands out reasonably well even in binoculars. The cluster stars appear scattered at random, but there's a neat arc of stars just to the southwest of it, like the base of a snow globe.

This cluster is estimated to be at least a billion years old, which is old for an open cluster (but not as old as NGC 188, above). Most open clusters drift apart within millions of years.

Algol – R.A. 03h 08m 09s, Dec. +40° 57' 03"

This is a naked-eye object. It's one of the most famous variable stars in the galaxy because its magnitude drop is so easy to see and its period is short enough that you can see it dim down and brighten back up in one night.

It's an eclipsing binary, which means there are two stars orbiting one another with the plane of their orbit aimed straight at us, so every half-orbit one of the stars disappears behind the other. Normally they shine at a combined magnitude of 2.1 (about the same as Polaris), but when the bright one disappears behind the dim one, their brightness drops to magnitude 3.4. That's 3 times dimmer, easily distinguishable even with a casual look. The drop happens every 2 days, 20 hours, and 49 minutes and lasts for about 10 hours. It spends about four of those hours dimming down, two hours at minimum, and four more climbing back to its usual brightness.

The cool thing is that there are two perfect reference stars nearby, so you can easily check to see if Algol is in a bright phase or a dim phase by comparing it to Almach (Gamma Andromedae, mag 2.2) or Metallah (alpha Trianguli, mag 3.4).

Because Algol takes several hours to dim and rebrighten, you're unlikely to see the entire process on any one night, but it's worth having a look whenever you're out and seeing if it's bright or dim, and looking again every hour or two to see if it's changing. *Sky & Telescope* magazine occasionally prints a table of Algol's minimum brightness times so you can watch for it with advance knowledge of when it'll be at its dimmest.

Algol was known as the "demon star" in ancient times because it defied the belief that the heavens were unchanging.

M34 – R.A. 02h 42m 04s, Dec. +42° 44' 42"

A somewhat sparse but large and bright open cluster, M34 is good in binoculars or any telescope. Many of its stars are arranged in pairs along three distinct arms.

NGC 891 – (Caldwell 23) – R.A. 02h 22m 34s, Dec. +42° 20' 51"

NGC 891 is an edge-on spiral galaxy with a prominent dust lane cutting right through the center. It's relatively faint (10.0 magnitude), so don't expect it to blind you, but it's worth looking at if you have an 8" scope or more.

NGC 891 is often called the "Outer Limits" galaxy because it was used in the opening credits of the TV show of that name.

If this one is too faint for your scope and/or skies, try NGC 4565 (on PSA page 45). That's a very similar galaxy, but larger and brighter.

Almach – Gamma (γ) Andromedae – R.A. 02h 03m 53s, Dec. +42° 19' 28"

Almach is one of the prettiest double stars in the sky. It's a mini-Albireo, with a

bright gold primary and a somewhat dimmer, bluer companion. Almach's two components' magnitudes are similar enough (2.2 and 5.0) and they're separated by enough distance (10") that they're an easy split in almost any telescope, and the colors are vivid enough to stand out under any conditions, even bad city skyglow.

Both stars are themselves doubles, making this a quadruple system, but only the dimmer double can be split by an amateur scope and at 0.5" separation even that is extremely difficult. So kick back and enjoy the two primaries, and leave the second split for a day of perfect seeing when you want a serious challenge.

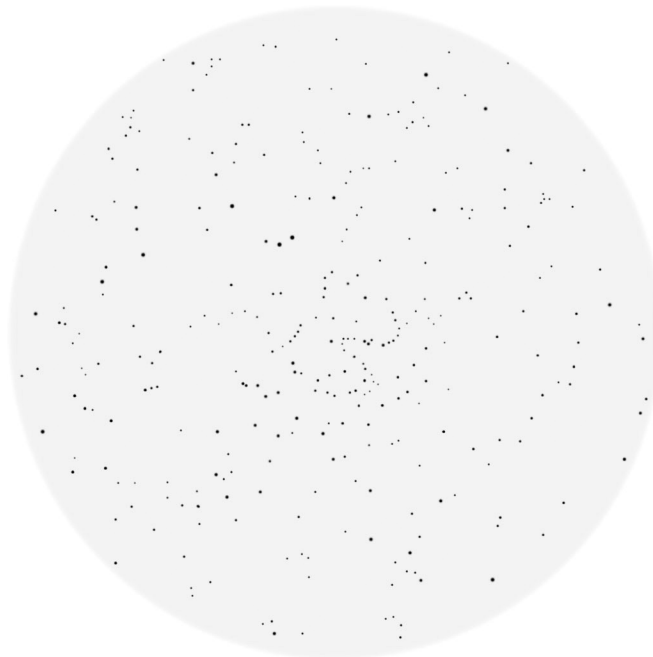
59 Andromedae – R.A. 02h 10m 54s, Dec. +39° 02' 36"

59 Andromedae is a challenging double in binoculars and an easy one in a telescope. Its components are magnitudes 6.1 and 6.8 with a separation of 17". They're just different enough to be noticeable. Best at low power.

NGC 752 – (Caldwell 28) – R.A. 01h 57m 40s, Dec. +37° 46' 43"

NGC 752 is a bright, sparse, and very large open cluster nearly a degree across. It's probably best in binoculars, but fun to cruise around in with a telescope to look at its many star chains, mini-clusters within the larger cluster, and doubles.

I've read several descriptions of NGC 752 that talk about its "gently curving arcs of stars," but nobody states the obvious: Two of those arcs look for all the world like a nice pair of...um...capital letter D's. Yeah, that's it. That's undoubtedly why my wife, Kathy, suggested we call this the "Double D" cluster.



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NGC 752, the Double D cluster

M31 – The Andromeda Galaxy – R.A. 00h 42m 43s, Dec. +41° 15' 52"

This is the biggest, boldest, best galaxy visible, unless you count the one we live in. At only 2.2 million light-years away, it's practically in our back yard. Indeed, it's heading toward us and will collide with the Milky Way in about 4-5 billion years.

A grand spiral like the Milky Way, the Andromeda Galaxy is over 3 degrees across, larger than six full Moons side by side. It's tilted so we look on it at an angle, making it three times longer than it is wide. You'll want your lowest power eyepiece for this one. I often think it looks better in binoculars than in a telescope. Under a dark sky you can see it easily by naked eye, making it quite probably the farthest thing you can see without optical aid.

From a light-polluted town you'll just see the core of the galaxy even in a telescope, but if you have dark sky you'll see two prominent dust lanes that define its spiral arms, and two companion galaxies, M32 and M110. You won't be able to resolve individual stars at that distance, although in a big scope you can spot globular clusters. The real spectacle here is just the grand sweep of an island universe that's bigger than the field of view of most telescopes. When you're looking at M31, you're looking at about a trillion stars. That's more than in our own Milky Way.

NGC 404 – Mirach's Ghost – R.A. 01h 09m 27s, Dec. +35° 42' 49"

Mirach is Beta Andromedae, the 2nd-magnitude star just 7 degrees to the southeast of the Andromeda Galaxy. It's a red giant, and appears distinctly yellowish in a telescope. Just a smidgen (7') to the northwest of it lies a 10th-magnitude elliptical galaxy. It would be easy to spot anywhere else in the sky, but next to Mirach's glare it can be 404-Galaxy-Not-Found. So crank up the power and move Mirach out of the field of view. When you do, the galaxy is fairly easy to spot. It has a star-like core with a circular outer envelope surrounding it that fades gently away to nothing. Once you've found it, try pulling Mirach back into the field of view to see if you can keep sight of the galaxy with that bright star right next to it. It's fun to blink it in and out. Now you see it, now you don't.

Σ 3050 – Struve 3050 – R.A. 23h 59m 29s, Dec. +33° 43' 26"

Struve 3050 is a nearly even (mags 6.5 and 6.7) double about 5° to the northwest of Alpheratz (Alpha Andromedae). With only 2.5" of separation, it's a challenge on nights of iffy seeing, but on steady nights it's a relatively easy and rewarding split.

6 Trianguli – Struve 227 – R.A. 02h 12m 22s, Dec. +30° 18' 11"

6 Trianguli, also known as Struve 227, is a relatively tight double star just under the triangle of Triangulum. Its components are magnitude 5.2 and 6.7, so they're noticeably different in brightness but not wildly so, and their separation is 3.9", which makes for a tough but do-able split in just about any telescope with a little magnification.

Σ 232 – Struve 232 – R.A. 02h 14m 43s, Dec. +30° 23' 44"

Struve 232 isn't labeled on the Pocket Sky Atlas, but it's marked as a double star just half a degree east of 6 Trianguli. It's worth a look while you're in the area, since its components are nearly equal at 7.8 and 7.9 magnitude and its separation is a more generous 6.5". In a telescope, these two are plenty bright, and nicely split at 50x or so.

M33 - The Pinwheel Galaxy – R.A. 01h 33m 50s, Dec. +30° 39' 22"

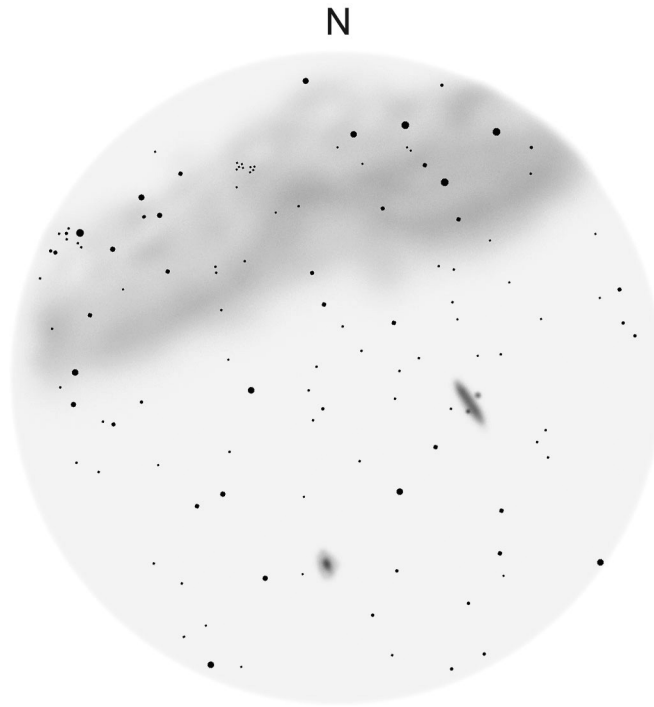
M33 is pretty faint, so I debated whether or not to list it here. I finally decided to include it because it is big and beautiful, and under dark sky it's reasonably bold as well.

It's a face-on spiral that reveals its arms, plus some clumpiness from star-forming regions along the leading edges of those arms.

Its visual magnitude is 5.7, which makes it just barely naked-eye visible under dark sky. It's faint in a telescope, though, because its face-on orientation spreads its glow over a wide area (about the size of two full Moons). It's worth a look if you have dark sky, because when you do see it well, it's glorious.

M33 and M31 are actually close to one another in space (about 730,000 light-years apart, which doesn't sound close but in terms of galactic distances it is) and are two of the larger spirals in our Local Group of galaxies.

When you're looking for M33, expand your attention to take in M31 (the Andromeda Galaxy) to the northwest of it, and that wide swath of Milky Way that runs through Cassiopeia and Perseus to the north of it. You're looking at a small cluster of three galaxies...from within. All three reside within a volume of space only 2.8 million light-years across, which is pretty close for galaxies. From M83, on the other side of the sky, we'd probably make a great galaxy trio.



Milky Way, M31, and M33

PSA Charts 4 & 5

Σ 239 – Struve 239 – R.A. 02h 17m 24s, Dec. +28° 44' 15"

Struve 239 is an easy double star halfway between Triangulum and Aries. Its components are magnitude 7.1 and 7.7, and their separation is 14", so it's fairly easy to split in just about any telescope and it's visible even under city skyglow.

The primary looks slightly bluer than the secondary to me, but not by a great deal.

Lambda (λ) Arietis – R.A. 01h 57m 55s, Dec. +23° 35' 34"

Lambda Arietis, two degrees straight west of Hamal, the brightest star in Aries, is a nice, easy double with components of magnitude 4.8 and 6.7 separated by a generous 37". They should be splittable in almost any telescope, and maybe even in well-braced binoculars.

Gamma (γ) Arietis – R.A. 01h 53m 31s, Dec. +19° 17' 26"

Gamma Arietis, also known as Mesartim, is a near-perfect double, in that its stars are very close to the same magnitude (4.75 and 4.83). They're separated by 7.5", making them a reasonably easy split in most scopes at medium-high power.

The more southerly of the two looks slightly yellower to me, but this is probably the effect of their differing magnitudes, since both are considered white.

Psi¹ Piscium – R.A. 01h 05m 41s, Dec. +21° 28' 13"

Psi¹ Piscium is a relatively close-matched double of magnitudes 5.3 and 5.5, separated by 30". They're not a true pair, being 20 light-years apart, but are just lined up along our line of sight. This pair might also be splittable in well-braced binoculars.

Σ 46 – Struve 46 – R.A. 00h 39m 56s, Dec. +21° 26' 19"

Struve 46 is an uneven double of magnitudes 5.4 and 8.5 with a separation of 6.6". It's a bit of a challenge, but doable on a steady night with 100x or better. Uneven doubles somehow seem more rewarding when they split, with the companion swimming up out of the background like a fish rising to the surface of a pond. This is one of the more classic of the uneven doubles: it provides just enough of a challenge to make you feel like you've accomplished something when you split it.

Zeta (ζ) Piscium – R.A. 01h 13m 44s, Dec. +07° 34' 31"

Zeta Piscium is a wide double of somewhat unequal magnitude (5.2 and 6.2) separated by a generous 23", which makes them a nice binocular target. They're good at low power in a telescope, too, but they're quite widely separated.

These two stars are just a line-of-sight pair, being about 50 light-years apart (200 and 250 light-years away).

77 Piscium – R.A. 01h 05m 49s, Dec. +04° 54' 30"

77 Piscium is another double very similar to Zeta Piscium above, but about a magnitude dimmer (6.4 and 7.3). It's a bit wider, though, at 33", so it should be easier to split in binoculars. In a telescope it's so wide it's not a challenge at all.

In the Pocket Sky Atlas 77 Piscium isn't labeled, but it's easy to spot as the double just to the southwest (lower right) of 80 Piscium, just below the plane of the ecliptic.

Alpha (α) Piscium (Alrescha) – R.A. 02h 02m 03s, Dec. +21° 26' 19"

Alpha Piscium is the link that joins the two leaping fish of Pisces. It's the constellation's third-brightest star, but it's actually a very tight double. Its component stars are magnitudes 3.8 and 4.1, so they're relatively even, but their separation is only 1.8", so they're pretty difficult to split except on nights of steady seeing. They're well worth a try, though.

Σ 330 – Struve 330 – R.A. 02h 57m 11s, Dec. -00° 34' 28"

Struve 330, with components of magnitude 7.1 and 9.1 and a separation of 8.6" is a fairly easy split at medium-high (100x+) power. Despite being only two magnitudes different, the two stars in this double seem very uneven to me, with one of them clearly dominant and the other one somewhat difficult to find at first. When your eye locks onto it, though, it becomes an obvious and pleasing split.

M74 and M77 – R.A. 01h 36m 41s, Dec. +15° 46' 51" (M74) and R.A. 02h 42m 41s, Dec. +00° 00' 48" (M77)

I'll mention these two face-on spiral galaxies so you won't think I've forgotten them, but these are neither big nor bold nor bright. They are beautiful in a big scope under dark sky, but in most scopes and most skies they're just dim smudges.

M77 is in a nice little cluster of galaxies, among which is NGC 1055, also known as the "Little Sombrero." It's not exactly BBBB, but it's nice if you have a big scope and dark sky.

PSA Charts 6 & 7

Mira (Omicron Ceti) – R.A. 02h 19m 20s, Dec. -02° 58' 47"

Mira, or Omicron (O) Ceti, is one of the most famous of the pulsating stars, giving its name to an entire class of variables. It changes in brightness from mag 3.5 to mag 10, with occasional runs up to mag 2.0. Its period is about 11 months. The rise from minimum to maximum brightness takes about 110 days, while the fade back to minimum takes about twice as long.

At its maximum, it's easily visible by naked eye. At its minimum, it fades to the point where it's difficult to distinguish from the general background even in a telescope.

Mira's brightness variations come from expansion and contraction due to instability in its core rather than from an orbiting companion blocking its light. It's a red giant that's approaching the phase where it will blow off its outer layers into a planetary nebula. Given its relative closeness (300 light-years), it should create one of the more spectacular planetary nebulae in our sky in a million years or so.

66 Ceti – R.A. 02h 12m 48s, Dec. +02° 23' 37"

66 Ceti isn't labeled on the Pocket Sky Atlas, but it's marked as a double about 2° to the west-northwest of Mira. It's an easy double of magnitudes 5.7 and 7.7. That's the same magnitude difference as Struve 330 above, but both stars are brighter and they have a separation of 16.7", nearly twice Struve 330's separation. That makes this pair more than twice as easy to split, and perhaps twice as pleasing.

37 Ceti – R.A. 01h 14m 24s, Dec. -07° 55' 22"

37 Ceti is a nice, easy double just above the body of Cetus the Whale. Its components are magnitudes 5.2 and 7.9, so there's quite a bit of difference in brightness, but their separation of 49" gives the secondary plenty of room to make its presence known.

NGC 157 – R.A. 03h 34m 46s, Dec. +08° 23' 46"

This galaxy is only 10.4 magnitude and 3.5 x 2.4 arc-minutes across, so it's not exactly big or bold or bright, but it's beautiful so I'm including it for people with large-

aperture scopes. It's a barred spiral, and one with a prominent bar at that, with two thick spiral arms sweeping outward in a big S-shape. It's definitely worth a look, especially if you have some light-gathering ability.

NGC 246 – (Caldwell 56) – The Skull Nebula – R.A. 00h 47m 03s, Dec. -11° 52' 20"

NGC 246 is a large, somewhat dim planetary nebula in Cetus. It's hard to see this one at all without a filter, but I include it here because it's beautiful with an OIII or UHC filter in a medium-large telescope. At 4' across it's big enough to see some detail within its gas envelope. Its central star and several other foreground stars give it a little sparkle.

This object is called the "Skull Nebula" because one side of it fades out faster than the rest, giving it a lopsided, distinctly skull-like appearance.

NGC 247 – (Caldwell 62) – R.A. 00h 47m 09s, Dec. -20° 45' 38"

NGC 247 is a medium-bright (mag 9.1) galaxy in Cetus. It's an elongated spiral about 19' long, so its light is spread out a bit, but it's relatively easy to spot under dark sky. Its spiral structure won't be evident; you'll just see an oval glow with a bright star at the southern end of it. It's a member of the Sculptor group of galaxies, of which NGC 253 (below) is the most prominent member.

NGC 253 – (Caldwell 65) – the Silver Coin Galaxy – R.A. 00h 47m 33s, Dec. -25° 17' 13"

If this galaxy were higher in the sky, it would rival the Andromeda Galaxy for northern observers. Even so, when it reaches its highest elevation it's a beautiful sight in binoculars or a telescope. At magnitude 7 it's just below naked-eye visibility, but quite bright in any optics. And it's big! It's nearly as wide as the full Moon. It's tilted to our line of sight much like the Andromeda Galaxy, so it's about five times as long as it is wide.

You can see mottling in its disk, but you can't really make out spiral arms. Instead, it just looks like a silvery oval, hence its name "The Silver Coin."

I go back to this one whenever I get the chance. It's an old friend, and a good one.

NGC 288 – R.A. 00h 52m 45s, Dec. -26° 34' 52"

Whenever I look at the Silver Coin Galaxy, I slew the scope just a degree to the southeast and have a look at NGC 288, a relatively bright (mag 8.1) globular cluster. In binoculars or a wide-field eyepiece you can see both objects at once.

NGC 288 is a nice globular, resolvable into individual stars all the way to the core. It's less than a degree from the south galactic pole, and it's about 29,000 light-years from Earth, so it's a long, long ways out there into the galactic halo. (It's about 39,000 light-years from the Milky Way's core.)

PSA Charts 8, 9, & 10

The sky in these charts is too far south for me (I live at 44° north), so I don't know what's down here except by reputation. With that in mind, here are the ones I hope to see someday:

The Small Magellanic Cloud – R.A. 00h 52m, Dec. -72° 48'

The smaller of our two main companion galaxies (there are many more even smaller dwarf galaxies), the Small Magellanic Cloud is a naked-eye patch of stars that looks like a fragment of the Milky Way that got torn loose and has drifted south. It's about 3° across, nearly as large as the Andromeda Galaxy, and considerably brighter.

Within the SMC are many star clusters and nebulae that can be seen through a telescope. You can spend many hours poking around here, and I hope to do just that someday.

47 Tucanae – R.A. 00h 24m 05s, Dec. $-72^\circ 04' 40''$

47 Tucanae is one of the best globular clusters in the sky. At 4th magnitude, it's the second brightest (after Omega Centauri) and is easily visible by naked eye just to the west of the Small Magellanic Cloud. In a telescope it's a mind-boggling ball of about a million stars that spans nearly the area of the full Moon. It's only 13,000 light-years away, so its stars are easily resolvable in a telescope.

NGC 362 – R.A. 01h 03m 14s, Dec. $-70^\circ 50' 56''$

NGC 362 lies just north of the Small Magellanic Cloud.. It's smaller and dimmer than 47 Tucanae just next door, but anywhere else in the sky it would be a showcase globular cluster. At magnitude 6.4 and 14' in diameter (half a full Moon) it's easily visible in binoculars and great in a telescope.

Sigma Octans – Polaris Australis – R.A. 21h 08m 49s, Dec. $-88^\circ 57' 23''$

The southern celestial pole doesn't have a convenient bright star nearby. The closest naked-eye star is Sigma Octans, but at magnitude 5.4 it barely qualifies. It's over a degree away from the pole and getting farther as precession moves the Earth's axis away from it. That said, this is the southern hemisphere's pole star, and worth a look when you're far enough south to see it.

PSA Chart 11

Σ 460 – Struve 460 – R.A. 04h 09m 56s, Dec. +80° 41' 32"

I mention this double star not because it's easy or particularly neat, but because it's a great test of the seeing and of your telescope. Its two components are 5.1 and 5.8 magnitude, so are pretty close to one another in brightness, but they're *extremely* close to one another in the sky: only 0.7". That's well beyond the limit for most scopes on most nights. But if you're knocking down doubles some night and everything seems to be working perfectly, give this one a shot. It'll give you bragging rights.

Kemble's Cascade – R.A. 03h 57m 24s, Dec. +63° 04' 12"

Kemble's Cascade is a wonderful stream of stars that runs for three degrees from northwest to southeast, ending in an open cluster (NGC 1502). It's best in binoculars, but it's fun to trace its length in a telescope, and the cluster is best in a scope at moderately high power.

The stars in the Cascade range from 5th to 9th magnitude, with the brightest one near the center of the chain. There's a gap below it and a star that's out of line to the southwest, as if the star that should be there has drifted off, lost in thought while the others continue to march in formation.

NGC 1502 – R.A. 04h 07m 49s, Dec. +62° 18' 52"

NGC 1502 is a fairly small cluster at the end of Kemble's Cascade with a nice double (Struve 485) in the middle. Actually there are five pairs of stars here; four in the cluster and one beside it. They're arranged in a rough cross with a scattering of stars in the middle, which leads to its common name: the Jolly Roger Cluster.

UV Camelopardalis – R.A. 04h 05m 53s, Dec. +61° 47' 32"

The carbon star UV Camelopardalis lies just a quarter degree below the bottom of Kemble's Cascade. Carbon stars are some of the most intensely red stars in the sky. Try de-focusing a little to spread out the color.

NGC 1501 – R.A. 04h 07m 00s, Dec. +60° 54' 55"

NGC 1501 is a nice planetary nebula just a bit farther to the south of UV Camelopardalis. It has a bluish color, and its central star is visible in medium-large apertures.

PSA Charts 12 & 13

Capella – R.A. 05h 16m 40s, Dec. +45° 59' 38"

At magnitude zero, Capella is the sixth brightest star in the night sky. It's a double, but the companion is way too faint and too close to the primary to see in any telescope. What makes it worth looking at, then? The way it twinkles!

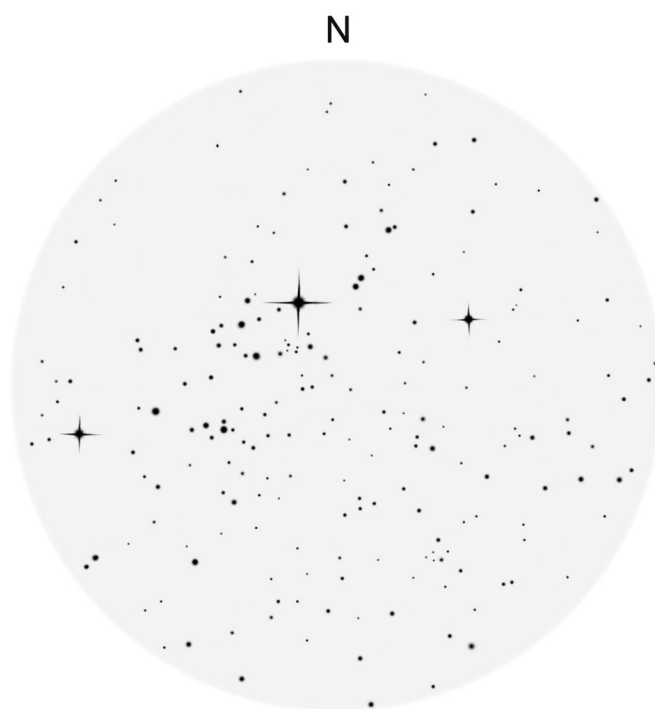
When it's near the horizon, Capella looks like a police car flashing red and blue. Turbulent air acts like dozens of prisms, splitting the starlight into its spectrum and flashing different wavelengths at you at random. In a telescope you'd swear the mothership was making a dive straight for you, lights ablaze.

If you're a fan of diffraction spikes on your stars (as I am — I think they're cool!), Capella will give you some of the best you can get. I can see spikes off Capella even when I push the star completely out of the field of view.

The Alpha Persei Moving Cluster (Melotte 20, Collinder 39) – R.A. 03h 24m 19s, Dec. +49° 51' 32" (Mirfak)

The constellation of Perseus is dominated by a wide scattering of blue-white stars, the brightest of which, Mirfak, anchors the center of the constellation. What's neat about this group is that it's a true cluster of stars; it's just so close to us (600 light-years) and it's old enough that it's scattered across several degrees of sky. Most of the stars you see here were born together 50 million years ago and are moving through space together, though.

This cluster is far too wide to appreciate even in binoculars; this is a naked-eye spectacle.



The Alpha Persei Moving Group

NGC 1528 – R.A. 04h 15m 22s, Dec. +51° 11' 52"

This is a nice open cluster to the east of Mirfak. It has a combined magnitude of 6.4, so it's just at the limit of naked-eye vision under dark sky, but it shows up just fine in binoculars or any telescope. It's 16' across, or about half the diameter of the full Moon, and composed of about 70 stars ranging from 10th to 14th magnitude. It looks roughly triangular in the eyepiece.

NGC 1545 – R.A. 04h 20m 56s, Dec. +50° 14' 52"

This is another nice open cluster just a little over a degree to the southeast of NGC 1528. You can see them both in the same binocular field, and even in a very wide telescope eyepiece field. NGC 1545 is a bit larger (18') and slightly brighter overall (6.2

mag.), but it's much sparser and less showy. It does reward close inspection: near the center is a triangle of contrasting colors (orange, yellow, white), and on the north edge is a nice orange double (Struve 519, mags. 7.7 & 9.2, separation of 18.3".)

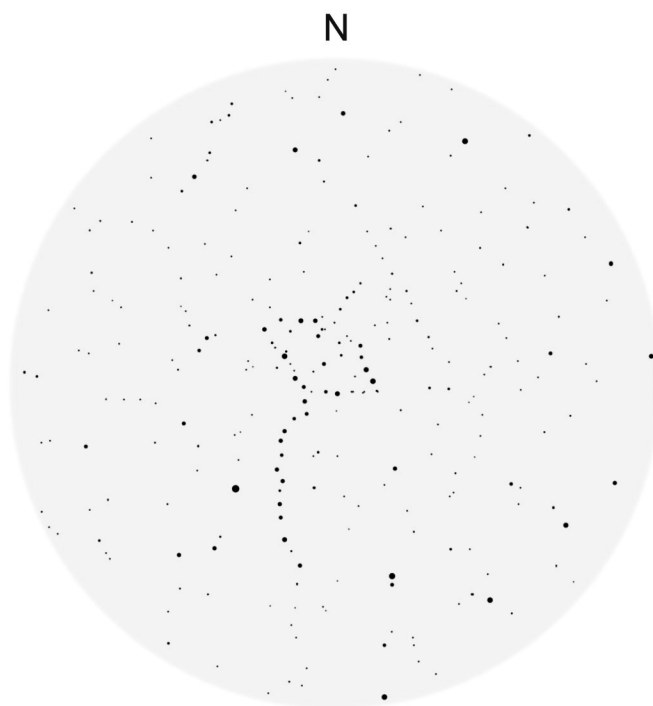
NCG 1491 – R.A. 04h 03m 23s, Dec. +51° 18' 52"

It's kind of funny: Every listing I can find for this object calls it a "bright emission nebula," but nobody says *how* bright. Fact is, it's pretty easily visible from a dark site with some aperture (10" or better), but it's a lost cause from town. An OIII filter helps. It's a roughly triangular patch of ionized hydrogen energized by the 11th magnitude star near its center. It reminds me a little of Hubble's Variable Nebula in Monoceros (PSA chart 25). It's about the same size (3' or so) and brightness (HVN is listed at mag. 9.2).

NGC 1664 – The Kite Cluster – R.A. 04h 51m 05s, Dec. +43° 39' 53"

NGC 1664 is a fairly large (12'), fairly bright (mag 7.6) open cluster between Auriga and Perseus that sports a loose diamond of stars that stand out well from the background, and an equally visible long tail that makes it look amazingly like a kite. There's even a smaller line of stars opposite the tail that looks like the kite string, and to the northwest there's a straight line of stars that could be the ground if the kite is flying along sideways. This is a must-see cluster any night it's up.

I can also see this one as a manta ray gliding along over the ocean bottom.



NGC 1664, the Kite Cluster

NGC 1582 – R.A. 04h 31m 39s, Dec. +43° 44' 00"

This is another open cluster 3.5° west of the Kite Cluster. It's much larger than the Kite Cluster, and brighter, although more sparsely populated. It's about the size of the full Moon, so it's easy to spot in binoculars and looks best at low power in a telescope. It

looks a little like a fairy ring, with more stars around the perimeter than in the middle. In binoculars the fairy ring becomes a sickle sweeping to the southwest. There's a fairly obvious triple star on the north edge of the cluster, and three much brighter stars making an obtuse triangle to the south-southeast (outside the cluster). The brightest of the three is m Persei, at magnitude 6.1. By contrast, the brightest star in the cluster itself is magnitude 8.6.

m Persei is a very wide (2') double of 6.1 and 6.8 magnitude that looks kind of neat in binoculars.

NGC 1893 – R.A. 05h 22m 44s, Dec. +33° 24' 00"

Just under 3° to the south-southwest of M38 you'll find NGC 1893, a large, loose open cluster with several stars of 9th and 10th magnitude and many more dimmer ones that's elongated north-south across about 25 arc-minutes (just smaller than the Moon). There's a bonus double star to the west, and a nice triple to the north.

NGC 1893 lies in a region of nebulosity called IC 410, but the nebula is harder to discern in a telescope than the cluster. It's not that difficult, though; I was able to see it easily in a 10" scope with an NPB filter under relatively dark sky.

NGC 1778 – R.A. 05h 08m 04s, Dec. +37° 01' 00"

This open cluster is considerably smaller than NGC 1893 and most of its stars are 10th magnitude or fainter, but with an overall magnitude of 7.7 it's still relatively easy to spot. There are several chains of stars in and around this cluster, the most obvious one being to the north. There's a nice double star within the cluster, too.

Theta (θ) Aurigae – R.A. 05h 59m 42s, Dec. +37° 12' 39"

Theta Aurigae is a tight double of uneven brightness (magnitudes 2.7 and 7.2 separated by only 4"). It's a challenge, but doable at high power on a night of steady seeing. I've split it at 140x in a 10" scope.

The M-Thirty-Somethings

M35 – R.A. 06h 08m 52s, Dec. +24° 19' 55"

M36 – R.A. 05h 36m 16s, Dec. +34° 07' 51"

M37 – R.A. 05h 52m 16s, Dec. +32° 32' 52"

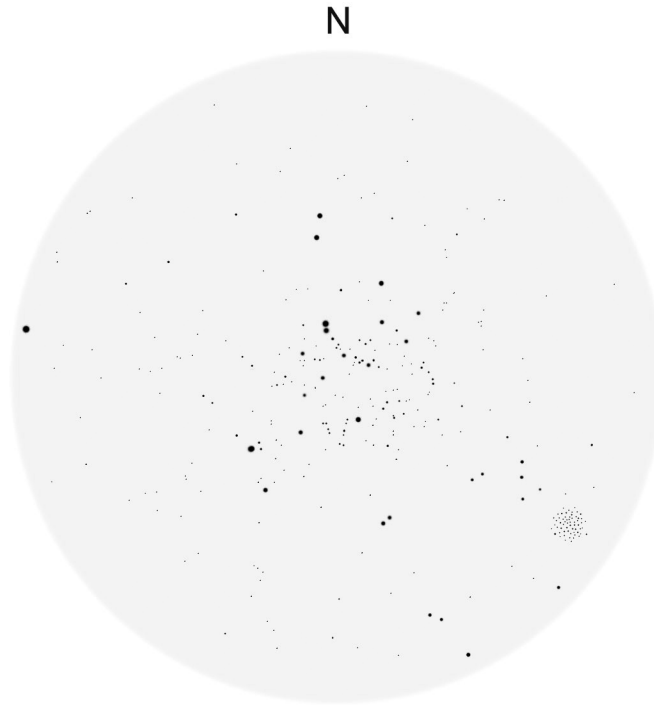
M38 – R.A. 05h 28m 38s, Dec. +35° 49' 50"

The Milky Way runs right through this region, and the stretch from Auriga down into Gemini is full of open clusters. Messier spotted the four brightest, and they're definitely the eye candy of this part of the sky.

They're not in order. M38 is at the top, but then we get M36, then M37, then M35 down at the feet of Gemini like a soccer ball about to be kicked. In binoculars you can sweep from one to the next, although the jump to M35 is a bit of a stretch. In a telescope you have to re-aim for each one unless you know the area well. The sky is rich with stars here in the midst of the Milky Way, but the clusters stand out nicely. Each one has its own appeal, from coarse (M35 and M36) to delicate (M37) to rich (M38).

M35 has a bonus cluster, NGC 2158, about a quarter degree to the southwest. It's much fainter, but very nice under dark sky, splitting into individual stars at high power even though it's 17,000 light-years away, six times farther than M35 (2,800 light-years). Seeing them both in the same field really provides a 3D effect, as NGC 2158 recedes way into the background.

M38, on the other end of the four-cluster chain, also has a companion cluster, NGC 1907. It's not as rich as NGC 2158, but it provides a nice contrast to M38 and it's neat to see two large, showy clusters each with a faint companion. I think of them as clusters in training, waiting in the wings for their chance in the spotlight.



M35 with NGC 2158 to the lower right

26 Aurigae – R.A. 05h 38m 37s, Dec. +30° 29' 26"

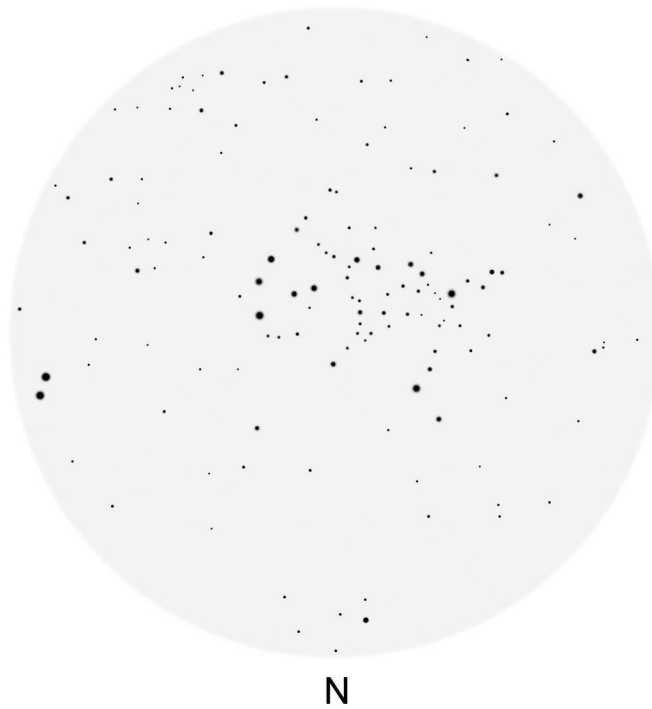
26 Aurigae is a nice double, although just a line-of sight pairing. Easily split at about 35", its magnitude 5.4 and 7.1 components provide enough difference in brightness to be interesting. Both are yellowish-white in color.

There's another companion closer in to the primary, at 8.6 magnitude and 12" separation, making this a relatively easy triple star. The closer components are probably a true binary.

NGC 1342 – R.A. 03h 31m 36s, Dec. +37° 21' 44"

A loose, coarse, bright (magnitude 6.7) open cluster of about 60 stars in an elongated east-west orientation. I call this one the "Chipmunk Cluster," for reasons that will be obvious when you see it. It looks just like a chipmunk scampering out of the Milky Way right into your telescope. This cluster is guaranteed to put a smile on your face.

It's about a quarter-degree (15') across, so it looks good at low to medium power.



NGC 1342, the Chipmunk Cluster

Σ 425 – Struve 425 – R.A. 03h 40m 07s, Dec. +34° 06' 59"

Struve 425 is a small double down in the feet of Perseus. On the Pocket Sky Atlas it looks like 40 Perseii would be the more interesting pair, but 40 Perseii's companion is way too faint to be much fun. Struve 425, however, has components of 6.8 and 7.6, just different enough to be noticeable, but close enough in brightness to make for a fairly easy split even though their 1.9" separation can pose a challenge if the seeing isn't good. On a steady night, however, this is a very pleasing pair.

NGC 1514 – Crystal Ball Nebula – R.A. 04h 09m 16s, Dec. +30° 46' 27"

NGC 1514 is called the Crystal Ball Nebula for good reason: the outer envelope is nearly spherical and the central star looks like the sparkle of sunlight off the surface of a glass ball. It's relatively dim at 11th magnitude, but aperture and magnification pull this out of the doldrums to make it a beautiful sight.

This nebula holds historical significance in that it's the one that convinced William Herschel that not all fuzzy objects were just star clusters too distant to resolve. The central star was too obviously connected to the nebulosity for coincidence.

NGC 1514 is actually a planetary nebula, the expanding shell of gas thrown off by a dying star.

PSA Charts 14 & 15

Collinder 89 – R.A. 06h 18m 00s, Dec. +23° 38' 00"

Often overlooked due to its proximity to M35, Collinder 89 is a nice open cluster in its own right. Nestled into the foot of Castor, this cluster is a full degree across so you'll want your widest field eyepiece. It's probably best in binoculars, actually, where it stands out even better from the rich stellar background in this area.

Eta (η) Geminorum – Propus – R.A. 06h 14m 53s, Dec. +22° 30' 25"

Eta Geminorum, also known as Propus, is the toe of Castor, the eastern twin of Gemini. It's a tight double star, with a bright red primary (3.3 mag.) and dimmer secondary (6.2 mag) separated by only 1.6". It's a tight, difficult split due to the difference in magnitudes, but worth a try on a steady night if you're in for a challenge.

Uranus was discovered very near Eta Geminorum in 1781 by William Herschel. Due to its long orbital period of 84 years, Uranus has only made it around twice since then. It will complete its third orbit in 2033. And not only will it cross the finish line; it goes retrograde soon after and crosses its discovery point again and again throughout early 2034, making a victory lap of sorts.

NGC 2129 – R.A. 06h 01m 07s, Dec. +23° 19' 00"

NGC 2129 is a small (5') yet reasonably bright (mag. 6.7) open cluster just 2° to the southwest of M35. If you go from M35 through NGC 2158 (M35's tiny companion) and keep going in the same direction, you'll hit it. It's straight west of 1 Geminorum, a 4th magnitude star that's hard to miss.

Two stars of magnitudes 7.4 and 8.3 dominate the cluster, with two more just a little fainter and a dozen more fainter still scattered around them.

118 Tauri – R.A. 05h 29m 17s, Dec. +25° 09' 01"

118 Tauri is a fairly easy-to-split double star with components of magnitude 5.4 and 6.7 separated by 4.7". It will take some magnification to split this one, but I got it easily in my 10" scope at 140x.

NGC 1746 – R.A. 05h 03m 50s, Dec. +23° 46' 00"

NGC is a somewhat sparse (~20 stars) but still fairly prominent open cluster high in the horns of Taurus the bull. It stands out nicely in binoculars, and at 42' is a bit large for anything but your lowest power in a telescope. Its stars range from 5th to 9th magnitude for an overall magnitude of 6.1. As such it's just barely visible to the naked eye from a dark site.

There's a nice double within it (mags 9.5 and 9.9, 20" separation), and a fainter but nearly perfect equilateral triangle on the western edge.

Two clumps of stars within this cluster have their own NGC designations: 1750 and 1758.

NGC 2174 & 2175 – R.A. 06h 09m 42s, Dec. +20° 30' 00"

This is a relatively bright (7th magnitude) and relatively large (40' x 30') nebula called the "Monkey Head" and an open cluster in the same area. The nebula is visible in binoculars (barely, under dark sky) as a half-degree-wide mostly circular glow, while the cluster is a sparse scattering of about 20 stars either superimposed or actually within the nebula. Nobody seems to know, and in fact there's considerable confusion over which number goes with which part. The cluster is also called Collinder 84.

I find the nebula easier to see than the cluster, at least with a scope of 10" or larger in

a dark sky. A nebula filter will definitely help pull this one out. Use low power; it's bigger than you'll expect, and it's easier to see when it sweeps across a wide field of view.

M1 – the Crab Nebula – R.A. 05h 34m 28s, Dec. +22° 00' 53"

Okay, this is neither big nor bold nor bright, but how could I not include it? We always stop for a look, don't we, no matter what the observing conditions? And under a dark sky with a nebula filter, it does indeed look beautiful. So have a look the next time you're in the area and see what you can pick out. Under ideal conditions you'll see an oval hazy patch that's underwhelming until you start thinking about what you're looking at.

This is the remains of a star that blew up in 1054 AD. It was visible in daylight back then! The debris cloud has been expanding ever since, and now covers an area 13 x 11 light-years across. Just to impress you with the math: the edge of that cloud is moving at over 1000 miles per second.

Down inside, a pulsar is blinking 30 times a second. It's actually visible in a big enough telescope. People have made occulting disks that cover the eyepiece at regular intervals, slowing the blink rate to a frequency the human eye can detect, and they've watched it wink on and off. (We're talking about the 90-inch Bok telescope on Kitt Peak, not your average back yard scope, but still, it has been done.)

Σ 742 – Struve 742 – R.A. 05h 36m 25s, Dec. +21° 59' 29"

Struve 742 is a tiny little double just half a degree to the east of the Crab Nebula. On the Pocket Sky Atlas it's not labeled, but it is marked as a tiny double just to the left of M1. Its components are mags. 6.9 and 7.5, with a separation of 4.2", so it's a bit of a challenge, but well worth a try when you're in the area. I'm able to split it at 140x, and split it easily at 200x in a 10" scope. The two stars look slightly uneven in brightness, but are pretty close.

Y Tauri – R.A. 05h 45m 39s, Dec. +20° 41' 42"

Y Tauri is a carbon star between Zeta Tauri and the end of Orion's club. It's also quite variable, so sometimes it's an easy find and sometimes not so much. At its brightest it's magnitude 6.8, but at its dimmest it's 9.2. Like most carbon stars, it's reddest when it's dim.

119 Tauri – R.A. 05h 32m 13s, Dec. +18° 35' 39"

119 Tauri isn't quite a carbon star, but it's nice and orange. In fact, it's considered the reddest naked-eye star in the sky. At magnitude 4.4 it might not be naked eye visible from town, but out in the dark you might be able to notice a ruddy tint to it. In binoculars or in practically any telescope it's a barbecue coal.

Chi (χ) Tauri – R.A. 04h 22m 35s, Dec. +25° 37' 46"

Chi Tauri is another neat double about two thirds of the way between the Crab Nebula and the Pleiades. Its components are mags. 5.4 and 8.6, so there's some difference in brightness, but their separation of 20" makes this an easy split. The primary is white, but the secondary is distinctly orange, sort of a reverse Albireo.

I like this one for a special reason: I discovered it myself when I was looking at Venus in twilight on April 12, 2020. The stars were just coming out, and there below and

to the right of Venus was this pretty double. Venus has moved on, but I keep coming back to Chi Tauri.

The Pleiades (M45) – R.A. 03h 46m 58s, Dec. +24° 06' 48"

Okay, this makes up for the Crab Nebula's dimness. This is without question the best open cluster in the sky, bar none. Tight enough to just fit in a low-power field, bright enough to see by naked eye, filled with bright stars, strings of stars, clusters within the cluster, and even surrounded by a faint reflection nebula that you can see under dark enough sky; the Pleiades has it all.

Called the Seven Sisters, only six Pleiads are easily visible by naked eye. If your eyes are sensitive enough to see more, you'll probably see 9, or even a dozen. Nobody has a clue why it's called the Seven Sisters, although that doesn't stop people from putting forth theories.

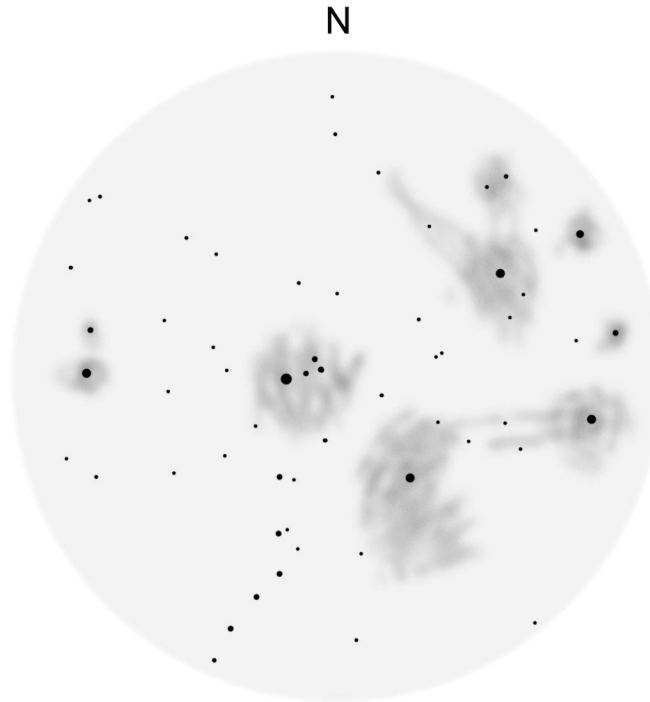
In binoculars or a telescope you'll see dozens of stars. One prominent chain runs out of the cluster to the south, and is often called the Waterfall. There's a nice little triangle near Alcyone, the bright star more or less in the center of the cluster.

We used to think the reflection nebula was the remnant of the cloud of gas and dust that the cluster formed in, but more recent observations have shown that the original cloud dissipated long ago and the current one is just a random cloud that the cluster is passing through on its way around the galaxy. Its motion will eventually carry it toward the feet of Orion several million years from now.

The reflection nebula can be seen in a medium-sized scope under dark sky, but it's easy to confuse atmospheric moisture for the nebula. The way you tell for sure that you're really seeing the nebula is to look at Atlas and Pleione, the bright star and somewhat dimmer one above it off by themselves to the east of the others. There's not much nebula around those two, so if you're seeing those with fuzz around them, you're seeing moisture in the air or dew on your lens or mirrors. But if those two are in the clear and the other bright stars have a faint glow around them, you're seeing the real thing. Merope, the south-central bright one, has the most readily visible nebula around it.

The distance to the Pleiades has been variously measured at anywhere from 380 to 600 light-years, but recent measurements have closed in on what seems to be an accurate figure of 446 light-years.

The Pleiades lie close enough to the ecliptic that the Moon passes through fairly often. It's great fun to watch its stars being occulted by the advancing limb of the Moon and reappearing up to an hour later on the other side.



The Pleiades

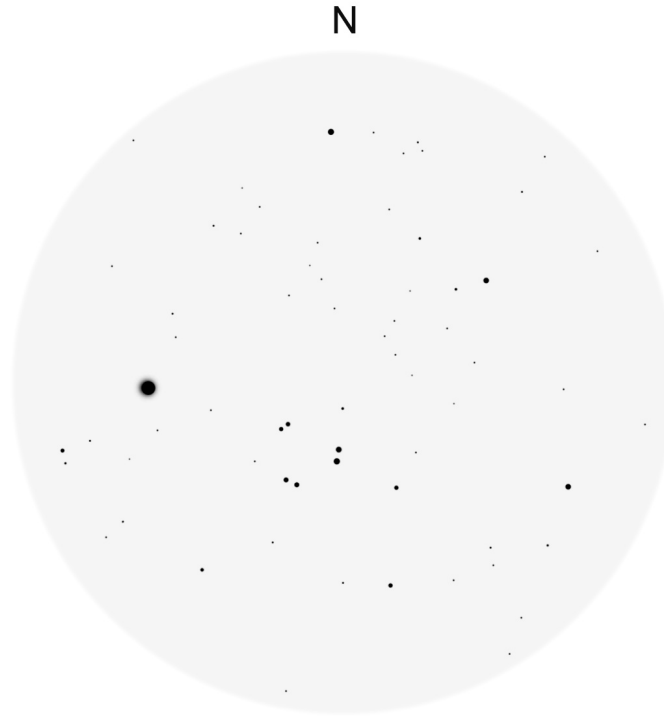
The Hyades – (Caldwell 41) – R.A. 04h 26m 52s, Dec. +15° 51' 52"

The Hyades make up the triangular head of Taurus the Bull. They're an open cluster a lot like the Pleiades, but closer so they appear more scattered. (The Hyades are about 150 light-years away, while the Pleiades are 446.)

Bright orange Aldebaran is the leader of the pack, with several other red stars forming the north end of the V and many blue ones scattered throughout.

One of my favorite asterisms within the Hyades is the group of six that make up what I call the Yield Sign about a degree to the west of Aldebaran. They form a triangle with the corners cut off, a very distinctive grouping that you'll never forget once you've seen it.

The Pleiades and the Hyades lie close enough to the ecliptic that the Moon often sweeps through them, occulting stars one after the other and turning them loose again an hour or two later. It's great fun to watch the Moon drift through these clusters. You really get a feeling for the solar system in motion.



The Hyades, with the Yield Sign below center

Davis's Dog – R.A. 04h 22m 30s, Dec. +21° 32' 00"

Inbetween the Pleiades and the Hyades, more straight north of the Hyades, lies a large (3° wide) field of 4th and 5th magnitude stars. They're too wide and sparse to be much of a cluster, but they do form an asterism that the late Massachusetts amateur John Davis saw as a dog. It's nose down and to the right, with omega Tauri as its nose and 72 Tauri (marked as Ced 34 in the Pocket Sky Atlas) as the tip of its tail. This is too large to see in a telescope, but binoculars show it nicely.

Σ 376 – Struve 376 – R.A. 03h 20m 20s, Dec. +19° 43' 47"

On the Pocket Sky Atlas, about 7° to the southwest of the Pleiades, you'll see a cluster of double stars. Only Tau (τ) and 63 Arietis are labeled, but you'll see another double to the lower right of them, and a tiny little double below a regular star below that. Struve 376 is that latter double. The others are all too tight to split in anything but a huge telescope, but Struve 376 is pretty easy. It's not super bright, with components of magnitudes 8.4 and 8.3, but they're well within reach of most telescopes. With a separation of 7.1" they're definitely splittable, and the nearly even brightness makes for a pretty sight.

NGC 1647 – R.A. 04h 45m 53s, Dec. +19° 05' 52"

This is a nice, if somewhat sparse, open cluster situated right between the horns of Taurus the bull. It's good in binoculars or a low-power telescope view. There's an easy double with a 30-second separation near the center, and another fainter double of about the same separation nearby.

NGC 1807 and 1817 – R.A. 05h 10m 43s, Dec. +16° 31' 00"

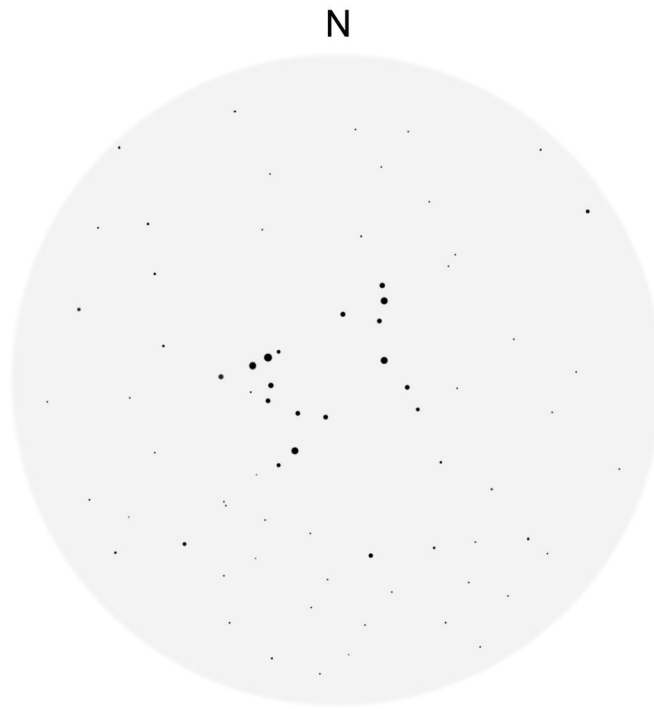
These two open clusters fit nicely within the field of a low-power eyepiece, and they're bright enough to show up in just about any telescope. NGC 1807 is coarsely populated with 9th and 10th magnitude stars in a rough cross, while NGC 1817 is finer and more populous.

The neat thing for me (an avowed double star nut) is the pair of double stars just half a degree to the southeast of the clusters. They're not marked on the Pocket Sky Atlas, but they're readily visible in the eyepiece. They're about equal in separation (about 33" and 37") and in brightness (10th magnitude), so they're a pleasing double-double next to a double cluster.

NGC 2169 – The 37 Cluster – R.A. 06h 08m 22s, Dec. +13° 56' 56"

This open cluster forms the number "37" in the eyepiece. No kidding. It's uncanny. It looks just like a number printed with an old-fashioned dot-matrix printer. If Douglas Adams had decided that 37 was the answer to Life, the Universe, and Everything (instead of 42), we'd have hailed him as a visionary and started a religion. It's that distinctive.

The brightest star in the top bar of the 3 is a tight double, Struve 848, with magnitudes of 7.3 and 8.2 and a separation of 2.5". You'll need a lot of magnification (probably over 200x) and good seeing to separate these two.



The 37 Cluster

NGC 2194 – R.A. 06h 13m 44s, Dec. +12° 47' 55"

NGC 2194 is an open cluster at the feet of Gemini, very near the 37 cluster. It's relatively bright at magnitude 8.5, and while it doesn't have many stand-out stars, it's a relatively rich, delicate cluster of 80 stars or so with a long line of 10 stars or so pointing at it from the southwest. This is one to study a while just because it's beautiful, especially

in larger scopes.

NGC 1662 – The Klingon Battle Cruiser – R.A. 04h 48m 25s, Dec. +10° 55' 54"

NGC 1662 is a long string of stars with three clumps hanging down below it, giving it a remarkable resemblance to a Klingon battle cruiser from the original Star Trek TV series. There's a horizontal bar of stars that make up the wings, and three downward clumps of stars that make the warp nacelles and the bridge. They're a bit distorted; it has clearly seen some action. Trekkies can argue whether it looks more like a battle cruiser or a Bird of Prey.

Meissa – the Head of Orion – R.A. 05h 03m 06s, Dec. +09° 55' 59"

Yeah, I always call this one "Melissa," too. Whatever you call it, it's the head of Orion and it looks pretty cool in a telescope, or even binoculars. It's a string of five stars running north to south, a bright one at either end and three in the middle slightly offset from a straight line. They're half a degree from end to end, and they're bright and bold and, well, cool. Ever wonder why stars seem to line up in strings? Do they form that way, or drift into alignment, or what? This one always makes me ponder it.

There's an entire cluster around these five called Collinder 69, but the five brightest stars are the main attraction here.

If you're in for a bit of a challenge, the northernmost star of this string (the actual "Meissa") is a fairly tight double star. The magnitudes are 3.5 and 5.5 and their separation is just 4.4", so go for high power on a night of steady seeing. Their position angle is 44 degrees, so the secondary might get lost in the diffraction spike from the primary if your spider vanes are angled at 45, as some are.

Betelgeuse – R.A. 05h 55m 08s, Dec. +07° 24' 23"

This one is big, bold, bright, and certainly attractive enough to qualify for inclusion, but the real reason I always take a look at Betelgeuse when I'm out is because I want to see the first flash of light when it explodes.

Yeah! Betelgeuse is going to go supernova any time now. Any time being, well, any time within the next million years or so. It has run out of fuel at its core and is oscillating the way red giants do before they collapse and blow up. Betelgeuse is big enough for us to measure its diameter, and that has been shrinking lately, so the process could have already begun. When it goes, it will be the brightest star in the sky except for the Sun. It'll be awesome!

And no, it probably won't kill us all. It's not close enough for that, and its rotation axis doesn't point at us, so the jet of gamma rays that shoots out from supernovae will sterilize some other solar system. We'll just get the light show to end all light shows, and an expanding supernova remnant that'll quickly outclass the Orion Nebula as the coolest object in that part of the sky.

In the meantime, it's a pretty neat, very orange star. It's fun to watch it twinkle near the horizon, although it doesn't give you the blue flashes that Capella or Sirius do.

In late 2019 and early 2020 Betelgeuse dimmed dramatically, going from 0.3 magnitude down to 1.5 over the course of a couple of months. Everybody held their breath, wondering if this was a precursor to the big flash, but so far...

32 Orionis – R.A. 05h 30m 47s, Dec. +05° 56' 53"

32 Orionis is a challenging double. It's two relatively bright components (mags 4.2

and 5.8) are separated by only 1.4", so you need some aperture and a night of steady seeing for this one. The two components will be just outside the glare of one another. I don't see much color difference between these two.

33 Orionis – R.A. 05h 31m 15s, Dec. +03° 17' 32"

33 Orionis is a little easier split than 32 (above). Its components are a little dimmer (5.5 and 6.7 mags.) and farther apart (1.9"), both of which make it easier to tease apart. This pair will take at least 150-200x, but they're a fun split when you manage it.

PSA Charts 16 & 17

Rho (ρ) Orionis – R.A. 05h 13m 17s, Dec. +02° 51' 41"

Rho Orionis is a nice, easy double star with components of magnitude 4.5 and 8.5 separated by a snug but not overly tight 7". Their unequal brightness makes their colors stand out pretty vividly, but unlike most uneven doubles where the dimmer component looks redder, most people see the primary here as yellow-orange and the secondary as bluish.

NGC 2112 – R.A. 05h 53m 45s, Dec. +00° 24' 00"

If you're a Rush fan, this might be your favorite open cluster. It's over on the left flank of Orion, just to the east of M78 by a couple of degrees. It's not marked on the Pocket Sky Atlas, but about 1/3 of the way between 60 Orionis and M78.

Whether you're a Rush fan or not, this is a pleasing open cluster of about 50 stars that stand out pretty well from the background. It's about the same diameter as the Moon, so it's nice at low to medium power. There are half a dozen relatively bright stars and a bunch of dimmer ones scattered around.

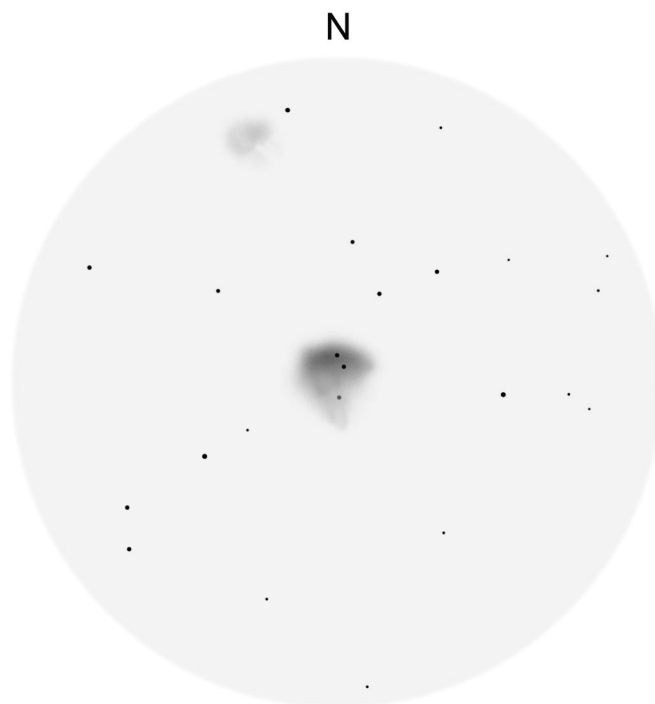
Don't expect to see Barnard's Loop while you're looking at (or for) this cluster. It's much too faint and much too diffuse to show up in a telescope.

M78 – R.A. 05h 46m 42s, Dec. +00° 03' 00"

M78 is one of the brightest reflection nebulae in the sky. A reflection nebula doesn't glow from ionized gas re-radiating the energy that ionized it; it glows instead by simply reflecting the starlight that hits it. You can see the two stars that are casting most of M78's light; they're off-center to the north end of the nebula. That end is the brightest, and the rest of the nebula trails away to the south in a cone shape that gives it a cometary appearance. There's a third dimmer star near the nebula's southern edge.

Stars are forming within this nebula. Most are still hidden within the gas and dust, but infrared studies have discovered nearly 200 young stars in several still-developing clusters.

M78 is part of the "Orion complex" of gas and dust that fills most of the constellation of Orion. The complex lies about 1,600 light-years away.



M78

NGC 2024 – The Flame Nebula – R.A. 05h 41m 40s, Dec. -01° 52' 01"

If M42 weren't nearby, the Flame Nebula might be the most famous nebula in Orion. It's not as bright, and it's right next to the glare bomb of Alnitak, but if you put Alnitak out of the field of view you can usually spot the glow of the nebula and the dark dust lanes that give it the look of a flickering flame. (Assuming you're not competing with too much sky glow, that is, and you're using enough aperture to pull it out.)

The Flame Nebula is both an emission nebula and a reflection nebula, so aggressive line filters like UHC or OIII filters will actually dim it down. If you're fighting a lot of light pollution you might try a wideband skyglow filter, but narrowband filters don't help this one much.

The Flame Nebula is part of the same cloud that includes the famous Horsehead Nebula (which is far too dim to include in this book).

NGC 1981 – The Halloween Cat – R.A. 05h 35m 06s, Dec. -04° 20' 01"

NGC 1981 is a large, loose open cluster one degree north of the Orion Nebula. It's at the top of the sword of Orion, about where a jeweled buckle on the scabbard would go. It's just above the Running Man Nebula (described below). It's not particularly showy, but it does have several 6th magnitude stars and even more 7th through 9th magnitude stars that add up to about 20 that you can find with a little study.

In binoculars or a wide-field eyepiece this cluster looks a little like a Halloween cat with its back and tail arched.

The tight (4") double star Struve 750 is part of this cluster. With magnitude 6.5 and 8.4 components, this one takes a little magnification to split, but the difference in brightness makes for a nice contrast.

N



NGC 1981, the Halloween Cat, with the Running Man below

NGC 1973, 1975, & 1977 – The Running Man Nebula – R.A. 05h 35m, Dec. -04° 41'

The Running Man Nebula gets its name from the shape of the dust cloud within it. The nebula itself is a reflection nebula (like M78 above), not an emission nebula, so it glows blue in photographs and looks cooler even in a telescope eyepiece. It's one of the brightest reflection nebulae in the sky, but that doesn't mean it's bright; it's considerably dimmer than M42 or M43, and will require some aperture and dark sky to bring it out. A nebula filter doesn't help here, since it's not radiating at a wavelength that a nebula filter enhances.

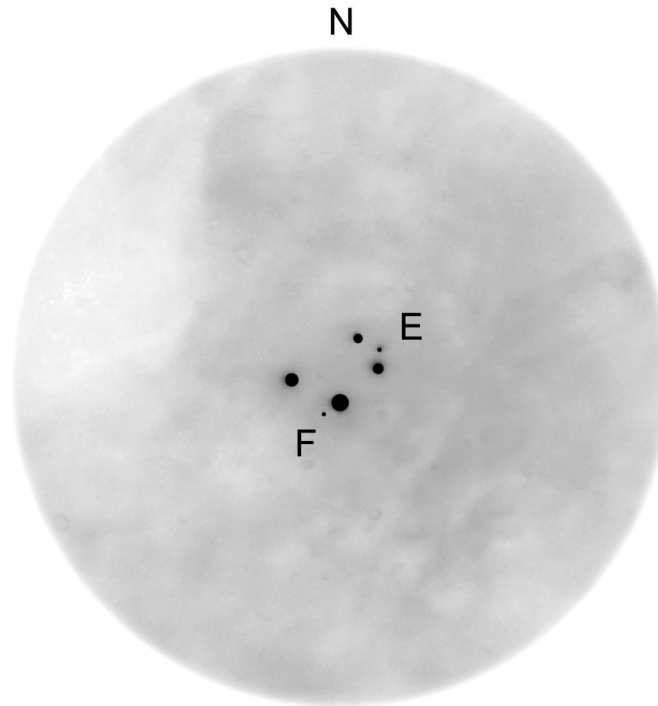
C Orionis is the brightest (mag 4.6) star in the nebula, with 45 Orionis the next brightest at mag 5.2. The other stars within the nebula are mag 7 or fainter, but together they give the whole picture a scintillating glow that makes up for the relative faintness of the nebula.

M42 – the Orion Nebula – R.A. 05h 35m, Dec. -05° 27'

Until Betelgeuse explodes, this is the showcase of Orion. The middle of the sword hanging from Orion's belt, this emission nebula is arguably the best one in the sky. It's visible by naked eye, although it just looks like a fuzzy star, but in binoculars or any telescope it's absolutely stunning. Big sweeping arcs of glowing gas and dust sweep outward and curve around like two hands cupping a precious jewel. That jewel is the Trapezium, a tight group of four stars, the brightest of which is the powerhouse that makes the entire nebula glow.

You can (and should!) spend hours studying the Orion Nebula. At low power you can see its overall structure as the birthplace of hundreds of brand new stars (indeed stars are still forming there), and as you crank up the power you can zoom in on more and more structure within the nebula. A nebula filter (OIII or UHC or even just a skyglow filter) will reveal even more.

At high power (and unfiltered) the Trapezium gives up two more stars, the first relatively easy between the two that make up the narrow end of the rectangle, and the other much more difficult just outboard of the brightest of the four main stars. You need good seeing and high magnification for this, but picking out the “E” and “F” stars of the trapezium is always a kick.



The Trapezium at the heart of the Orion Nebula

M43 – R.A. 05h 35m, Dec. -05° 16'

If M42 were a sea turtle, then M43 would be its head. It's actually part of the same nebula complex, but a dark lane of dust obscures the connection, giving it a separate look. It's shaped like a fat comma, with a single bright (mag 6.5-7.6 variable) star near the center. Like the Trapezium in M42, this star is responsible for lighting up M43.

Rigel – R.A. 05h 14m 32s, Dec. -08° 12' 06"

Rigel is the lower right star of Orion. It's big and bright and fun to watch twinkle. When it's near the horizon it looks like a police car flashing red and blue. Turbulent air acts like dozens of prisms, splitting the starlight into its spectrum and flashing different wavelengths at you at random. In a telescope you'd swear the mothership was making a dive straight for you, lights ablaze. When Rigel rises high enough to steady out, crank up the power and look for its binary companion just 10" away. The difference in magnitude is pretty extreme (0.3 and 6.8), so the secondary will be just outside the glare of the primary, but if the seeing is relatively steady it's usually there as a distinct separate star.

Rigel is good practice for splitting Sirius, whose companion is the same distance and nearly the same brightness (at least in 2019 when I'm writing this), but buried in Sirius's much brighter glare. When I try to split Sirius I always go to Rigel first just to calibrate my eyes.

Omicron² (o²) Eridani – Keid – R.A. 04h 15m 12s, Dec. -07° 40' 15"

Keid is a triple star, with two easily splittable components of magnitudes 4.4 and 9.5 and a separation of 83". The secondary is a white dwarf, and the most easily seen of its kind. The secondary has a red dwarf companion of magnitude 11.2 separated by about 9". It takes some aperture and magnification to see all three, but triple stars are rare enough it's worth the trouble.

This triple-star system is only 16 light-years from Earth.

39 Eridani – R.A. 04h 14m 23s, Dec. -10° 15' 30"

39 Eridani is a medium-difficult double star with components of magnitude 4.9 and 8.5 and a separation of 6.3". The difference in magnitude makes for a nice contrast when you do split it (about 150x or more will do), and the color difference is pleasing. The primary is distinctly yellow-orange, while the secondary is white.

NGC 1535 – Cleopatra's Eye – R.A. 04h 14m 16s, Dec. -12° 44' 11"

Cleopatra's Eye is a planetary nebula in Eridanus that's very reminiscent of the more famous NGC 2392 in Gemini formerly known as the Eskimo Nebula, which I now call the "Anorak" (PSA page 25). It sports a similar bright inner shell about 20" across and an outer, more tenuous shell about twice that diameter. At 9th magnitude it's a pretty easy target in even reasonably dark sky, and it takes magnification well, but unlike the Anorak, Cleopatra's central star is difficult to see.

With large aperture scopes and dark sky, without a filter, you might be able to detect a subtle blue-greenish tinge to this nebula, which is what gives it its name.

R Leporis – Hind's Crimson Star – R.A. 04h 59m 36s, Dec. -14° 48' 23"

Hind's Crimson Star is a carbon star, and thus a deep orange-red. It's also a pretty extreme variable, ranging from magnitude 5.5 to 11.7 with a period of about 14 months. There's another periodic cycle superimposed on the first: its maximum brightness varies from 5.5 to 6.5 and back over a scale of 40 years.

This is a huge star: If placed in our solar system its surface would extend into the asteroid belt. Its outer envelope will eventually blow away to create a planetary nebula, leaving a hot white dwarf at its core.

Gamma (γ) Leporis – R.A. 05h 44m 28s, Dec. -22° 56' 24"

Gamma Leporis is a wide (95") double of magnitudes 3.6 and 6.3. They're far enough apart and bright enough to split easily in binoculars, and are in fact so separated that they don't really look like much in a telescope...except for their extreme color difference. The primary is bright yellow while the secondary is distinctly red.

M79 – R.A. 05h 24m 11s, Dec. -24° 31' 29"

M79 is one of the few globular clusters visible in the winter sky. It's almost directly opposite the galactic core, where most globular clusters congregate. It's about 40,000 light-years away, which puts it out in the distant reaches of the galaxy's edge. In fact, recent observations suggest that it may not have originated in the Milky Way at all, but has arrived here with the Canis Major dwarf galaxy, which is currently being captured by the Milky Way.

M79 is easy to find: just start at the top of Lepus's two central stars, go through the

bottom of the two, and keep going the same distance again in the same direction. You'll come across a fuzzy spot at low power, but higher power will bust it into at least a few dozen stars around a tightly packed core.

NGC 1300 – R.A. 03h 19m 41s, Dec. -19° 24' 40"

NGC 1300 is one of the best barred spiral galaxies visible from the northern hemisphere. In dark sky its central bar is readily visible in scopes of 6" or greater. Its two big spiral arms take a little more aperture, becoming fairly apparent in 10" scopes and obvious in larger. At -19° declination it never gets high in the sky for mid-North American observers, but it's well worth the trouble to track down when it culminates. If you like to play the "Which way do the arms spiral?" game with your observing companions, this one is a fine subject.

NGC 1360 – The Robin's Egg or Comet Nebula – R.A. 03h 33m 15s, Dec. -25° 52' 20"

This planetary nebula is pretty low in the south for most northern hemisphere observers, but it's worth tracking down because it's fairly large (7.7' x 5.3') and reasonably bright (mag. 9.6). An OIII or NPB filter really helps pull it out of the background. It's a distinctly oval planetary with an easily spotted (mag. 11.5) central star. With some aperture you can detect mottling in the oval gas envelope, and maybe a hint of the blue-greenish color that gives it its name.

PSA Charts 18, 19, & 20

NGC 1365 – R.A. 03h 33m 37s, Dec. -36° 08' 26"

NGC 1365 contends with NGC 1300 for the title of best barred spiral galaxy in the sky. Its low declination makes it a difficult find for northern observers, so I've seldom seen it, but I'm told it's a delight for people farther south. It's part of the Fornax galaxy cluster, which is also a pretty sight in a large telescope. (The more prominent galaxies in the cluster are mostly 10th and 11th magnitude, so readily seen with some aperture and dark sky.)

NGC 1851 – (Caldwell 73) – R.A. 05h 14m 07s, Dec. -40° 02' 48"

This globular cluster is way far south for northern observers, but it's a neat challenge object. Can you spot it through all that air between you and the horizon and beyond? I was surprised at how well it stood out for me just above the trees. It's magnitude 7.1 and about 12 arc-minutes across (about half the size of the Moon), so it's a pretty easy target.

Once you find it, can you break the outer regions into individual stars. On a night of good seeing you can manage it, but it's rare. Give it a go and see if you get lucky!

The Large Magellanic Cloud – R.A. 05h 24m, Dec. -69° 45'

The LMC is the largest of the Milky Way's companion galaxies. It's a fairly good-sized galaxy in its own right, measuring about 14,000 light-years across and containing about 1/10 as much mass as the Milky Way. It has a central bar much like many larger galaxies, but only one rough spiral arm.

The LMC is filled with interesting features, most prominently the Tarantula Nebula (see below). Also, in 1987 a supernova exploded there, providing astronomers with the nearest, most well-observed supernova since the invention of the telescope.

The LMC is 160,000 light-years distant, not quite twice the diameter of the Milky Way. From its vantage point, the Milky Way would be an incredible sight spanning a fifth of the sky and shining over 14 times brighter than the LMC appears to us.

The Tarantula Nebula – R.A. 05h 38m 42s, Dec. -69° 06' 00"

The Tarantula Nebula is the largest and richest star-forming region in the local galaxy group, and one of the largest known anywhere. It far outclasses the Orion Nebula (by a factor of 100!) Open cluster NGC 2070 lies at its center and provides the ultra-hot radiation that makes the rest of the nebula glow. This will be a hotbed of supernovae in coming millennia, so keep an eye on it.

PSA Chart 21

NGC 2403 – (Caldwell 7) – R.A. 07h 36m 51s, Dec. +65° 36' 09"

NGC 2403 is bright enough (8.5 mag.) to be a Messier object, but Messier either missed it or just didn't bother to catalog it. It's well worth a look, though, in just about any telescope. It's a spiral galaxy tilted a little to our line of sight so it's distinctly longer in one direction than another. It's similar to M33 in shape, although a bit smaller. Fortunately its surface brightness is higher than M33's, so it's easier to see. It's flanked by two bright foreground stars, with a dimmer star masquerading as the galaxy's core. Photos show that it's offset from the true core, and is just another foreground star.

NGC 2403 is about 10 million light-years distant and is a member of the M81 galaxy group.

Sigma² (σ²) Ursae Majoris – R.A. 09h 10m 21s, Dec. +67° 08' 03"

This is a very uneven and relatively close double, with stars of magnitude 4.8 & 8.9 separated by 4.5", but it's definitely splittable in most scopes. The primary is yellow-white and the secondary more orange. This pair lies only 66 light-years away, so is relatively close as stars go.

Σ 948 – Struve 948 – R.A. 06h 46m 13s, Dec. +59° 26' 26"

This is one of the rare visually splittable triple stars, but it takes some magnification and steady seeing to split the tight components. The stars are magnitudes 4.5, 6.0, and 7.2, and their separations are A-B = 1.7", A-C = 8.7". So splitting the A-C pair is easy, but A-B can be a trick. It's well worth the attempt, though, for the sense of accomplishment when you finally tease out that third star.

ΟΣ 159 – Otto Struve 159 – R.A. 06h 57m 15s, Dec. +58° 25' 18"

This one, like Struve 460 on PSA page 11, is a tight double that makes a great test of the seeing and of your telescope. Its two components are 4.4 and 5.4 magnitude, so they're a smidgen brighter than Struve 460 and are a little closer to one another in brightness. They're the same separation, 0.7". so the split will be similarly difficult. It's worth a try on a night of steady seeing.

PSA Charts 22 & 23

NGC 2683 – The UFO Galaxy – R.A. 08h 52m 40s, Dec. +33° 25' 21"

This is a spiral galaxy seen almost edge-on, with a conspicuous central bulge. The resulting lens shape with bulge at the center looks like a classic UFO, hence its popular name. It's reasonably bright at magnitude 9.8 and reasonably large at 9' x 1.5', so it's visible in a medium-sized scope.

NGC 2537 – Bear Paw Galaxy – R.A. 08h 13m 13s, Dec. +45° 59' 23"

This is a barred spiral galaxy, but its shape in the eyepiece is more of a roundish blob with smaller blobs around it, giving the overall impression of a bear's paw or paw print. Its magnitude is only 11.6, but that's a bit misleading. I can see this fairly well in a 10" scope, and in a 12" or larger it's pretty impressive.

Psi⁵ (ψ⁵) Aurigae – R.A. 06h 46m 03s, Dec. +43° 34' 34"

There are more psi stars in Auriga than you can shake a stick at. Psi⁵ is a nice double, easy in any scope. Its components are magnitude 5.3 and 8.6, with a generous 31" separation. The primary is yellow, the secondary is reddish, and there's a third field star (dimmer) to the northwest that makes it look like a triple.

NGC 2281 – R.A. 06h 48m 16s, Dec. +41° 03' 56"

This is a nice, big open cluster. It's bright (5.4 mag) and large (25', almost as big as the Moon) and composed of about three dozen easily distinguishable stars. There's a diamond-shaped asterism in the center, all four stars of which supposedly have fainter companions, but I am only able to spot two of them. There's another double a little to the east.

UU Aurigae – R.A. 06h 36m 32s, Dec. +38° 26' 39"

UU Aurigae is a carbon star, so you'd expect it to be deep red, but this one is more orange, or it has been when I've observed it. It varies from magnitude 4.9 to 7.0, so its color probably changes considerably with brightness. Its period is 441 days, so check this one out over the course of a year or so and see what it does.

Theta (θ) Aurigae – R.A. 05h 59m 42s, Dec. +37° 12' 40"

Theta Aurigae is the third brightest star in the oblong circle of Auriga. It's the one that pokes out toward Gemini. It's also a relatively tough double. I include it here because it's the kind of double that makes you jump up and down and howl at the Moon and scare your observing companions when you split it. The magnitude difference is extreme: 2.7 and 7.1, and they're only 3.5" apart, so you need well collimated optics, steady seeing, and high magnification for this one. But when you get it, you'll feel like you've summited Mt. Everest.

And there's a bonus: It's just a field star, but there's one in a direct line with the secondary, but much farther (52") away. Definitely go for this one when you're looking for a challenge.

Σ 872 – Struve 872 – R.A. 06h 15m 37s, Dec. +36° 08' 41"

Struve 872 is a relatively easy double with magnitude 6.8 & 7.5 stars separated by a snug but not overly tight 11". They're just slightly uneven in brightness with a very subtle color difference. I see the primary as slightly yellower than the secondary.

NGC 2419 – (Caldwell 25) – The Intergalactic Wanderer – R.A. 07h 38m 07s, Dec. +38° 52' 04"

A very distant globular cluster, so far away (270-300,000 light-years) that it was originally not thought to be part of the Milky Way. It turns out it does orbit the Milky Way, but it takes about 3 billion years to go around.

This one is hard to bust into individual stars, but it's relatively easy to find. Two medium bright field stars (mags. 8.0 and 7.2) point right at a fuzzy patch the same distance away as the stars are separated (about 4').

The cool factor here isn't in the visual spectacle, but knowing you're seeing the most distant object that's still part of our galaxy that you're likely to see.

Castor – R.A. 07h 34m 35s, Dec. +31° 53' 15"

Castor is the head of the northeastern twin of Gemini. It's a neat triple star and one of the brightest doubles in the sky. The bright pair (mags 1.6 & 2.5) are only 5.2" apart, so they require some magnification and at least reasonably steady seeing. The dimmer (mag. 8.8) companion is 73" away, an easy split.

Now here's the interesting bit: all three stars are spectroscopic binaries. There are actually six stars there! The spectroscopic components are way too close to split in a telescope, but they're there. Imagine being on a planet in one of those stars' solar systems. The C component's pair are red dwarfs orbiting each other so tightly that they only take 20 hours to complete a circuit. That has to look crazy up close.

PSA Charts 24 & 25

Iota (ι) Cancri – R.A. 08h 46m 41s, Dec. +28° 45' 35"

Iota Cancri is a beautiful two-color double up on the northern end of Cancer. It's an easy split with magnitude 4.0 & 6.6 components and a generous 30" separation. The primary is orange-yellow and the secondary is bluish, much like Albirio or Algieba (Gamma Leonis). This is an easy split and a beautiful sight in any scope. It's possible to split it in steady binoculars, too.

Rho¹ (ρ¹) Cancri – R.A. 08h 52m 35s, Dec. +28° 19' 51"

Rho¹ Cancri is just to the lower left of Iota Cancri, and is part of an easy and pleasing binocular double with 53 Cancri 4.6' away. At magnitudes 5.9 and 6.3 they're pretty evenly matched, and they're subtly different in color, with the dimmer star (53 Cancri) looking more yellow-orange than the whitish Rho¹.

Rho¹ has been officially given the name "Copernicus" in honor of the 16th-century Polish astronomer Nicholas Copernicus. It has five known planets, named Galileo, Brahe, Harriot, Janssen, and Lippershey.

Phi² (φ²) Cancri – R.A. 08h 26m 46s, Dec. +26° 56' 07"

This is a relatively easy double. The perfectly evenly matched stars of magnitude 6.2 & 6.2 help with that, as does the snug but not difficult 5.2" separation. This is a very nice pair of headlights a long ways off. (They're actually about 277 light-years away, which is relatively close as far as galactic distances go.) I don't see any colors here; both appear white to me.

Kappa (κ) Geminorum – Al Kirkab – R.A. 07h 44m 26s, Dec. +24° 23' 50"

Kappa Geminorum is the outstretched hand of Pollux, the SE twin of Gemini. It's a nice double star with what would be an easy separation of 7.2" if the stars were equally matched, but these two are magnitudes 3.6 & 8.1, which makes them relatively difficult to split. They will split, though, on a night of good seeing and with some magnification. The primary is orange-yellow in color and the secondary is supposedly blue, but I find the latter too dim to trigger color vision.

Delta (δ) Geminorum – Wasat – R.A. 07h 20m 06s, Dec. +21° 58' 53"

Delta Geminorum is Pollux's pelvis. It's also a medium difficult double of magnitudes 3.5 & 8.5 (a pretty extreme difference in brightness) with only 5.5" of

separation. They're supposedly yellow-white and reddish-purple, and the primary is indeed yellow, but I find the secondary too dim to trigger color vision.

Historical note: Clyde Tombaugh discovered Pluto near Wasat in 1930. It will swing back around in the year 2179. Mark your calendar!

NGC 2420 – R.A. 07h 36m 23s, Dec. +21° 034' 00"

NGC 2420 is an interesting object: It's an open cluster that looks like a globular. It's not particularly large (5' across), but at 8th magnitude it stands out pretty well from the background. Start at low power and see how it looks like a globular cluster, with a few bright stars easily resolved around a mist of fainter stars in the middle. Then zoom in to see that you can actually bust that mist into individual stars all the way to the core. Rather than the hundreds of thousands of stars in a true globular cluster, NGC 2420 has about 50-100 stars.

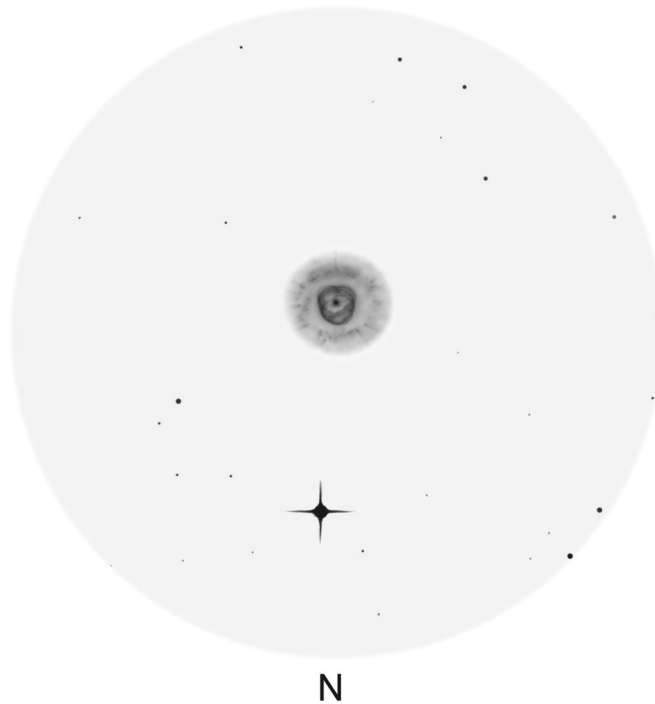
Another fun aspect of this cluster is that no matter how much aperture you throw at it, you can see even fainter stars contributing to the impression of a crowded globular-like core. This is one of my must-observe objects whenever I'm in the neighborhood.

NGC 2392 – (Caldwell 39) – The Anorak Nebula – R.A. 07h 29m 11s, Dec. +20° 54' 37"

This is one of the best planetary nebulae in the sky. It's smaller than the Ring Nebula, and at magnitude 9.2 it's a little fainter, but it's far more complex and visually interesting. It has two distinct rings of glowing gas surrounding its central star, the inner ring elongated and looking vaguely like a human face and the outer ring with its wispy tendrils of gas and dust looks like a big fur parka around that face. The central star is easily visible in just about any telescope. This is a nebula to study and return to often. The more aperture and the darker your sky, the better. It responds well to nebula filters, too, so you can see it even in moderately light-polluted sky.

This used to be called the Eskimo Nebula, but the term "Eskimo" has been deemed derogatory in modern times so people have taken to calling it by various other names. I don't much like "Clown Face," so I'm advocating calling it the "Anorak" nebula instead. That's the name of the fur-lined parka that looks so distinctive.

In early 2018 I got the chance to look at this nebula through the 2-meter Faulkes telescope atop Haleakala on the Hawaiian island of Maui. The view knocked my socks off! I will go to my grave with that image burned into my brain.



NGC 2392, the Anorak Nebula

20 & 21 Geminorum – R.A. 06h 32m 17s, Dec. +17° 46' 42"

This is marked as an unlabeled double just to the east of NGC 1900 in the PSA, but it's a nice easy pair nestled in between the feet of Gemini. The stars are fairly evenly matched at magnitudes 6.3 and 6.9, with a separation of 20". This should look nice in just about any telescope. The Astronomical League even includes this one on their double star list for binoculars, so give it a try with binks if you're up for a challenge.

Σ 932 – Struve 932 – R.A. 06h 34m 21s, Dec. +14° 45' 04"

This is a pretty tight double (only 1.6" separation), but at magnitudes 7.6 and 7.7 it's a well-matched pair that should make detection possible on a night of good seeing. My notes from the first time I split it read "Dim, but rewarding when you finally get it. Tight, tight, tight even at 200x!"

NGC 2355 – R.A. 07h 16m 58s, Dec. +13° 44' 56"

This is an open cluster below Pollux's knee in Gemini. It's 8' across (about 1/4 the Moon's diameter) and somewhat delicate against the Milky Way background, but it stands out reasonably well and responds nicely to magnification. There's an 11th-magnitude double in the NW quadrant.

NGC 2356 is apparently the same cluster.

NGC 2395 just a few degrees to the east is supposedly larger and brighter, but I find it hard to distinguish that one from the background, so 2355 is my choice when I'm in this part of the sky.

M44 – The Beehive Cluster – Praesepe – R.A. 08h 40m 23s, Dec. +19° 40' 00"

The Beehive Cluster is one of the most beautiful open clusters in the sky. It's over a degree across and its combined glow is magnitude 3.7, so it's an easy naked-eye object and spectacular in binoculars. It's too big for a telescope, really, except it's fun to swoop around within it and check out all the clumps and arcs and swirls of stars. Near the center is a V-shaped asterism that I've heard call the "heart," but to me it looks more like a miniature version of the constellation Cepheus or an elongated version of the head of Taurus the bull. Just shy of the point of the V is a nice easy double of 7th magnitude stars with 45" separation.

Depending on the aperture of your scope you'll see anywhere from 50 to a couple hundred stars within the Beehive, ranging from 6th magnitude all the way down as far as you can see.

The Beehive and the Hyades cluster that makes up most of Taurus's head are very similar in composition, age, and motion through space; enough so that it's considered likely that they formed from the same molecular cloud some 600-700 million years ago. The Hyades is closer at 152 light-years, but the Beehive is still relatively close as clusters go at 577 light-years.

Zeta (ζ) Cancri – R.A. 08h 12m 12s, Dec. +17° 38' 50"

Zeta Cancri is a showcase double, with stars of magnitude 5.0 & 6.2 separated by 5.9". The primary looks slightly bluer to me than the secondary, but it's a subtle difference. Others see both stars as yellow.

This system is actually a triple, but the brighter component's separation is only 1.1" at maximum in 2020, so it's a difficult split.

X Cancri – R.A. 08h 55m 22s, Dec. +17° 13' 52"

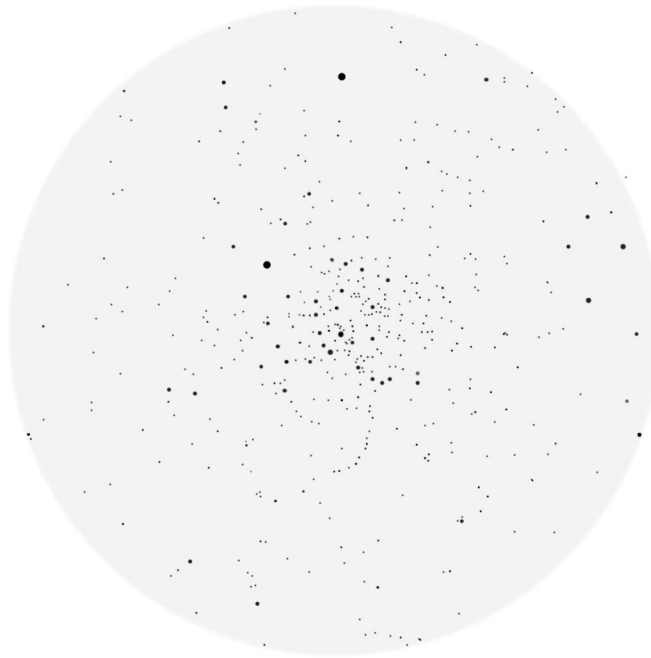
X Cancri is a carbon star, which gives it a deep orange, sometimes red appearance depending upon its brightness. It's a variable, ranging from magnitude 5.6 to 7.5 with a period of 193 days. When it's brightest it's orange, and when it's dimmest it's redder.

M67 – R.A. 08h 51m 17s, Dec. +11° 48' 00"

M67 is one of the most under-appreciated open clusters in the sky. Most people skip right over it for its more showy big sister, the Beehive Cluster (M44), but M67 is beautiful in its own right. It's a rich, tightly packed cluster of some 100 or so 10th to 14th magnitude stars. Many of the stars are arranged in chains, and there are dark gaps scattered throughout as well. There's a single bright (7.5 mag) star at the northeast edge. At half a degree across (about as big as the Moon), this is a standout cluster in binoculars or in a telescope.

M67 is one of the oldest open clusters in the galaxy, at 3-5 billion years.

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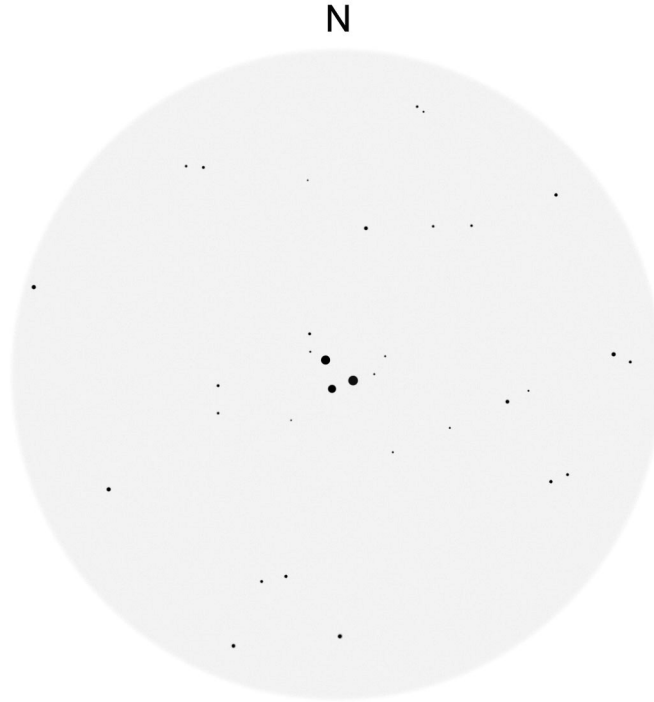


M67

HD 51502 and Friends – 06h 58m 06s, Dec. +14° 13' 39"

The Pocket Sky Atlas shows this as just a tiny unmarked double to the upper left of 38 Geminorum, but this is a real gem. It's a triple star of 7th and 8th magnitude components with enough separation (80", 100", and 120") to just be splittable in binoculars if you steady them on something solid. It's nice in a telescope at low power, too. They make a nearly equilateral triangle, which I always find pleasing in triple stars, and they have subtle color differences of white, yellow, and blue. They're not a true triple, since they lie at different distances, but they're a neat little asterism.

This whole region of the sky is a delight in binoculars or in a wide-field scope. There are countless strings of stars in this whole area of Gemini and Monoceros. It's like someone popped a confetti shooter.



HD 52502 Triplet

38 Geminorum – 08h 54m 38s, Dec. +13° 10' 30"

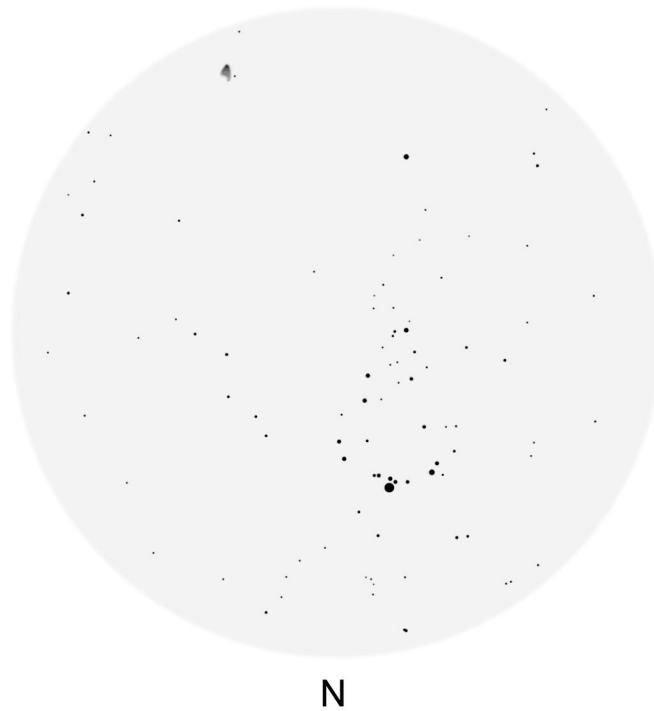
This is an easy double, with components of magnitude 7.8 and 4.7 separated by 7.3", which is just enough to make them interesting. The primary is yellowish and the secondary bluish.

The Christmas Tree Cluster (NGC 2264) – 06h 40m 57s, Dec. +09° 52' 55"

The Christmas Tree Cluster is a big (half a degree), showy cluster just south of the feet of Gemini. The base of the tree is the bright (4.7 mag) star 15 Monocerotis. The tree itself is composed of a dozen or so medium bright stars scattered in a tall triangle with the point directly to the south of 15 Mon. The top of the tree is capped by a 7.1 mag. star that stands out nicely for a tree topper. The tree will be upside down in binoculars, right side up in a Newtonian scope.

15 Monocerotis, the base of the tree, is a relatively difficult to split double star because of the difference in magnitudes (4.6 and 7.8) and tight (2.9") separation, but it does split at high power.

The Cone Nebula is right at the top of the tree, but it's a tough find in even the largest scopes.



The Christmas Tree Cluster, with Hubble's Variable Nebula to the upper left.

Σ 953 – Struve 953 – R.A. 06h 41m 09s, Dec. +08° 59' 11"

This is a nice double star just off the top of the Christmas Tree. It's marked on the Pocket Sky Atlas, but not labeled. It's the one next to the final "a" on the label "Hubble's Variable Nebula." To find it in the eyepiece, start at the trunk of the tree and go through the top of the tree, and keep going in the same direction for one more tree's worth. It's fairly bright (7th magnitude, with components of 7.7 and 7.1), and is in fact the brightest star anywhere nearby (beyond the top of the tree). The separation is 7", which is medium tight but easy enough to split.

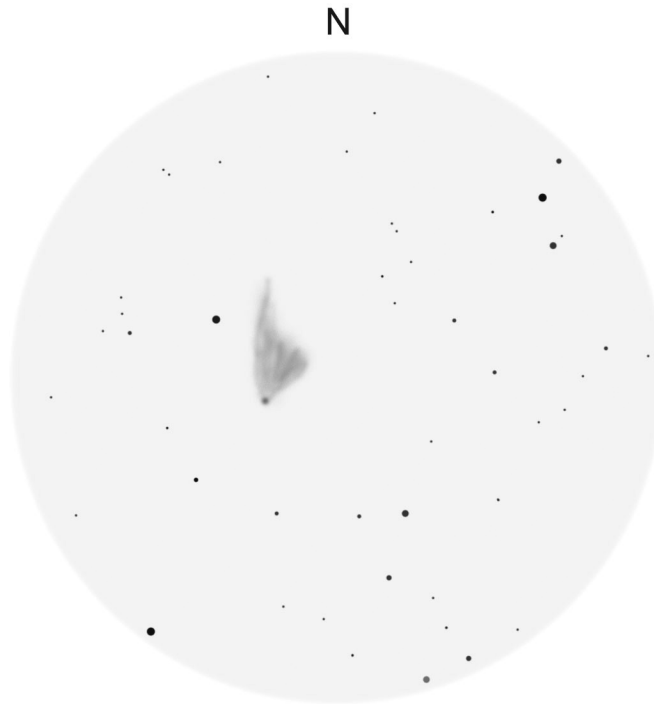
When you do split it, you'll notice a beautiful, if somewhat subtle, difference in color. I see the slightly brighter component as yellow and the dimmer one as blue.

NGC 2261 – (Caldwell 46) – Hubble's Variable Nebula – R.A. 06h 39m 12s, Dec. +08° 45' 00"

This is one of my favorite nebulae. It's a reflection nebula, and the star that lights it up is at one edge of the nebula, giving it a bright point with a big fan of light leading away from it that looks for all the world like you expect a great comet to appear if it were far off in the distance. The star is a variable, plus it's orbited by dense clouds of dust and gas, so the intensity of the light reaching the nebula varies with the star and its obscuring gas. Time lapse photos show shadows from the gas clouds sweeping through the nebula at speeds faster than light! (This is possible because the shadows aren't physical objects; they're shadows of objects moving slower than light, but a long way away.)

This is a small nebula (4' x 2') so it requires magnification and some aperture to see detail in it, but a large scope at high power will show striations and mottling within the nebula. It's brighter on the west side, tailing off to the north.

It's fairly easy to find if you start at the Christmas Tree Cluster and go off to about 10 or 11 o'clock about 3/4 of a degree (assuming the Christmas Tree is standing upright).



Hubble's Variable Nebula

NGC 2251 – 06h 34m 37s, Dec. +08° 21' 55"

I include NGC 2251 not because it's BBBB in its own right (it's kind of sparse, although it does stand out relatively easily from the background), but because there's a nice asterism to the south of it, between 2251 and the bright stars 13 and 14 Monocerotis. The asterism is a big V of stars that looks to me like a flock of geese heading south for the winter.

NGC 2252 – 06h 34m 41s, Dec. +05° 21' 55"

In the Pocket Sky Atlas (and probably other maps as well), this open cluster looks like the runt of the litter among all the larger Collinder clusters surrounding it. In the sky, it's another matter. The Collinder clusters are hard to distinguish from the rich field of background stars, so they're not much to look at, but NGC 2252 stands out well. It's soft and delicate, but nice, made up of a couple swirls of stars.

The real highlight, though, is the great little equilateral triplet of 8th and 9th magnitude stars just to the east of it by a quarter degree or so. Their separations are 30, 34, and 40 arc-seconds, so they're an easy split, and their close-to-symmetrical arrangement is very pleasing to the eye. This is what we all think triple stars ought to look like.

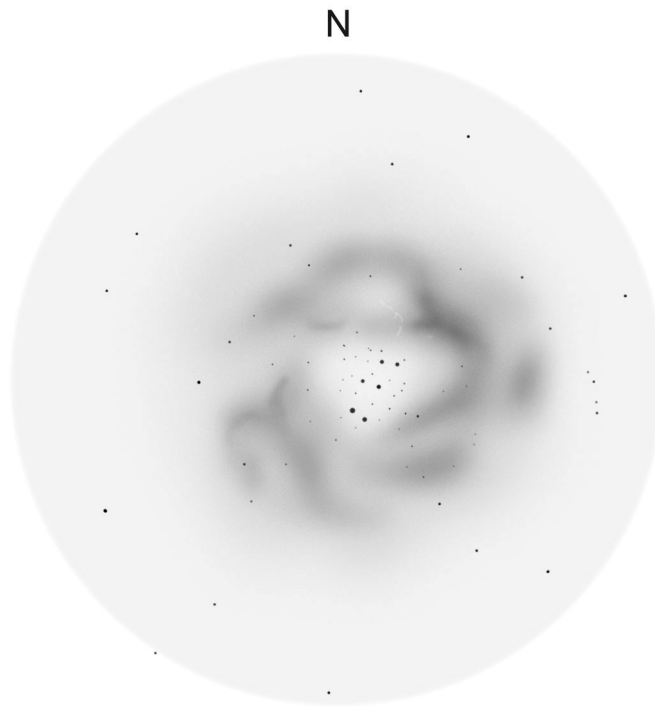
Rosette Nebula – (Caldwell 49 & 50) – R.A. 06h 31m 54s, Dec. +04° 56' 55"

This is a big and beautiful nebula! It's not exactly bold and bright, however, because it's so large that its light is spread out across the entire field of view. It so big (over a degree across) you'll want your lowest magnification, widest-field eyepiece just to make

it out. An OIII filter or narrowband filter or even just a skyglow filter helps draw it out from the background. The northwest side is the brightest, but in a dark sky with some aperture and a filter you can usually trace it all the way around. You can see brighter and darker knots within it, too. The central cluster contains six bright (6th-8th magnitude) stars, and many fainter ones. This whole area is worth some study.

It's big enough and bright enough to see in binoculars. The cluster stands out nicely; the nebula is just a faint glow, but it's quite evident if you sweep your view back and forth across it.

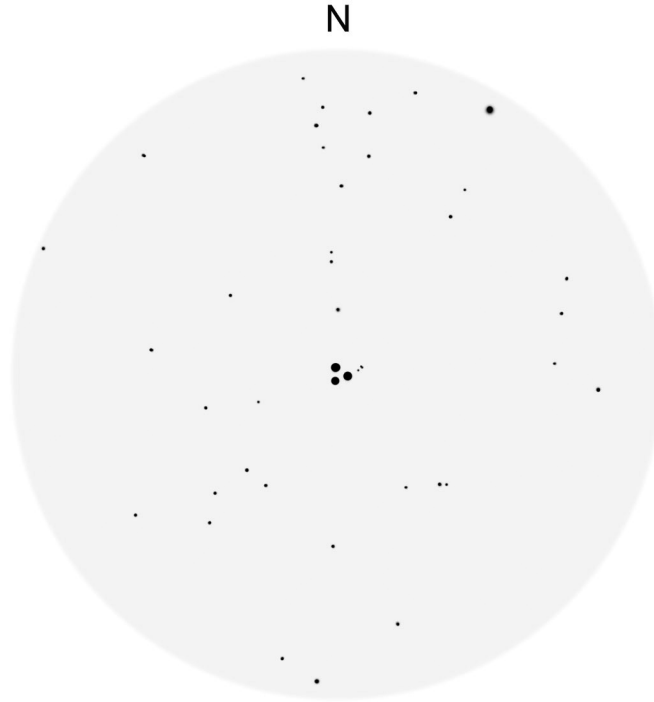
The open cluster within the Rosette Nebula is designated NGC 2244. The nebula itself has several more NGC numbers for its various bright components. The star cluster was born from the nebula, and more stars are still being born there. Their light pressure is blowing out the center of the gas cloud, leaving a central hole about 30 light-years wide. The nebula itself is about 130 light-years across, and its distance about 5,200 light-years.



Rosette Nebula

HD 46867 and friends – R.A. 06h 35m 55s, Dec. +05° 18' 35"

HD 46867, not labeled in the *Pocket Sky Atlas* but just east of the Rosette Nebula in Monoceros, is the anchor of a nice nearly-equilateral triangle. These three split at 30", 34", and 40", so they're pretty tight in binoculars but easy in a telescope.



The HD 46867 triplet near the Rosette Nebula

8 Monocerotis – Epsilon (ϵ) Monocerotis – R.A. 06h 23m 45s, Dec. +04° 35' 29"

This is a nice, easy double star with magnitudes 4.4 and 6.7 and a separation of 12.7". The primary is pale yellow and the secondary white or a soft blue.

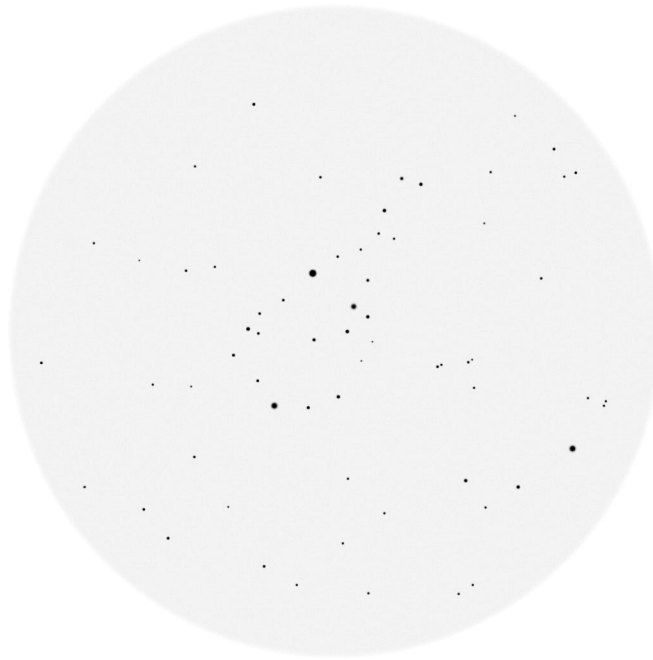
Collinder 91 – R.A. 06h 21m 41s, Dec. +02° 21' 55"

Like NGC 2252 above, Collinder 91 is an exception to the easily missed Collinder clusters near the Rosette Nebula. This one is a little showier than the others, but it also has the neat added property of having its stars arranged in a pattern that suggests something astronomical: an analemma.

What's an analemma? It's the pattern the Sun makes in the sky if you photograph it at exactly noon every day for an entire year. Not only does it climb up and down in the sky with the seasons, but it lags left and right as the Earth speeds up and slows down in its elliptical orbit. It makes a big bowling-pin-shaped figure-8 in the sky.

Collinder 91's major stars are arranged in just such a pattern. The narrow end of the analemma doesn't quite close the loop — it looks like the photographer still has a few weeks left to go — but the rest of it makes a remarkably good figure-8. It's a little over half a degree long, so it's best viewed at low power. I can even make it out in binoculars.

I can also see it as an ampersand (&), or a musical treble clef, but I think it's coolest to think of it as an analemma.



N

Collinder 91, the Analemma Cluster

NGC 2301 – R.A. 06h 51m 44s, Dec. +00° 26' 56"

This is another nice open cluster in Monoceros. It's relatively rich and distinctive, with about 80 stars of 9th to 11th magnitude. It stands out nicely in binoculars as well as in a telescope.

PSA Charts 26 & 27

M48 – NGC 2548 – R.A. 08h 13m 43s, Dec. -05° 45' 00"

M48 is a bright (mag 5.8) open cluster in Monoceros, about a third of the way between the head of Hydra and Sirius. It's naked-eye visible under dark sky, and easily visible in binoculars or just about any telescope. It's about the size of the full Moon and is relatively coarse in appearance. (Compare it to NGC 2506 below for a real contrast between a coarse and a fine cluster.)

There's some historical confusion over whether Charles Messier actually discovered this cluster or not. His coordinates are correct in right ascension but off by 5° in declination. His description of it matches, however, so most people assume he just got his declination figures wrong.

NGC 2232 – R.A. 06h 27m 15s, Dec. -04° 45' 00"

NGC 2232 is a large, coarse open cluster in southern Monoceros, about halfway between Betelgeuse and Sirius. It's not heavily populated, but it does stand out nicely from the background and is visible in just about any sky.

NGC 2506 – (Caldwell 54) – R.A. 08h 00m 01s, Dec. -10° 46' 00"

NGC 2506 is an open cluster in Monoceros about 6° to the southwest of M48. It's relatively bright at magnitude 7.6, but its brightness comes from its high population of stars rather than any intrinsically bright stars. Most of its members are 11th magnitude and fainter. The result is a cluster that looks like fine powder sprinkled on dark velvet, rather than salt crystals. There are three distinct knots of stars within this cluster, each with a brighter (foreground?) luminary and dozens of fainter ones that stand out nicely with averted vision.

NGC 2539 – R.A. 08h 10m 37s, Dec. -12° 49' 00"

Like NGC 2506 above, this cluster is soft and delicate, but it still stands out nicely from the background. The 4.7-magnitude star 19 puppis just to the southeast makes it easy to find. This cluster is sometimes called "The Dish Cluster," but I've never been able to make out a dish. Like most open clusters, this one looks to me like sugar spilled on black velvet. But it's a nice scattering of sugar.

NGC 2479 – R.A. 07h 55m 06s, Dec. -17° 42' 00"

NGC 2479 is a coarse but easy open cluster in northern Puppis, about the same declination as Sirius but several (17) degrees to the east. It's somewhat bowl-shaped, with a nice, easy (9th-magnitude, 20" split) double star to the southwest.

NGC 2509 – R.A. 08h 00m 48s, Dec. -19° 03' 00"

This is a smallish (6') open cluster, and at 9th magnitude it's not particularly bright, so I hesitated in including it here, but it's a pleasing sight in a medium-large scope on a dark night, so I ultimately decided to err on the side of inclusivity. The central portion of the cluster has a V-shape of stars, with a scattering of fainter stars all around it.

M50 – R.A. 07h 02m 41s, Dec. -08° 23' 04"

M50 is a great open cluster to the northeast of Sirius. It's relatively big (a quarter degree across) and full of relatively bright stars (up to 8th magnitude), so it stands out nicely in binoculars. In a telescope it's very rich, filled with stars in long curved arcs. To me those arcs look like the top of a palm tree, or the head of the "Simpsons" character Sideshow Bob.

There are a couple of red giants bracketing the cluster, but most of the stars appear white.

Beta (β) Monocerotis – R.A. 06h 28m 49s, Dec. -07° 02' 04"

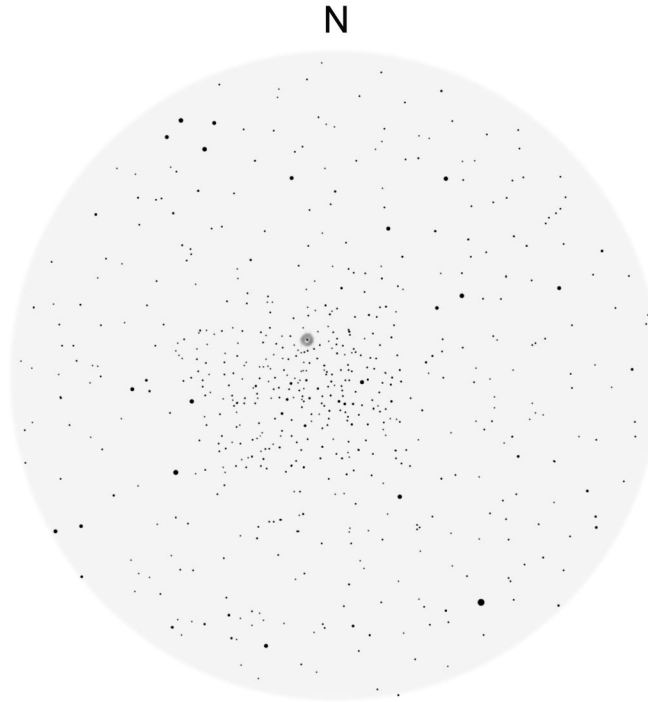
Beta Monocerotis is actually the brightest star in Monoceros. It's also a great triple star easily spotted about 2/3 of the way between Betelgeuse and Sirius. Its components are magnitudes 4.6, 5.4, and 5.6, so they're plenty bright, and their separation is 2.8" and 7.4". The tight pair is a challenge in a small scope, but no worse than the double-double in Lyra.

M46 – R.A. 07h 41m 45s, Dec. -14° 48' 03"

M46 is one of my favorite open clusters, because it has a beautiful planetary nebula right in front of it. The planetary nebula, NGC 2438, is relatively large and easy to spot under dark sky, and one of the cluster stars shines through to masquerade as the central

star (which isn't visible itself in a normal-sized amateur scope).

The cluster itself is a fine collection of over 150 10th-13th magnitude stars spread over a third of a degree. It stands out well in binoculars, and is best appreciated at low power in a telescope...until you zoom in and see how many more stars appear. This is an eye-pleaser at any magnitude, in any aperture. In fact, it's just visible to the naked eye under a dark sky.



M46 with NGC 2438 to the north-northwest

M47 – R.A. 07h 36m 34s, Dec. -14° 29' 03"

M47 is just a degree to the west-northwest of M46, and indeed this is the cluster you're most likely to find first in a search for either one. It's stars are brighter and showier, and at magnitude 5.2 it's even more easily visible to the naked eye than M46. The two of them are close enough together to make it hard to discern both by eye, but they stand out separately in binoculars.

M47 is a much coarser cluster than M46. It's sparser, but showier because its individual components are brighter.

There's a nice double (Struve 1121) of 8th-magnitude stars separated by 7.4" nearly dead center in the cluster, and another double (Struve 1120, mags. 5.7 and 9.6 at 19" separation) on the western edge.

NGC 2423 – R.A. 07h 37m 05s, Dec. -13° 52' 30"

Half a degree to the north of M47 lies NGC 2423, a fainter, sparser cluster that's often mistaken for M46 by people who arrive at it first. It's smaller and sparser than either of the two Messier objects, but still a nice cluster in its own right.

The three clusters will all fit easily in a binocular field, and that may be the best way to appreciate them.

NGC 2359 – Thor’s Helmet – R.A. 07h 18m 35s, Dec. -13° 12' 04"

Some people call this the Duck Nebula. They’ve got to be kidding. With a name like “Thor’s Helmet” already associated with it, they want to call it a duck? Get real. This one is appropriately named after a Norse god because it’s seriously cool.

Thor’s Helmet is an emission and reflection nebula not far from M46 and M47, and it’s probably the best example in the sky of a bubble being blown by a Wolf-Rayet star. The bubble makes up the helmet, and two arcs of nebulosity sweeping away from the bubble make the upswept wings of the helmet.

It’s not overly bright, (11th magnitude), but it’s visible in an 8" scope. A nebula filter helps a lot. And in a big scope, this one’s stunning.

Wolf-Rayet stars are hot, massive, fast-burning stars that explode in supernovae. WR 7, at the center of Thor’s Helmet, will blow someday. Good thing it’s 1800 light-years away.

An OIII filter doesn’t help much with this nebula unless you have a lot of aperture to compensate for the dimming of the nebula as well as the background. An NPB filter works better, or a UHC.

NGC 2360 – (Caldwell 58) – R.A. 07h 17m 42s, Dec. -15° 38' 04"

Caroline Herschel discovered this cluster in 1783, and much like the one we call Caroline’s Rose (NGC 7789 in Cassiopeia), it’s a beautiful concentration of stars amid a rich region of the Milky Way. This one looks to me like a fireworks explosion of the kind called appropriately enough a “starburst.”

It’s about a quarter of a degree across and relatively bright (total combined magnitude of 7.2), so it’s easy to spot in binoculars and very nice in a telescope at low to medium power.

Just 1/3 of a degree to the west lies a 5.4 magnitude star that rests between two obvious arcs of stars like a jewel on a necklace.

Sirius – Alpha (α) Canis Majoris – R.A. 06h 45m 09s, Dec. -16° 42' 58"

Sirius is the brightest star in the sky, other than the Sun. It’s only 8.6 light-years away, so that accounts for some of its brightness, but it’s inherently bright, too. It’s an A-type star 2.4 times as massive and 1.8 times larger than the Sun, and it’s much hotter (9,900 K to our Sun’s 5,800 K).

Sirius is great fun to watch by naked eye when it’s low on the horizon. It’s so bright that when atmospheric turbulence splits its light into spectral colors, it flashes blue and green and red and yellow like a blinking Christmas tree.

Sirius is part of the Ursa Major Moving Group, a loose scattering of bright stars that include most of the stars in the big dipper and a few others scattered around the sky that are all moving in the same direction at the same speed and probably formed together in a cluster millions of years ago.

Sirius is a binary star with a white dwarf companion 11" away. It’s a very difficult double to split, though because Sirius is magnitude -1.4 and the companion is magnitude 8.5, which means Sirius is 9,000 times brighter than the white dwarf. It can be split, though, on a night of good seeing with a scope with good optics. Try it at twilight when the sky isn’t quite dark yet; that often helps. And if you can rig up an obscuring mask at the focal plane of a high-power eyepiece and hide Sirius behind the mask, the secondary (often called “the pup”) can often be picked out more easily.

I've split them with direct vision in a 10" scope before, though, and late at night at that, so you don't necessarily need a mask or twilight sky. Good seeing and good optics are the main requirements.

The two stars have a 50-year orbit and are about as far apart as they're going to get as of my writing this in 2020. They'll stay pretty much the same distance until 2030 or so, after which they'll slowly close the gap until they're only 2.5" apart in 2044.

M41 – R.A. 06h 46m 01s, Dec. -20° 45' 00"

M41 is a wonderful, bright open cluster 4° south of Sirius. At magnitude 4.5 it's easily seen by naked eye, and in binoculars or a telescope it's glorious. It's coarse, with a couple of dozen bright stars defining the cluster and many dozen fainter ones filling it in. It's low in the sky for northern observers, but well worth a look any time it's visible.

h3945 – R.A. 07h 16m 37s, Dec. -23° 18' 56"

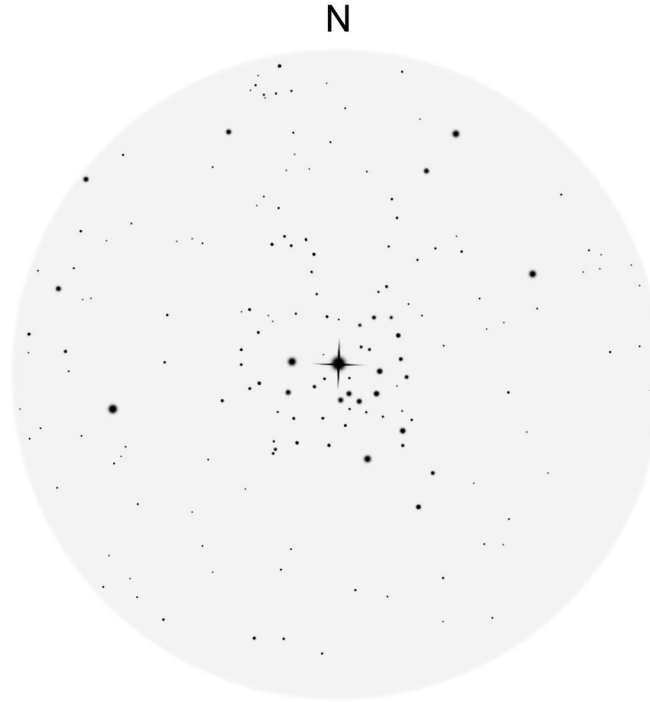
This star goes by many names. The lower-case "h" indicates that it's John Herschel's 3945th entry in his double star catalog. It's also 145 Canis Majoris, and HD (Henry Draper) 56577. It's more commonly known as "The winter Albireo." Whatever you call it, everyone agrees it's beautiful. It's a bright, easy double star (mags 4.8 and 5.8, separated by 26") with two distinct colors: The primary is orange-yellow and the secondary looks blue in comparison.

So when Albireo drops out of the sky, don't despair. The winter Albireo is right here to fill that two-color double gap. (Also note Almach [Gamma Andromedae] on PSA page 2 for a similar double.)

NGC 2362 – (Caldwell 64) – The Tau (τ) Canis Majoris Cluster – R.A. 07h 18m 40s, Dec. -24° 57' 04"

A small but bright open cluster near Sirius, just off the rump of Canis Major the dog. It's remarkable for the single bright star, Tau Canis Majoris, that dominates all the rest. Tau is assumed to be a true cluster star, which, compared to the others, makes it very bright indeed, about 50,000 times brighter than the Sun.

The cluster itself is pretty, too, with a coarse scattering of relatively bright stars surrounding the central luminary. Many of these stars are intrinsically bright, hot O- and B-type stars, which means they're relatively young (~5 million years). Indeed, this is one of the youngest known clusters.



NGC 2362, the Tau Canis Majoris Cluster

NGC 2354 – R.A. 07h 14m 10s, Dec. -25° 41' 00"

Just one low-power field of view to the southwest of the Tau Canis Majoris Cluster you come across the larger but much more delicate open cluster NGC 2354. It requires dark sky to really stand out well from its Milky Way background, but it's a nice, pleasing cluster when you do have the sky to reveal it.

M93 – R.A. 07h 44m 30s, Dec. -23° 51' 00"

M93 is a relatively bright (mag. 6.2), medium sized (10') open cluster in Puppis, just to the east of Canis Major. It has a dozen or so bright stars, and several dozen more of varying magnitudes scattered among them.

PSA Charts 28, 29 & 30

NGC 2451 – R.A. 07h 45m 24s, Dec. -37° 57' 00"

We're getting pretty low in the sky for northern observers, but NGC 2451 is so bright (mag. 2.8!), and large (almost a degree across) that it's visible to the naked eye even through all that air. It's spectacular in a telescope, with about 40 stars ranging from 4th to 11th magnitude. Their wide separation and individual brightness makes this look like a shotgun blast through the veil of night...using buck shot, not bird shot.

NGC 2477 – (Caldwell 71) – R.A. 07h 52m 10s, Dec. -38° 31' 00"

This open cluster is also worth going close to the horizon for. It's a large, rich open cluster that stands out beautifully from the background in even a small telescope. Its stars

are mostly faint and delicate, very reminiscent of Carolyn's Rose (NGC 7789) in Cassiopeia, but there are over 300 of them so they add up to magnitude 5.8.

This cluster is so tightly packed it looks like a globular cluster, but it's actually an open cluster that has hung together for about 700 million years.

There's a line of brighter stars leading off to the northeast that's kind of cool, too, like a trail of ants leading away from the pile of sugar crystals.

IC 2391– The Omicron Velorum Cluster – R.A. 08h 40m 32s, Dec. -53° 02' 00"

This is below my horizon, so I'm going on reputation here, but I've read that this is a bright, coarse cluster that's visible to the naked eye (magnitude 2.6) and very nice in binoculars or a telescope. It's a full degree across, twice the size of the Moon, and while it's sparsely populated the stars you do see are bright and reminiscent of the Pleiades.

Canopus – R.A. 06h 23m 57s, Dec. -52° 41' 44"

Canopus is the second-brightest star in the sky (after Sirius). It's only half as bright as Sirius from our perspective, but that's only because Sirius is much closer. In terms of absolute magnitude Canopus is about 40 times brighter. It's a rare F0 supergiant 65 times the diameter of our Sun and has already burned through its hydrogen fuel. It will either become a red giant or it has already gone through that phase and is on its way to becoming a white dwarf; we don't yet know. It's not quite massive enough to explode as a supernova, so its ending will be relatively quiet when it comes.

NGC 2516 – The Southern Beehive – R.A. 07h 58m 04s, Dec. -60° 45' 00"

The Southern Beehive is so named because of its similarity to M44, the Beehive Cluster in Cancer. The southern version is in Carina, a constellation not visible from mid-northern climes. From south of the equator, though, it's an excellent cluster. At magnitude 3.8 and with a size about equal to the Moon it's visible to the naked eye.

In a telescope you'll find that the stars fall into two camps of differing brightness. The brightest dozen or so shine at magnitude 6 to 8, while the more numerous dimmer ones shine at magnitude 10 or so. There are doubles and even a triple star within the cluster, so it's well worth spending some time here.

PSA Chart 31

Σ 1694 – Struve 1694 – R.A. 12h 49m 14s, Dec. +83° 24' 46"

Struve 1694 isn't labeled on the Pocket Sky Atlas, but it is marked as a double just above the planetary nebula IC 3568 (which is a bit too small to be BBBB). Struve 1694 is all four Bs however, with components of 5.3 and 5.7 magnitude separated by a generous 21". That's wide enough to split in binoculars if you hold them steady enough, and easy-peasy in a telescope. Low power is best so they look closer together. Both stars are hot blue A-types, so you won't see much color here; just two bright points shimmering up near the pole.

M81 & M82 – (M81) R.A. 09h 55m 33s, Dec. +69° 03' 55" – (M82) R.A. 09h 55m 52s, Dec. +69° 40' 47"

While looking for these two galaxies, you might run across NGC 3077 nearby and wonder what all the fuss is about. Keep looking. It gets better. Way better!

M81 and M82 are two of the best galaxies in the northern sky. They're easy to spot even under moderate light pollution, and they're close enough together to see in one low-power field. They also take magnification well, especially M82, which reveals tendrils of dark gas and dust scattered across the galaxy's disk. Astronomers used to think this was evidence of a core explosion, a chain reaction of supernovae in the center of the galaxy, but they later realized that supernovae can't set one another off like that. The streamers are more likely just the result of intense star formation caused by gravitational perturbances as M81 and M82 have interacted over millions of years. So it's star *birth* rather than star death that caused the streamers of gas and dust.

M82 was also considered an irregular galaxy until recently, when spiral arms were discovered in near-infrared images. We now know that it's a relatively normal spiral "starburst" galaxy that's angled just enough and is just dusty enough to look peculiar from our vantage point.

M81 is a more obvious spiral. It's angled more face-on to us, for one thing, and it's also larger and less filled with dark clouds, so its arms stand out better. It takes some aperture (8" or larger) to see the spiral arms, but under a dark sky they do stand out fairly well. It's fun to ask everyone around to see if they can determine which way the spiral goes. Most people will just get a vague notion and will have to guess, but I've found that the guesses are always better than 50-50 in favor of the true spiral direction.

M82 has two foreground stars that always make me wonder if I've discovered a supernova. I nearly did once! On January 20th of 2014, before I had memorized those two stars, I saw three foreground stars in front of M82. I remarked to my observing companion, "Isn't it odd how many galaxies have foreground stars in front of them?" I thought no more about it until the next night, when an undergraduate class of astronomy students in London saw the same thing and reported it to the International Astronomical Union. So they got the discovery, as they should have because they had the wit to recognize it for what it was.

Dubhe – R.A. 11h 03m 44s, Dec. +61° 45' 04"

Dubhe is the star at the end of the Big Dipper's cup, the more northerly of the two pointer stars that direct you to Polaris. It's an easy binocular double, with components of magnitude 1.8 and 7.2 separated by a generous 6.3 arc-minutes. Those two stars are just line-of-sight doubles, but the brighter one, the actual Dubhe, is a genuine double as well.

It's way too tight to split in anything but a large scope, though, with components of magnitude 1.8 and 4.9 separated by only 0.8".

The middle five stars of the Big Dipper are part of a true cluster called the "Ursa Major Moving Group," but Dubhe and Alkaid (the end of the handle) aren't part of the group. They're going in the opposite direction, so over time (millennia) the Big Dipper will become the Big Spatula.

PSA Charts 32 & 33

Mizar & Alcor – R.A. 13h 23m 55s, Dec. +54° 55' 31"

Mizar and Alcor are two of the most well-known pair of stars in the sky (along with Castor and Pollux and my favorites: Zubenelgenubi and Zubeneshamali). Mizar is the middle star in the handle of the Big Dipper, where the handle kinks. Look carefully at this star, and if you have sharp eyes you'll see a dimmer companion very close to the bright one. Averted vision might help. Legend has it that whether or not you could split Mizar and Alcor was a test of visual acuity in the Roman army. If you could see Alcor, you could be an archer; otherwise you were infantry.

Mizar and Alcor are 12 arc-minutes apart, about 1/6 of a degree. If you look at Mizar in a telescope you'll see that it also splits into two components, these two at 14 arc-seconds. They're both brilliant white, one considerably brighter than the other (mags. 2.2 and 3.9).

Surprisingly, despite their wide separation, Mizar and Alcor seem to be a true double star rather than a chance alignment. They're the same distance from Earth (80-85 light years) and moving in the same direction, anyway. And it turns out that each of the three stars is itself a spectroscopic double, so there are actually six stars in the system.

Inbetween Mizar and Alcor lies 7.6 magnitude Ludwig's Star, so named in 1722 by the German astronomer Johann Liebknecht, who thought it was a planet and named it in honour of his patron, the Landgrave Ludwig of Hessen-Darmstadt. Alas, Benedetto Castelli observed it over a century earlier in exactly the same position, which indicated it was a background star. Liebknecht was roundly ridiculed for his mistake, but the name stuck. He did get one thing right: Ludwig's Star isn't part of the Mizar-Alcor system. It's over four times farther away.

M97 – the Owl Nebula – R.A. 11h 14m 46s, Dec. +55° 00' 59"

The Owl Nebula is a fairly large (3.4'), round planetary nebula that has two distinct dark hollows in it that look for all the world like the eyes of an owl. At 9.8 magnitude it's bright enough to see without a filter, but it responds reasonably well to an OIII or UHC filter, especially if you're dealing with city light pollution. It's nice at about 100x.

M108 – R.A. 11h 11m 31s, Dec. +55° 40' 27"

M108 is a nice spiral galaxy tilted to make an oblong oval of light just a little less than a degree to the northwest of the Owl Nebula. Its disk is mottled with dust lanes that make for an interesting irregular appearance, and it has two foreground stars that masquerade as the core and a supernova.

It's actually a barred spiral, but that's not evident in the eyepiece or even in photos.

M109 – R.A. 11h 57m 36s, Dec. +53° 22' 28"

M109 is a barred spiral galaxy just to the east of the bottom of the bowl of the Big Dipper. It's medium bright at 9.7 magnitude, and medium-big at 8.1 x 5.6 arc-minutes. The spiral arms aren't readily apparent except in photos, so you'll probably just see an oval glow.

NGC 3953 nearby is easily mistaken for M109. You might as well check them both out while you're in the neighborhood; they're quite similar, NGC 3953 being just a little smaller but about the same brightness.

NGC 2841 – R.A. 09h 22m 03s, Dec. +50° 58' 36"

This is a small but relatively bright galaxy down in one of the lower paws of Ursa Major, the Great Bear. It's not the most remarkable galaxy in the region (M51 surely takes that title), but it's well worth a look if you're interested in seeing some of the variation in galaxy shapes and sizes in this part of the sky.

NGC 2841 shines at magnitude 9.2, so it's visible even in binoculars, but it's fairly small (6.9' x 3.3') so it won't look like much there. In a telescope, however, it's a distinctly oval patch of light twice as long as it is wide. The spiral arms are wound too tight to see visually, but they show up nicely in photographs. What you might see visually is how the northeast side of the galaxy fades much faster than the southwest side. That's due to the high amount of dust visible on that side of the galaxy. The nucleus is bright and star-like.

M106 – R.A. 12h 18m 56s, Dec. +47° 18' 20"

M106 is a relatively large (17'), relatively bright (8.4 mag.) spiral galaxy that the Pocket Sky Atlas doesn't show as much different from all the other galaxies spilling out of the bowl of the Big Dipper toward Coma Berenices, but it's a showpiece compared to the others. Like the Andromeda Galaxy, it's tipped a bit to our line of sight so we see it as a big oval. It has two prominent spiral arms that are pretty evident with enough aperture and magnification, but even in a small scope this one is a pleasing oval of light.

The core looks stellar at low power, but expands to a wider patch of light with magnification. There's a foreground star at the southern end that looks about as bright as the galaxy core, but doesn't expand with magnification (unless you overdo it!)

The whole area around M106 is lousy with galaxies, many of which you can spot with a slow sweep around, especially to the north, south, and west.

La Superba – Y Canum Venaticorum – R.A. 12h 45m 08s, Dec. +45° 26' 24"

La Superba sits inside the curve of the Big Dipper's handle, right about where the point of your compass would go if you were to extend the handle around in a circle. It's a carbon star, which means it's one of the deepest red stars in the sky. At an average magnitude of 5.3 you can see it directly under dark sky, but you probably won't notice its color until you look at it through binoculars or a telescope. When you gather enough light, you'll trigger your color vision and suddenly you're looking at a glowing barbecue coal.

Seriously, that's about what you're looking at. Carbon stars are so cool that carbon soot collects in their atmospheres and scatters most of the blue light, leaving only the red charcoal glow to escape the photosphere and travel to your eye.

Like many carbon stars, La Superba is variable, ranging from 4.8 to 6.4 with a period of about 157 days. The intensity of its color changes with its overall brightness, so check this one often and see if you can figure out when it's brightest, and when it's reddest.

NGC 4449 – (Caldwell 21) – R.A. 12h 28m 11s, Dec. +44° 05' 36"

I include this not because it's Big, Bold, or Bright, but because it's Beautiful — at least in a big scope. In a small scope it's a dim smudge, but with some aperture and dark sky you see a deeply disturbed, irregular galaxy that looks very much like the Large Magellanic Cloud, which northerners like me never get to see.

NGC 4449 is 14 million light-years away, so it's a bit smaller than the LMC, but you can still make out a roughly rectangular shaped glow of stars and quite a bit of mottling from its many star-forming regions.

Most galaxies are ovals or lines; this one is a box. Well worth a look if you have the aperture for it.

M63 – Sunflower Galaxy – R.A. 13h 15m 49s, Dec. +42° 01' 45"

M63 is one of the better Messier objects. At magnitude 8.6 it's fairly easy to spot, and at 12' x 7' it's big enough to easily see it's a galaxy. Its spiral structure isn't easy to spot, but its surface does look distinctly mottled, like the seeds in a mature sunflower. It has a stellar core amid a bright nuclear bulge.

Even though it's 6° to the south of M51, M63 is part of the M51 galaxy group.

M94 – R.A. 12h 50m 53s, Dec. +41° 07' 13"

M94 is similar to M63 (above) in brightness (8.0 mag.) and size (8' x 7'). It's easy to find about 3° above Cor Caroli. Since it's a little smaller and a little brighter, it stands out from the background a little better. It's a spiral galaxy, but the spiral arms aren't very evident so it looks like an elliptical in a telescope. Its core looks stellar at low power, but becomes non-stellar with increased magnification. This is probably because of the "starburst ring," a region of intense star formation surrounding the actual core of the galaxy. The galaxy's disk falls off rapidly in brightness as you move away from it. To me, M94 looks like an unresolved globular cluster.

M94 is somewhat unusual in that it apparently has very little dark matter, its spiral structure and halo orbits being adequately explained by the bright visible matter that make up the disk.

M94 acts as the anchor of a galaxy group that itself is part of the larger Virgo Supercluster.

Cor Caroli – R.A. 12h 56m 02s, Dec. +38° 19' 06"

Cor Caroli is one of the classic doubles, easy to find and easy to split. Its components are uneven in brightness at magnitudes 2.9 and 5.6, but at 19.3" of separation they're splittable in just about any telescope. There's a subtle color difference, with the bright one appearing white or blue and the fainter one yellowish.

There's another pair of 9th magnitude stars 30' to the east, but these are just an optical lineup. Both pairs are visible in the same field at low to medium power.

Cocoon Galaxy – NGC 4485 & 4490 – R.A. 12h 30m 36s, Dec. +41° 38' 37"

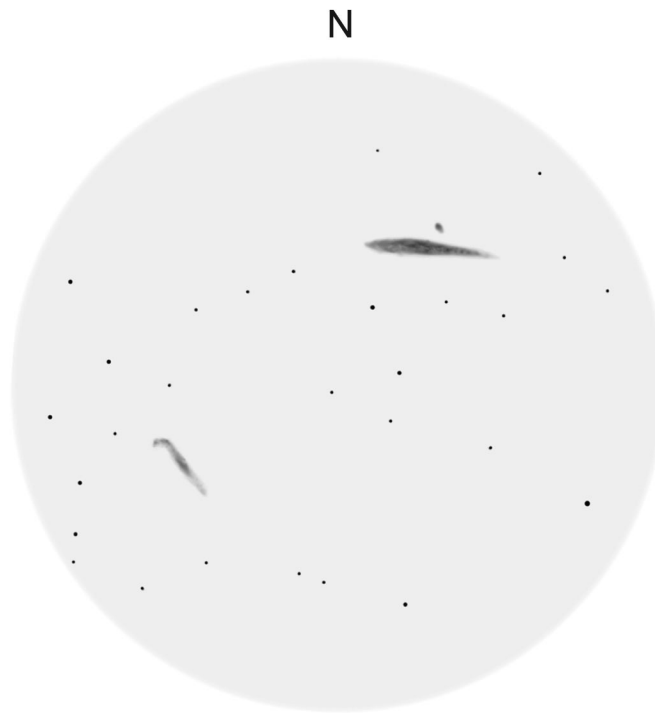
This is a pair of interacting galaxies. At 9.8 and 11.9 magnitude neither is exactly bright, but with enough aperture (say 10" or better) they're definitely worth a look. They have recently collided and have been distorted by their passage through one another. The brighter of the two is a direct-vision object and its twisted oblong shape is clearly visible. The dimmer, smaller galaxy is best seen with averted vision and requires some

magnification to show its lumpy texture.

They make a pleasing pair at about 70x in a 10" scope.

Whale Galaxy – (Caldwell 32) – NGC 4631 – R.A. 12h 42m 07s, Dec. +32° 32' 38"

This galaxy isn't marked as anything special on the *Pocket Sky Atlas*, but it's one of the best galaxies in the area. One look will reveal why: it's relatively bright at 9th magnitude, and it's thicker on one end than the other. It does, in fact, look a lot like a whale swimming along through the ocean of night. It's fairly big, too, extending 15' (half a Moon diameter) from end to end. There's a smaller elliptical galaxy just to the north of it (NGC 4627) which some people call the calf, but to me it looks like a puff of steam from the whale's blow hole drifting back over its body as it swims along to the east. You'll need some aperture and dark sky to see the steam puff. (10" seems to be about the minimum aperture, but it stands out nicely in a 12" or larger.)



The Whale and Hockey Stick galaxies

Hockey Stick – NGC 4656 – R.A. 12h 43m 56s, Dec. +32° 10' 20"

To the southeast of the Whale about half a degree you might find the Hockey Stick if you have dark enough sky and a large enough scope. It's two galaxies (NGC 4656 and 4657) that join together in what looks remarkably like a hockey stick. The main part of the stick is magnitude 10.5 and the blade is 12.4, so this isn't exactly B3 as far as Big, Bold, Bright, and Beautiful goes, but it's a frequent side-stop when visiting the Whale. At low power they'll both fit in the same field of view.

Silver Needle Galaxy – (Caldwell 26) – NGC 4244 – R.A. 12h 17m 28s, Dec. +37° 48' 35"

At 10th magnitude this is one of the fainter objects in this catalog, but it's pretty cool

if you have enough aperture to see it well, so I'm including it. It's an edge-on spiral galaxy that's so thin it looks like a little slash in the fabric of the night. Unlike NGC 891 or 4565, this one has no discernable dust lane cutting through it, at least not until you get into serious (like meter-scale) aperture. Averted vision really makes this galaxy stand out.

NGC 4214 – R.A. 12h 15m 38s, Dec. +36° 19' 43"

NGC 4214 is just a degree and a half to the south-southwest of the Silver Needle Galaxy. It's about the same brightness, but smaller, which means it actually stands out better. And rather than being a long skinny streak, this one is an irregular blob with bright and dark mottling all through it. Even photographs show it that way. The mottling is due to large regions of star formation scattered throughout the galaxy's irregular shape.

Lalande 21185 – R.A. 11h 03m 19s, Dec. +35° 58' 16"

Lalande 21185 is red dwarf star that's remarkable for two reasons: at 8.31 light years away it's the fourth-closest star to the Sun, after the Alpha Centauri system, Barnard's Star, and Wolf 359; and it's the brightest red dwarf in the northern hemisphere. It has the 8th largest proper motion, so you can (and should!) track it from year to year as it moves across the sky. At magnitude 7.5 it's easily visible in any scope or binoculars, and it's noticeably red (although not as red as a carbon star!)

Since 1996 there have been various claims of planets discovered around it, but none have been confirmed to date.

NGC 3184 – R.A. 10h 18m 17s, Dec. +41° 25' 28"

NGC 3184 is a spiral galaxy seen nearly face-on. It's a classic spiral, with arms reaching all the way in to the core and stretching all the way out to the outer fringes. As such, it's often called the "Little Pinwheel" galaxy since it resembles M101, the big pinwheel, on the other end of Ursa Major.

At 9.5 magnitude it's bright enough to see in binoculars, and it shows up well in just about any telescope. It has two bright knots of star-forming regions that have NGC numbers of their own: NGC 3180 and 3181.

Alula Australis – Xi Ursa Majoris – R.A. 11h 18m 11s, Dec. +31° 31' 45"

Alula Australis is a bit of a challenge. The stars are relatively evenly matched (3.8 and 4.3), but they're only 2" apart. They're worth splitting, though, and sketching with some background stars for reference, because this system has an orbital period of only 60 years. If you keep an eye on it, you'll see about 6 degrees of motion per year. Within three or four years, that should be enough to definitely tell it has moved. And if you're starting out young, wouldn't it be cool to watch it go all the way around?

Alula Australis has a neat bit of history attached to it as well: it's the first binary (i.e. true double rather than just an optical double) star to be recognized as such (by William Herschel in 1780) and the first one to have its orbit calculated (by Felix Savary in 1828).

Another neat (and more recent) discovery: Both components are spectroscopic binaries.

That long string of galaxies

You may notice that long string of galaxies stretching from the bowl of the Big Dipper down through PSA page 32 into Coma Berenices and wonder why I've only mentioned a few of them. That's because the rest are pretty dim. On the other hand, they

are kind of fun to sweep through with a wide-field eyepiece in a large scope. They're all over the place up there, little puffs of light just waiting to be found and admired.

The Box Galaxies – NGC 4169, 4173, 4174, & 4175 – R.A. 12h 12m 22s, Dec. +29° 10' 56" (to center of cluster)

These four galaxies are part of the stream mentioned above. They're neither Big, Bold, nor Bright, so they're not even marked in the *Pocket Sky Atlas*, but if you have a big enough scope to pull them out of the mist, they're definitely Beautiful enough to warrant a look. You'll find them a little less than halfway between NGC 4136 and NGC 4251. They're arranged in a tight rectangle only 3' across, with three of the galaxies being edge-on spirals and the other one more elliptical. They range from 12.2 to 14.4 magnitude, so you'll need a scope at least 12" in diameter to really appreciate them, but when you do see them it's like seeing a neat little asterism. It makes you smile...and then you realize these are entire galaxies. Well worth a look if you have the aperture for them.

PSA Charts 34 & 35

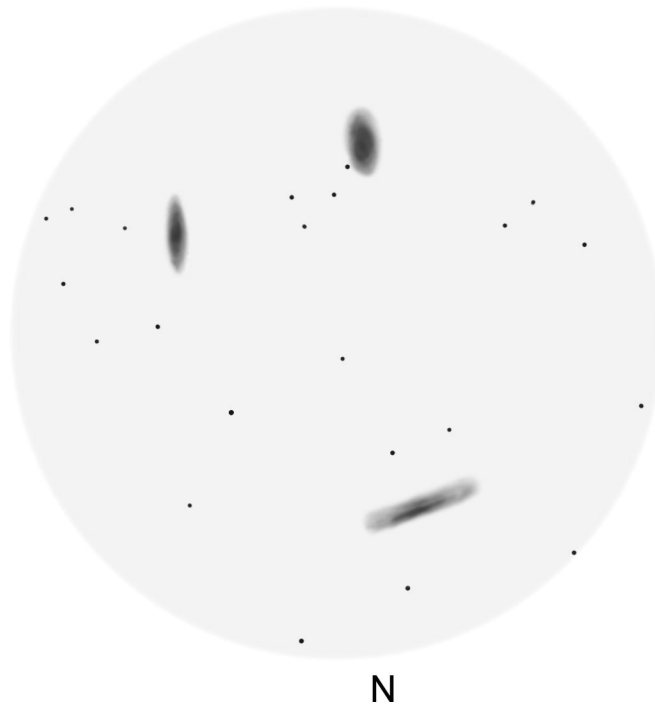
54 Leonis – R.A. 10h 56m 37s, Dec. +24° 44' 57"

54 Leonis is a nice double star. At magnitudes 4.5 & 6.3 and with a separation of 6.5" it's an easy split in just about any scope. The pair is uneven, but not so much so that they're difficult; they're just interesting. Both stars look white to me, but they've been described as bluish and greenish.

The Leo Triplet – M65, M66, and NGC 3628 – R.A. 11h 20m 00s, Dec. +13° 13' 00" (to center of triplet)

Comprised of M65, M66, and NGC 3628, the Leo Triplet is one of the most spectacular galaxy groups in the sky. All three galaxies are near 9th magnitude, and they all fit comfortably within the view of a one-degree true field eyepiece. They're all spirals seen at varying degrees of tilt, with 3628 being nearly edge on to us, showing some interesting dust lanes. They're well worth studying each one at high power when you get tired of looking at them all in one field.

M66 has some nice foreground stars close by to add a little spice.

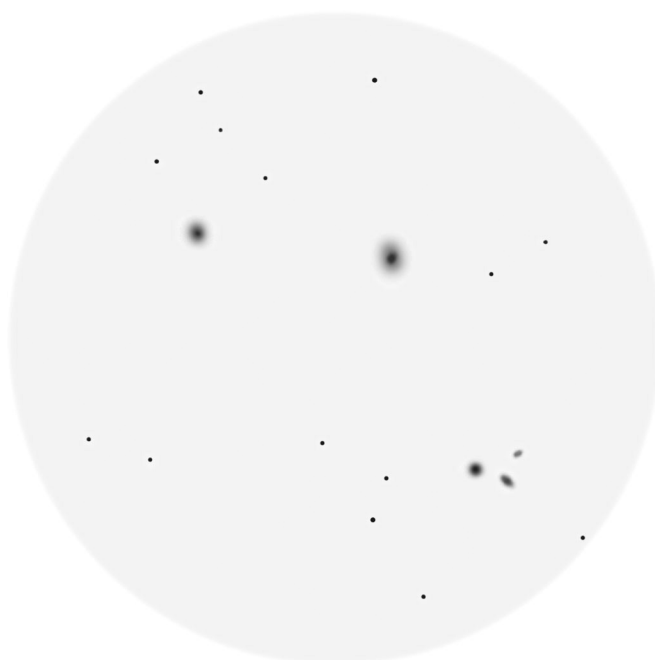


The Leo Triplet (the one below the hindquarters)

The Other Leo Triplet – M95, M96, and M105 – R.A. 10h 46m 46s, Dec. +11° 49' 12" (to M96)

There's another triplet under Leo's belly, and it's all Messier objects: M95, 96, and 105. M95 and 96 are spirals, while M105 is a bright elliptical. They're spread out a little more than the previous triplet, so you'll need about a degree and a half of true field to see them all at once.

When you're ready to zoom in, though, zoom in on M105. To the northeast only a couple of galaxy diameters away you'll find NGC 3371, just half a magnitude fainter. Then look to the southeast about the same distance and do the averted vision thing. With some aperture and dark sky, you'll see 12th-magnitude NGC 3389, making up a triplet within a triplet.



N

The Other Leo Triplet (the one below the belly)

Algieba – Gamma (γ) Leonis – R.A. 10h 19m 58s, Dec. +19° 50' 29"

Algieba is one of my favorite double stars. At magnitudes 2.2 & 3.4 and situated right in the bottom of the lion's mane it's easy to find in almost any sky, and with a separation of 4.6" it's a relatively easy split in any scope. It'll take a little magnification to put darkness between the two components, but it's usually possible unless the seeing is truly awful.

Like 54 Leonis (above), they're an uneven pair, but unlike 54 Leonis these are more golden than blue-green.

Algieba is very near the radiant of the Leonid meteor shower, which peaks on November 17th.

NGC 2903 – R.A. 09h 32m 10s, Dec. +21° 30' 06"

NGC 2903 is a relatively bright (8.9 mag.) spiral galaxy near Leo's nose. SkySafari calls it "The tongue of the lion." It's in the right spot, and certainly has that oval cat's-tongue look. It would have undoubtedly been a Messier object if Messier had discovered it, but he somehow missed it.

It's not exceptionally large (12' x 6'), but it's an obvious oval of a spiral seen at an angle. With a big telescope on a night of good seeing with high magnification you can get a glimpse of the two major arms sweeping out from either side.

Regulus – R.A. 10h 08m 21, Dec. +11° 58' 04"

Regulus is the brightest star in Leo. It's either at the lion's breast or at his left foot depending on how you draw the constellation. At magnitude 1.4 it's one of the brightest stars in the sky (21st brightest, to be exact). As such, I like looking at it just for the sparkle and the diffraction spikes, but it also has an 8th magnitude companion star nearly 3' away that makes for an easy split in binoculars.

On August 21, 2017, I watched a total solar eclipse that occurred right next to Regulus (between Regulus and ν Leonis). Regulus was easily visible during totality, just outside the solar corona. That was a cool sight!

Iota (ι) Leonis – R.A. 11h 23m 55s, Dec. $+10^{\circ} 31' 51''$

This is a challenge double. With components of 4.1 & 6.7 magnitude and a separation of only 2.2", it's one for a night of steady seeing, but it's a rewarding split when you can manage it. The stars are different enough in brightness to make spotting the secondary difficult even when you've got enough magnification (probably well over 200x) to split them.

The secondary is interesting for another reason: It's an almost perfect duplicate of our own Sun.

Σ 1529 – Struve 1529 – R.A. 11h 19m 22s, Dec. $-01^{\circ} 39' 13''$

This is an easy double with magnitudes 7.1 & 7.9 separated by a generous 8.9". It's not a particularly bright pair, but it's an easy split in just about any telescope. Give this one a go if you weren't able to split Iota Leonis (above). It'll restore your smile.

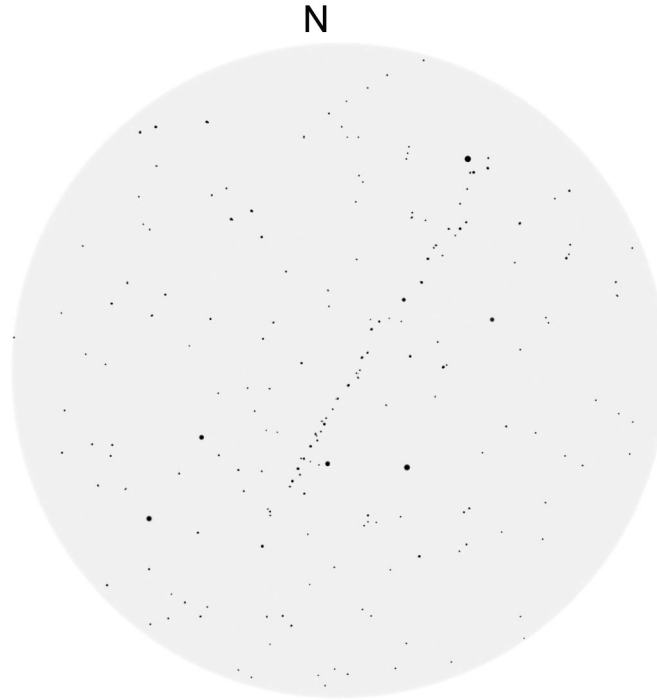
35 Sextantis – R.A. 10h 43m 20s, Dec. $+04^{\circ} 44' 55''$

This isn't labeled on the Pocket Sky Atlas, but it's marked as a double to the lower right of NGC 3423. 35 Sextantis is another easy double with magnitudes 6.1 and 7.1 separated by 6.8". They're a little brighter than Struve 1529 (above), and although they're tighter I find them easier to split. They're pleasantly colored, too, with the primary distinctly orange and the secondary more blue-white.

Rinnan's Run – R.A. 10h 45m 13s, Dec. $+03^{\circ} 43' 51''$ (to the star at the midpoint.)

Here's a sight that's all four B's. In fact, it's so big you'll need binoculars; a telescope won't do. Start at 35 Sextantis, down beneath the belly of Leo, and follow a long chain of stars south-southeast for three full degrees. The top end has two nice binocular doubles (one of which is 35 Sextantis and a nearby field star), and the bottom packs the stars in tighter and tighter. It's such an obvious line that it looks like a rip in the fabric of space. The closer you look, the more stars you see in the line. It's unreal. How could such a thing form? Is it random chance? Evidence of a cosmic string? Leo sharpening his claws? I have no idea.

This cascade of stars is called Rinnan's Run, after Oregon amateur Dan Rinnan, who found it in his binoculars one night in 2010.



Rinnan's Run

PSA Charts 36 & 37

NGC 3115 – (Caldwell 53) – Spindle Galaxy – R.A. 10h 05m 14s, Dec. -07° 43' 07"

This is an edge-on spiral galaxy a little like NGC 4565 or NGC 891, but without the obvious dust lane cutting it in half lengthwise. As a result, this one looks like a bright scratch in space with a stellar core in the middle. At magnitude 9.1 it's visible in just about any scope under dark sky, but it's more impressive the larger the aperture you put on it.

U Hydrae – R.A. 10h 38m 34s, Dec. -13° 29' 26"

U Hydrae is one of the brighter, yet still quite colorful, carbon stars. At magnitude 4.9 it's naked-eye visible under medium-dark sky, but you'll need binoculars or a telescope to detect color. When you do, you'll see a deep orange-red.

NGC 3242 – (Caldwell 59) – Ghost of Jupiter – R.A. 10h 24m 46s, Dec. -18° 38' 38"

This is a bright, obvious planetary nebula even though it's quite low in the sky for northern observers. It's called the "Ghost of Jupiter" because it's round and about the same diameter and it looks somewhat translucent. It's bright enough (mag. 7.3) to trigger color vision, so we see it as slightly greenish, which adds to its ghostly appearance. At high power I see a couple candidates for the central star, but the real one is the one that's centered. The other one is just a bright knot in the surrounding shell of gas.

Speaking of shells of gas, there are two here, the obvious outer envelope and another oval one inside that. The oval one is pinched at the ends, giving it a stylized eyeball sort

of look. That has led to its nickname as the “CBS Eye,” after the CBS TV broadcasting company logo. The inner shell also makes it reminiscent of the Anorak Nebula (NGC 2392) in Gemini.

Under dark sky with some aperture and magnification, this is one of the best planetary nebulae in the galaxy.

V Hydrae – R.A. 10h 51m 37s, Dec. -21° 15' 00"

V Hydrae is another deep red carbon star. It's dimmer than U Hydrae (above), but in some ways it's more interesting. Its magnitude varies from 6 to 12 in a 17-year cycle, with another 1-2 magnitude variability on a 1.5-year cycle. So sometimes this star is easy to see and sometimes not. When it's bright, it's one of the best carbon stars in the sky.

It has an 11.5-magnitude companion 46" away to the south, and a much closer companion on an 8.5-year orbit that's too tight to split.

V Hydrae is in the last stage of its life as a red giant, and will blow off its outer atmosphere into a planetary nebula in the near future (astronomically speaking).

PSA Charts 38, 39, & 40

NGC 3132 – The Eight-Burst Nebula – R.A. 10h 07m 02s, Dec. -40° 26' 10"

The Eight-Burst Nebula is so named because in photographs we can see eight concentric shells of material ejected by the central star as it transformed from a red giant into a white dwarf. It's a relatively small oval, only 60" across (a little bigger than Jupiter), but bright enough (Mag. 9.7) to be obvious in a telescope. The central star is 10th magnitude, so it should be visible in a medium-sized scope, but it's actually a dimmer 16-magnitude star right next to it that's responsible for the nebula

NGC 3918 – The Blue Planetary – R.A. 11h 50m 19s, Dec. -57° 10' 51"

The Blue Planetary is a relatively bright (Mag. 8) planetary nebula that shines a rich blue in the eyepiece. It's relatively small at 18" (and that's photographically — visually it's more like 10"), but relatively easy to spot at medium power. This is one of the far-south's brightest planetary nebulae, so well worth looking for.

NGC 3532 – (Caldwell 91) – Wishing Well Cluster – R.A. 11h 05m 39s, Dec. -58° 45' 00"

At 3rd magnitude, this open cluster is easily visible by naked eye. People call it the Wishing Well because in binoculars or a telescope it looks a little like a bunch of shiny coins shimmering underwater. It's large, about twice the size of the Moon, and contains about 150 stars ranging in brightness from 6th magnitude to 10th and beyond. A couple of them are distinctly redder than the others.

Eta (η) Carina Nebula – R.A. 10h 43m 48s, Dec. -59° 52' 00"

The Eta Carina Nebula is one of the few nebulae that can be seen with the naked eye. At magnitude 1.0, this one is not just visible, but in your face. It's two degrees (four full Moons) across and brighter than the Orion Nebula. It has dark lanes in front of it that separate it into sections a little like the Trifid Nebula, and one of the dark clouds is dense enough to have its own name: The Keyhole Nebula.

Down inside the Eta Carina Nebula lies the star Eta Carina itself, which is a massive,

unstable star that went through an intense eruption in 1841, making it briefly the second-brightest star in the sky. Now, going on two centuries later, we see a bright two-lobed nebula that we call the Homunculus Nebula expanding around the star, blocking much of its light but glowing brightly itself.

NGC 3114 – R.A. 10h 02m 36s, Dec. -60° 07' 00"

NGC 3114 is a bright open cluster about 5° to the west of the Eta Carina Nebula. At magnitude 4.2 it's visible to the naked eye, and at 35' in diameter it's nice in binoculars or at low power in a telescope. It's a bit overshadowed by IC 2602 (The Southern Pleiades) just to the southeast of it, but it's well worth a stop along the way.

NGC 3766 – The Pearl Cluster – R.A. 36h 14m, Dec. -61° 36' 00"

The Pearl Cluster is relatively small at only 9' across, and at magnitude 5.3 it doesn't pop out to the naked eye (especially since it's in the thick of the Milky Way), but in a telescope it's a delightfully tight blast of bright stars set against a rich background. Two of its stars are distinctly redder than the rest in photographs; when I finally get far enough south to observe this cluster myself I hope to find out if they look that way to the naked eye as well.

IC 2944 – Caldwell 100 – R.A. 11h 42m 20s, Dec. -63° 22' 00"

Also known as the Lambda Centauri Cluster and the Running Chicken Nebula, this object is both a nebula and an open cluster. The cluster isn't particularly dense or rich, but it's obvious enough to appreciate, and I read that the nebula is visible with filters. I await the chance to find out for myself. The bright star Lambda Centauri lies just outside the cluster to the northwest.

IC 2602 – The Southern Pleiades – R.A. 10h 42m 58s, Dec. -64° 24' 00"

The southern hemisphere gets all the bright clusters. We northerners get the Pleiades and Hyades and the Beehive, while southerners get dozens of equal or greater brightness and extent. The Southern Pleiades is one of the best. At magnitude 1.6 it's the fifth-brightest cluster in the sky, and at a degree and a half across it's big enough to swallow three full Moons edge to edge.

It's not rich, though, unless you have enough aperture to bust up the Milky Way background into distinct stars. The cluster itself has about a dozen really bright stars, the easternmost half dozen arranged in a dot-matrix 3 or perhaps a miniature Orion.

PSA Chart 41

Thuban – R.A. 14h 04m 23s, Dec. +64° 22' 33"

Thuban is just a medium-bright (mag 3.7) star in Draco. It's nothing special to look at, but you might want to check it out for its historical coolness. About 5000 years ago, it was the North Star. The Earth's axis precesses around in a big circle every 26,000 years, sweeping all the way around past Vega, and on its way back toward Polaris it sweeps past Thuban. It'll get there again in the year 20,346.

We've known for a long time that Thuban was a double star with a period of only 51 days (much too close to see optically), but we recently (in 2020) discovered it to be an eclipsing binary, where one star goes in front of the other on its way around. The eclipse isn't complete, so the drop in light intensity is only about a tenth of a magnitude, but it can be seen in very careful photometric measurements.

RY Draconis – R.A. 12h 56m 26s, Dec. +65° 59' 40"

This is a carbon star, one of the reddest type of stars in the sky. Like most, RY Draconis varies in brightness, and therefore in intensity of color. RY's variability is pretty extreme, going from 6th magnitude (just naked-eye visible under dark sky) to 8th magnitude and back in a little over 6 months. At its brightest it's more orange than red, but still distinctly colored.

Note that there are two RY entries on PSA chart 41. We want the one that says RY (c).

ΟΣ Σ 123 – R.A. 13h 27m 05s, Dec. +64° 44' 08"

At 69" of separation and nearly even in brightness (6.6 and 7.0 mag.), this is a good binocular double, but it's nice in a telescope, too. There are two wider optical doubles in the field as well. To me, this one looks a lot like Nu Draconis, just a little dimmer.

PSA Charts 42 & 43

NGC 5982, 5985, & 5981 – R.A. 15h 38m 40s, Dec. +59° 21' 21" (to 5982)

This is a famous galaxy trio in Draco. It consists of a face-on spiral, an elliptical, and an edge-on spiral in a straight line all within a quarter of a degree of each other. At 11.1, 11.1, and 13.0 magnitude they're a bit dim to be listed here, but they're too cool to leave out. If you've got the aperture and the sky to pull them out, they're an amazing sampler of galaxy types.

Only the brighter two are listed in the PSA, but the third (NGC 5981, the edge on spiral) is just to the west of the other two. They're evenly spaced and in a straight line, which should give you a good spot to focus your attention on while you do the averted vision thing.

M40 – R.A. 12h 22m 16s, Dec. +58° 05' 04"

I mention M40 for completeness, not because it's BBB or B. It's just a pair of 9th magnitude stars that happen to be the right distance apart (50") to look fuzzy in a small telescope. Johann Hevelius thought it was a nebula, so Charles Messier checked it out and realized it was just two stars, but he included it in his catalog of "not comets" anyway.

It's surprisingly dim for a Messier object, and difficult to split in binoculars, but it splits easily in a telescope.

M101 – R.A. 14h 03m 13s, Dec. +54° 20' 56"

This is a big galaxy above the last two stars in the handle of the Big Dipper. It has low surface brightness, but it's as big as the Moon, so it's actually quite easy to spot in binoculars or at low power in a telescope. It's a face-on spiral, and with even modest aperture (say 8") and dark sky you can see the spiral arms. It's not a symmetrical galaxy; its core isn't centered and its arms aren't even, but that gives it unusual charm. Its arms are full of star-forming regions that make bright knots in the already mottled spiral.

This galaxy is so large that even though its overall magnitude of 7.9 is fairly bright, its surface brightness is quite low. You can sweep back and forth across it without realizing you're there, especially at high power. Use your lowest magnification for this one, and go after it in sky that's not light polluted.

Kappa (κ) Bootis – R.A. 14h 13m 29s, Dec. +51° 47' 24"

Just three degrees to the southeast of M101, at the top of Bootes's club, is Kappa Bootis, a fine double. Uneven in brightness at 4.5 and 6.7 magnitude, their 14" separation makes the stars an easy split in just about any telescope. There's a subtle color difference to them, with the primary mostly white and the secondary bluish.

Iota (i) Bootis – R.A. 14h 16m 10s, Dec. +51° 22' 02"

Another double very close to Kappa Bootis, Iota Bootis is a wider split (38.5") and of more uneven brightness (4.7 and 8.2 mags.). These two have a more distinct color difference, too: the primary is yellow, the secondary more red.

Kappa and Iota and nearby Theta Bootis are called Aselius Primus (Theta) Aselius Secundus (Kappa), and Aselius Tertius (Iota), which means "first, second, and third donkey colt." I didn't make that up. Theta is also a double, but its companion is 11th magnitude (not bright) and 69" away (not close).

M51 – Whirlpool Galaxy – R.A. 13h 29m 53s, Dec. +047° 11' 43"

M51 is arguably the best spiral galaxy in the sky. M31, the Andromeda Galaxy is bigger and brighter, but its spiral arms are obscured by dust clouds and its tilt angle. M51 is almost perfectly face on and its arms stand out in bold detail, thus the name "Whirlpool." It's best under dark sky with a lot of aperture, but it's a fine sight in any telescope.

There's a companion galaxy, NGC 5195, just outside the spiral. It's apparently a true companion in the process of colliding with M51, and has in fact already made at least one pass through the larger galaxy. The tidal effects of the collision are at least partly responsible for the intensity of the spiral arms and the many star-forming regions within them.

There's a foreground star about halfway out from the core to the edge of the big spiral that's easy to mistake for a supernova. In 2005 there really was a supernova in M51, and it was about as bright as that foreground star.

Nu¹ and Nu² Bootis – R.A. 15h 31m 22s, Dec. +40° 51' 56" (to mid-point between)

This is a very wide double, mags. 5.0 & 5.0 with a 10.5 arc-minute separation. These two are just a smidgen tighter than Mizar and Alcor, but evenly matched, which makes

them another good test for sharp vision. You should be able to split them by naked eye if you're 20-20 or better. Binoculars will split them easily, and in a telescope they're so far apart they don't look like much.

OS 298 – Otto Struve 298 – R.A. 15h 36m 02s, Dec. +39° 48' 09"

A nice binocular double with stars of mag. 6.8 and 7.5 separated by 2'. The brighter component is a double itself, but with a very tight split of 1.2". You'll need aperture and very steady seeing to split that one.

Alkalurops – R.A. 15h 24m 29s, Dec. +37° 22' 38"

Alkalurops, a.k.a. Mu¹ Bootis, is a triple star. The A-B pair are widely separated (1.8'), so are easy in binoculars and are even technically possible by naked eye, but the B-C pair are tight at 2.2". The A star is magnitude 4.3, B is 7.2, and C is 7.8, so all three are easily bright enough to be visible in almost any telescope, but it will take some magnification to split the B-C pair. All three stars line up in a north-south orientation at the moment. In 65 years or so the BC component will have rotated about a quarter of the way around.

Delta (δ) Bootis – R.A. 15h 15m 30s, Dec. +33° 18' 53"

Bootes is full of double stars, and this is a good one for binoculars or a telescope. It's components are magnitudes 3.5 & 7.8 so they're pretty uneven, but their 62" split makes them easy even so. The primary is a pale yellow, the secondary looks white to me.

NGC 5005 – (Caldwell 29) – R.A. 13h 10m 56s, Dec. +37° 03' 33"

NGC 5005 is a medium-bright but small spiral galaxy in Canes Venatici. I probably wouldn't include it here except that it's #29 in the Caldwell catalog, so a lot of people go looking for it. It's easy enough to spot as a little oval with a relatively bright core, but I see no detail in it even with a fairly large scope.

NGC 5033 next door is very similar in appearance, but it's elongated north-south, whereas 5005 is elongated more east-west.

PSA Charts 44 & 45

Izar – R.A. 14h 44m 59s, Dec. +27° 04' 27"

Izar is a relatively tight double in Bootes. The components are uneven at 2.5 & 4.9 magnitude, and the separation is only 2.9", so you need high power and steady seeing for this one. There's a slight color contrast of yellow and greenish. Wilhelm Struve named this star "Pulcherrima" for "the most beautiful." I'm not sure if I'd go that far, but it's pretty neat when you do manage to split it.

M3 – R.A. 13h 42m 12s, Dec. +28° 22' 38"

"Oh, wow!" That's what I think every time I run across this globular cluster. Just a little over halfway between Cor Caroli and Arcturus and with no easy guide stars closer by, you have to do some searching to find this one, but when you do, that's what you say. It's bright (mag. 6.2) and big (18') and it's also bold and beautiful. In fact, it's the third brightest globular cluster in the northern half of the sky.

It's just barely visible by naked eye under dark sky, which helps immensely in aiming a telescope at it since there's pretty much nothing else nearby. In binoculars it's a fuzzy ball, and in a telescope it's stunning. The core is packed so tight it's hard to resolve, but at high magnification you can spot individual stars all the way to the center. Its periphery resolves easily in nearly every telescope into strings and loops of stars. It's estimated that there are about half a million stars here, all packed within a ball about 180 light-years across.

M13 gets all the press when it comes to northern-hemisphere globulars, but M3 is just as beautiful. And bonus: it's visible way earlier in the year. M3 is one of the first globulars of spring, a welcome sight after a long winter looking outward away from the core of our galaxy (where the globulars mostly hang out).

NGC 5466 – R.A. 14h 05m 27s, Dec. +28° 32' 04"

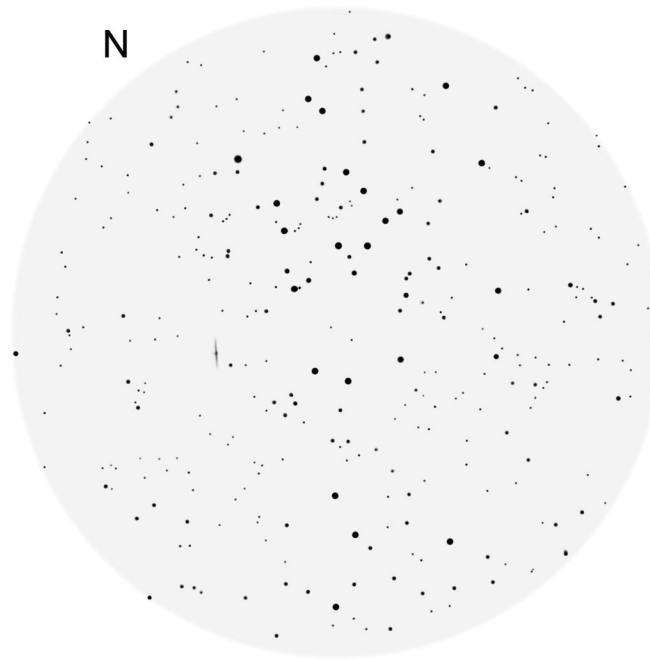
This is another globular cluster 5° to the east of M3. At 9th magnitude it's not nearly as bright, and at 9-11' it's considerably smaller, but it's still easily visible. It's much more loosely packed, so it provides a nice contrast to M3.

Melotte 111 – a.k.a. Coma Berenices – R.A. 12h 25m 06s, Dec. +26° 06' 00"

Up and to the left of Leo's hindquarters you'll see a large naked-eye dusting of stars that's the most prominent feature in Coma Berenices. In fact, most people call the cluster Coma Berenices and forget there's more to the constellation. The cluster itself is cataloged as Melotte 111, and it's stunning in binoculars, with dozens of stars ranging from 4th to 10th magnitude in a field about five degrees wide. The cluster looks lopsided to me, with most of its stars to the west of an obvious vertical dividing line. At 288 light years, it's the third-closest star cluster to us, after the Hyades and the Ursa Major Moving Group.

There are several doubles within it. 24 Comae, down near the bottom of the cluster, is especially nice, with a yellow mag 5.1 primary and blue mag. 6.5 secondary spaced 20" apart.

The north galactic pole resides just to the northeast of the cluster, which means when we're looking at this cluster we're looking straight out of the plane of the galaxy.



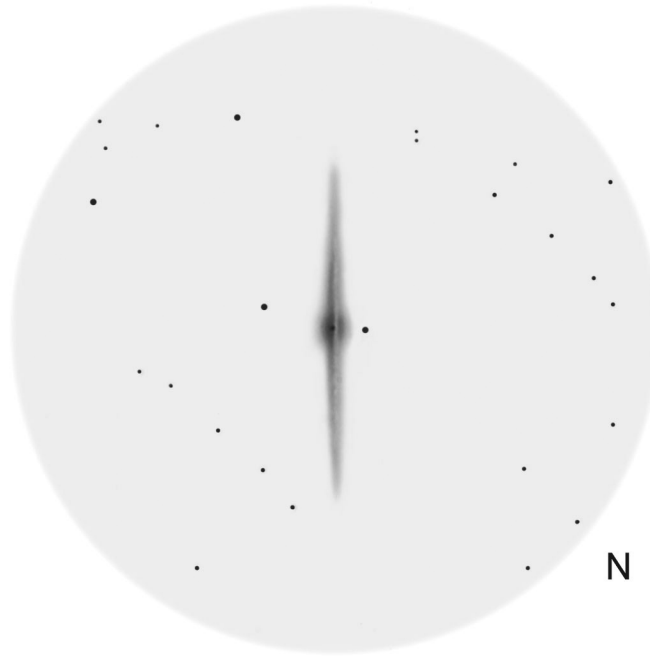
Melotte 111, also known as Coma Berenices

NGC 4559 – (Caldwell 36) – Bigfoot Galaxy – R.A. 12h 35m 58s, Dec. +27° 57' 35"

NGC 4559 is a medium bright (9.8 mag.), medium large (5 x 10 arc-minute) galaxy in Coma Berenices. There are dozens of galaxies in the Coma cluster, but this is one of the brighter ones and one of the more interesting ones due to the three stars on the southeast end of it. To me, they look like toes of a big footprint, which is why I call this the Bigfoot Galaxy. It's one of my favorites. I check it out every time I'm cruising through Coma Berenices, and it always brings a smile to my face.

NGC 4565 – (Caldwell 38) – Needle Galaxy – R.A. 12h 36m 21s, Dec. +25° 59' 15"

Just on the east side of the dividing line down the middle of Melotte 111, the Needle Galaxy is one of the best galaxies of spring and summer. It's an edge-on spiral, and it's big (half a Moon diameter) and bright enough that you can easily see the dark lane cutting across its core and disk. The galaxy is tilted just enough that the core peeks over the dust lane, so it looks like a bright star there at the center. This is probably the best edge-on spiral in the sky, and is one of those objects that just gets better and better the more aperture you throw at it.



NGC 4565, the Needle Galaxy

M64 – Black Eye Galaxy – R.A. 12h 56m 44s, Dec. +21° 40' 55"

M64 is a spiral galaxy with an obvious dark dust lane separating the core from the side of the disk closest to us. That dust lane looks a lot like a classic fistfight “shiner” under an eye, thus the name “Black Eye Galaxy.”

It’s fairly bright (8.4 mag.) and fairly large (10' x 5'), so it’s easy to spot in just about any telescope. You can see it in binoculars, but the dark lane is difficult to pick out at that low magnification. It has spiral arms, but their contrast is quite low, so all you’ll see in a scope is an oval with a bright core and the dust lane.

Fun fact: the inner part of the galaxy rotates in the opposite direction from the outer part, evidence of a major collision some time in its distant past.

Σ 1687 – Struve 1687 – R.A. 12h 53m 18s, Dec. +21° 14' 42"

Struve 1687 is a nice double just a degree to the southwest of M64. Its components are magnitudes 5.2 and 9.8, so there’s quite a brightness difference, but their separation is a generous 29" so it’s easily accomplished in just about any telescope. The primary is itself a double with components of magnitude 4.9 and 7.1, but their separation is only 1.2". Their difference in brightness and tiny separation have kept me from splitting this one so far. Enjoy the wider pair unless you’re up for a challenge on a night of exceptional seeing.

M53 and NGC 5053 – R.A. 13h 12m 55s, Dec. +18° 10' 05" (M53)

This one is both a treat and a challenge. The treat is M53, an easy globular in any telescope, visible even in binoculars. The challenge is NGC 5053 just a degree to the east southeast. Bigger, but much dimmer (9.5 mag), it’s just a faint smudge until you watch it a while, when it starts breaking into individual stars. The two clusters are only a degree

apart, so you can fit both in one low-power eyepiece in all but the largest scopes.

I used to think NGC 5053 must be a lot farther away than M53, but that's not so. They're about the same distance (57,000 light-years), which means that they're physically quite different. NGC 5053 is just way less dense than M53. It might even be considered an open cluster if its stars didn't have the characteristic age of a globular cluster.

NGC 5248 – (Caldwell 45) – R.A. 13h 37m 32s, Dec. +08° 53' 06"

NGC 5248 is a small but relatively bright galaxy in south-west Bootes, kind of out in the middle of nowhere between Bootes and Virgo. Even so, it's easy to find and it stands out well from the background. It's a spiral galaxy, but I don't see arms, just an oval patch of light with a bright stellar core.

Virgo Cluster – R.A. 12h 27m 00s, Dec. +13° 00' 00" (to center of Markarian's Chain)

The Virgo cluster is a huge conglomeration of galaxies in the spring sky. It's easy to find halfway between Denebola, the tail of Leo the Lion, and Vindemiatrix, the outstretched upper arm of Virgo. When you get into this region with a medium-aperture telescope and dark sky...holy cow! There are more galaxies than you can count. So many they form patterns, like asterisms!

The anchoring pattern is Markarian's Chain, a 1.5-degree-long arc of relatively bright galaxies that starts off with M84 in the west and runs past M86, past a galaxy pair called "The Eyes," and several more NGC galaxies.

There are literally hundreds more galaxies scattered all around the chain. M87, one of the biggest, brightest elliptical galaxies known, lies about a degree to the southwest of the chain. M89 is another bright one. And so on. You can spend hours poking around in here, often seeing half a dozen galaxies in a single field of view.

Just for completeness, in the event you're searching for all the Messier objects, I'll list the ones in the Virgo cluster here: M49, M58, M59, M60, M61, M84, M85, M86, M87, M88, M89, M90, M91, M98, M99, and M100. Remember that Messier was looking for comets, and marking things that looked sort of like comets but weren't. The Virgo Cluster must have driven him crazy.

The Pocket Sky Atlas has a blown-up-scale map of the Virgo Cluster in appendix C.

M60 and NGC 4647 – R.A. 12h 43m 40s, Dec. +11° 33' 10"

I mention this one separately because M60 is the third brightest galaxy in the Virgo cluster. It's a giant elliptical galaxy, so it's just an oval glow in the eyepiece, but at 8.8 magnitude it's a bright glow and at 6.8' x 5.4' it's large enough to see easily.

The cool thing about M60 is not the galaxy itself, but its fainter companion, NGC 4647. This is a somewhat smaller (2.8' x 2.3'), dimmer (mag. 10.9) spiral galaxy that nearly overlaps the outer envelope of M60. (It does in photos, but there's likely to be some separation in the eyepiece). It looks a little like a ghost or a shadow of the larger, brighter galaxy.

These galaxies are both about 56 million light-years away, so they're likely interacting gravitationally, but if so, they're still on the approach. NGC 4647 hasn't been distorted much yet, and there hasn't been a burst of star formation yet. That's apparently a few million years in the future yet. Something to look forward to!

3C-273 – Quasar – R.A. 12h 29m 07s, Dec. +02° 03' 09"

3C-273 is remarkable not for what it looks like, but for what it is: one of the few quasars that you can actually see in a back yard telescope. What's a quasar? We didn't know for a long time. They were just pinpoints in the sky that blasted out a lot of radio noise (which led to their name: Quasi-Stellar Radio Source.) Now we understand them to be the cores of galaxies with actively feeding black holes. Matter falling into the black holes glows tremendously bright as it accelerates to nearly the speed of light in an accretion disk around the black hole, and giant jets of radiation shoot out along the rotation axis. Quasars were much more numerous in the early universe than they are now, which means the ones we see today are a long, long way away. (3C-273 is one of the closest at 2.4 billion light-years. (Yes, *billion*.) Because of that they have high red-shifts, so their light is stretched out to become radio waves. What started out as ultraviolet and x-rays got stretched into the visible range, and that's what we see when we look at one through a telescope.

3C-273 is the brightest quasar in the sky, but it's still only 12.9 magnitude. So it takes a little aperture to see it, although I've managed it in an 8" telescope and it should be possible in a 6" under ideal conditions. I've found it easy in a 12.5" scope.

What you'll see is just a star-like point of light. There's not a whole lot else in the field of view, so you'll have to star-hop to it with a wide-field eyepiece, but there are several 9th-12th magnitude stars to guide the way. It's worth a look for the coolness factor alone. When you spot it, those are 2.4-billion-year-old photons hitting your eyeball!

SS Virginis – R.A. 12h 25m 14s, Dec. +00° 46' 11"

SS Virginis is a carbon star near Zaniah (Eta Virginis). Carbon stars are deep orange-red in color due to the absorption of blue light by carbon soot in the stars' atmospheres. This one is more orange than red, but at 6.8 magnitude it's one of the brighter ones in the sky and so really dazzles.

Porrira – Gamma (γ) Virginis – R.A. 12h 41m 40s, Dec. -01° 26' 55"

It seems like an odd coincidence that so many "gamma" stars (the third stars to receive Greek letter designations in their respective constellations) are doubles. Gamma Virginis is no exception. This is a tight one, though, at only 2.6" separation (as of 2020). Luckily its components are evenly matched at 3.5 magnitude, so they're as easy to split as any pair at that separation. And the gap is getting wider. They were at their closest (0.7") in 2007, and will be at about 6" separation in 2091. Check them out early and often; it'll be fun to watch them drift slowly apart and change their position angle over the years.

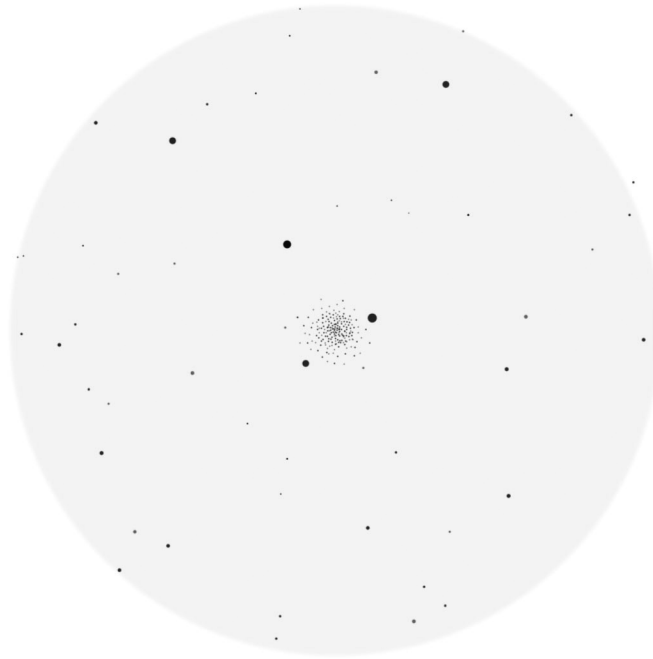
Porrira is only 38 light-years away, which is pretty close as far as stars go (and they go a long way).

PSA Charts 46 & 47

NGC 5634 – R.A. 14h 29m 37s, Dec. -05° 58' 35"

This is the only globular cluster in Virgo, but it's a neat one. It's small (5.5'), but relatively bright (Mag. 9.5) so it's easy to find. At its distance of 82,000 light-years it doesn't split into individual stars very well, but that's okay because it's in the perfect position for a fuzzy glow to be just what we want. How can that be? Because it's nestled

in among three stars in just the perfect orientation so it looks like the engine glow of a science-fictiony rocket.



N

NGC 5634

NGC 4697 – (Caldwell 52) – R.A. 12h 48m 36s, Dec. -05° 48' 03"

There's nothing particularly special about this galaxy, but it's relatively bright (9.3 mag.) and easy to find, and it's on the Caldwell list, so I include it here. It's an elliptical galaxy, so it looks oval in a telescope without any spiral arm structure. With averted vision it elongates a little more. It's inside a distinctive arc of four 9th- and 10th-magnitude stars.

Mu (μ) Librae – R.A. 14h 49m 19s, Dec. -14° 08' 55"

Mu Librae is a tight (2") but rewarding double. Its components are magnitude 5.6 & 6.5, so they're just uneven enough to be interesting, but not so much that the bright one makes the dimmer one too difficult to see. This one requires high power and good seeing, but it's a neat sight when it splits.

Zubenelgenubi – Alpha (α) Librae – R.A. 14h 50m 53s, Dec. -16° 02' 30"

Zubenelgenubi and Zubeneshamali are my favorite star names. Once you get the hang of it, they come ringing off the tongue. I'd like to compose a poem someday, maybe even do a rap about them. In the meantime, it's fun to have a look at 'Genubi because it's a super-wide double. Its separation is 231" (almost 4', or 1/8 of the Moon's diameter) and its components are magnitudes 2.8 and 5.2, so you can just make it out by naked eye in a dark sky, and it's easy-peasy in binoculars. In a telescope it's too wide to really get much

of a “Wow” out of it, but it’s fun to look at just to say the name aloud to your observing companions.

Zubenelgenubi means “The Southern Claw” in arabic. Not surprisingly, Zubeneschamali means “The Northern Claw.” This is a holdover from the days when they were considered part of Scorpius, the scorpion.

M104 – The Sombrero Galaxy – R.A. 12h 39m 59s, Dec. -11° 37' 23"

M104 is one of the best galaxies in the sky. It’s a bit low for northern observers, but it’s well worth a look. This is a spiral galaxy seen not quite edge on, so the dust lanes in its spiral arms make a distinct dark line across the rest of the disk. And that disk is unusually thick, swelling up into a bright core that’s about a third of the galaxy’s diameter, so the dust lane is quite easy to see. It’s similar to NGC 4565, the Needle Galaxy, in Coma Berenices, but with a much thicker galaxy behind the dust lane.

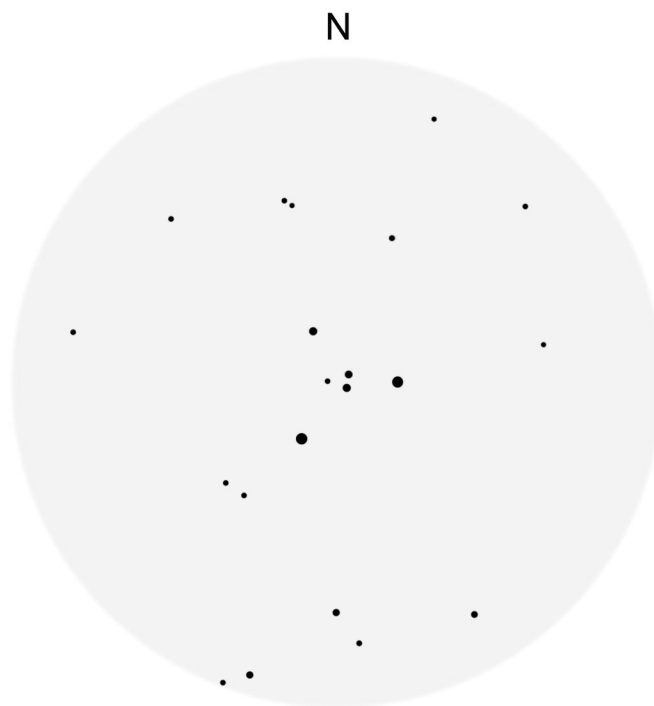
This is a big galaxy, a third again as big as the Milky Way and much more massive. Its central black hole alone is 1 billion times the mass of our Sun.

When you’re looking for it, you might run across a little arrow of four stars that looks a little like the head of an alligator. That “gator head” points right at the Sombrero.

The Stargate – R.A. 12h 35m 44s, Dec. -12° 01' 30"

Just one degree to the west-southwest of the Sombrero Galaxy lies a neat asterism of six stars called the Stargate. It’s a triangle within a triangle with the vertices perfectly opposite one another. One of the inner three stars is fainter than the others, and is probably variable since it’s often much harder to see than at other times, but the overall impression is so regular and so impossible-seeming that it looks like an artificial arrangement.

This one isn’t listed in the Pocket Sky Atlas, but it’s well worth tracking down. You’ll probably run across it while looking for the Sombrero, in fact. It and the alligator head mentioned above are the most distinctive asterisms in the area.



The Stargate

Σ 1669 – Struve 1669 – R.A. 12h 41m 16s, Dec. -13° 00' 54"

Struve 1669 is a nice double star relatively close to the Stargate and the Sombrero Galaxy. It's components are exactly the same brightness (5.2 mag.) and split by a just-tight-enough-to-be-challenging 5.4". It should be possible in just about any telescope, though, and it's a delight to see the two evenly matched stars peering out at you from the depths.

Algorab – Delta (δ) Corvi – R.A. 12h 29m 52s, Dec. -16° 30' 56"

Algorab is an easy yet quite interesting double star. Its two components are of vastly different magnitude (3.0 and 8.5), so the primary is 158 times brighter than the secondary. That would normally make the secondary hard to see in the primary's glare, but their 25" separation puts them far enough apart to easily split.

The difference in brightness and the stars' inherent difference in temperatures also provides a nice color contrast. I see the bright one as blue-white and the dim one as much yellower.

NGC 4038 & 4039 – (Caldwell 60 & 61) – Antennae Galaxies – R.A. 12h 01m 53s, Dec. -18° 52' 06"

Here are two galaxies caught in the act of colliding. They have probably already made one pass through each other, and will loop around and join to form a single giant elliptical galaxy. At the moment, though, they're still two distinct galaxies with two long streams of stars ("tidal tails") arcing out in opposite directions.

At magnitude 10.2 they're not bright, so in a small scope you're just going to see two smudges very close to one another, but they're beautiful in a big scope. Well worth

tracking down if you have the aperture.

They're relatively easy to find: just sight from the top-left star of Corvus's squashed trapezoid past the next star to the lower right and keep going the same distance. The Antennae will be just below the spot you land on.

NGC 4361 – R.A. 12h 24m 31s, Dec. -18° 47' 09"

NGC 4361 is a small planetary nebula inside the body of Corvus the Crow. At 11th magnitude you wouldn't expect this to be very visible, but I can see it fairly well in my 12" scope under dark sky. The mag. 13 central star is easily visible. Under high magnification the surface looks mottled, almost like a globular cluster that's too distant to resolve into stars or a spiral galaxy whose arms won't quite come into focus.

NGC 5694 – (Caldwell 66) – R.A. 14h 39m 36s, Dec. -26° 32' 20"

This is one of the most distant globular clusters known: 113,000 light-years, which is farther away than the Milky Way galaxy is across. Even so, it shines at magnitude 10.2, which is pretty bright for that distance, so it must be quite large. It's estimated to be about 120 light-years across. It's small from our perspective, and difficult to bust into individual stars, but it's relatively easy to spot even so. It's nice at about 100x.

One of the interesting things about this cluster is that it's moving way too fast to stay part of the Milky Way. It's on its way out, never to be seen again.

M68 – R.A. 12h 39m 28s, Dec. -26° 44' 39"

M68 is a smallish (11') globular cluster to the south of Corvus's squashed trapezoid. At 7.8 magnitude it's easy to see despite its southerly declination. If the seeing is steady enough, you can split it into individual stars in scopes of 6" aperture or more.

M83 – Southern Pinwheel – R.A. 13h 37m 01s, Dec. -29° 51' 56"

M83 is a face-on spiral galaxy with prominent arms, which gives it its nickname of the "Southern Pinwheel." At magnitude 7.5 it's fairly easy to see, and it spans a relatively generous 12 x 13'. Its core looks like a bright star, and in most telescopes the galactic disk looks more like a round fuzzball than a pinwheel, but it's obviously a face-on spiral. It's right on the Centaurus border, so it's quite low in northern skies, but still well worth a look.

PSA Charts 48, 49, & 50

NGC 5128 – (Caldwell 77) – Centaurus A – R.A. 13h 25m 28s, Dec. -43° 01' 05"

Centaurus A is way south for me, but I saw it once on a trip to New Mexico and it was worth four days on the road to see it. This is a peculiar galaxy indeed. It's a giant elliptical/lenticular galaxy, bright (mag. 6.7, the fifth brightest galaxy in the sky) and large (26' x 20'), with a huge dust lane cutting right across the middle of it. And I do mean huge; the dust lane is at least as wide as the galaxy bulge sticking out on either side of it.

Astronomers have determined that this is the result of a merger between an older elliptical galaxy and a youngish spiral galaxy, with the spiral's dust and gas settling in a ragged ring around the two merged cores.

Centaurus A is also a bright radio galaxy, presumably the result of the black hole at

its center feeding on gas and dust from the merger.

This one is well worth looking for if you have a good southern horizon or if you're far enough south to get it above whatever horizon you have.

NGC 5139 – (Caldwell 80) – Omega (ω) Centauri – R.A. 13h 26m 47s, Dec. -47° 28' 47"

Omega Centauri is the largest, brightest, most amazing globular cluster in the sky, bar none. Unfortunately it's also way south of the equator, so those of us in North America and Europe and Russia and the like never get a chance to see it. I saw it once from Florida, braving a cloud of mosquitos as thick as the globular cluster, and again on the same trip to New Mexico where I saw Centaurus A (above). I would brave both the mosquitoes and the road trip to see it again. It's that cool.

It's distinctly oval in shape, rather than the usual spherical form of the typical globular cluster. It's probably not a normal globular at all, but rather the core of a dwarf galaxy that merged with the Milky Way a long time ago. At magnitude 3.8 it's easily naked-eye visible, and at 55 arc-minutes it's way bigger than the Moon. It looks like a cloud out there in the darkness, raining stars on some distant town.

In addition to its intrinsic size (about 200 light years in diameter), it's also very close to us as globular clusters go (17,000 light-years). It contains several million stars, many more than average, and it also contains an intermediate-sized black hole at its center, which is more evidence for its origin as the core of an old galaxy.

If you have the chance to look at this one, don't pass it up. A lot of people north of you would give an eyepiece for the opportunity.

Alpha Centauri – (Rigel Kentaurus, Toliman) – R.A. 14h 39m 36s, Dec. -60° 28' 02"

Alpha Centauri is the third brightest star in the sky, and also the closest star system to the Sun (4.36 light-years). It's a triple star, with two Sun-like stars orbiting one another with an 80-year period and a third red dwarf, Proxima Centauri, on an orbit so wide (15,000 AU) that it may or may not be gravitationally bound to the larger pair. Proxima is closer to us by about a seventh of a light year, so it's the closest individual star to the Sun at 4.22 light-years.

The A-B pair make a fine double in a telescope. The components are magnitudes 0.0 and 1.3, so they're easy to spot, and they range from 2" to 22" separation. In the 2020s the gap expands from 6" to 10", then shrinks through the 2030s to a minimum in 2038, then expands again to its maximum 22" in 2061.

Alpha Centauri A is a very sun-like star. Alpha Centauri B is cooler and obviously redder in a telescope, but could easily support life on a planet at the right distance.

Many, many science fiction stories and novels have been set on planets within the Centauri system, but ironically the only confirmed planets to date (2022) are two orbiting Proxima, which is a flare star that would almost certainly wipe out any life with its frequent extreme outbursts.

The Southern Cross – R.A. 12h 29m, Dec. -59° 12'

Alpha and Beta Centauri (not to be confused with Alpha Centauri A and B) are often called "the pointers" because a line drawn through them points at the Southern Cross, a bright kite-shaped cross of four stars that themselves point toward the south celestial pole.

The southernmost of the four, Alpha Crucis, also known as Acrux, is a great double

star of magnitudes 1.3 and 1.6 separated by a tight 3.9". This should be splittable in just about any decent telescope on a steady night.

NGC 4755 – The Jewel Box – R.A. 12h 53m 39s, Dec. -60° 21' 00"

The Jewel Box is one of the best clusters in the sky. At magnitude 4.2 it stands out okay by naked eye, but in a telescope it breaks into more than 100 stars. The brightest of them display a variety of colors, from blue giants through yellow and orange to brilliant red. Found just off the eastern arm of the Southern Cross, the Jewel Box is not to be missed if you find yourself far enough south to see it.

The Coal Sack – R.A. 12h 50m, Dec. -62° 39'

Between Alpha Centauri and the Southern Cross (right next to Acrux) lies one of the most famous dark nebulae in the sky: The Coal Sack. It's a large (7° x 5° across!) cloud of dust and gas that blocks the Milky Way behind it, creating an obvious black blotch against the starry background. This is a naked-eye object, not a telescopic object. It's simply too large to appreciate in a telescope. You can sweep binoculars back and forth across it and get an impression of its size, but it's best appreciated with bare eyeballs.

PSA Chart 51

40/41 Draconis – R.A. 18h 00m 09s, Dec. +80° 00' 15"

Located right at the intersection of two main gridlines of R.A. and Dec., 40 and 41 Draconis make a nice, easy double star. It's rare for two stars this close together to receive separate Flamsteed numbers, but 40 and 41 Draconis have that honor. Maybe it's because they're such an obvious double in a telescope (and even splittable in big binoculars) and they're so similar to each other in brightness (magnitudes 5.7 and 6.0) that Flamsteed couldn't number just one of them. In any case, they do make a very nice easy pair between the body of Draco and the handle of the Little Dipper. These stars are both spectral class F, a little cooler than our Sun, so some people see them as cream colored, but I see them as brilliant white.

Psi¹ (ψ¹) Draconis – R.A. 17h 41m 56s, Dec. +72° 08' 56"

Psi¹ Draconis is the west component of a naked-eye pair a full degree apart about a third of the way along the body of the dragon. In a telescope the brighter star is itself a nice, easy split (30") on a mag. 4.6 and 5.7 pair. They've been described as yellow and lilac, but both appear yellowish to me.

NGC 6543 – (Caldwell 6) – The Cat's Eye Nebula – R.A. 17h 58m 33s, Dec. +66° 38' 05"

The Cat's Eye is one of the most popular planetary nebulae in the northern sky. At 8th magnitude it's bright enough to see in just about any telescope, although its small size (0.4' x 0.3') makes it look stellar until you crank up the magnification a bit. When you do, you'll see a bright, maybe greenish oval with uneven mottling. In large scopes you can make out a tiny pinprick of a star at the center. It's called the Cat's Eye because in photographs it comes to points at the ends of its elongated lobes, giving it the look of a cat's slitted iris.

When you're looking at the Cat's Eye, you're looking at the north ecliptic pole, which means you're looking straight up out of the plane of the solar system.

PSA Charts 52 & 53

Nu (ν) Draconis – Kuma – R.A. 17h 32m 16s, Dec. +55° 10' 23"

Nu Draconis, also known as Kuma, is a wide, even double of two 4.9-magnitude stars separated by an easy 62". You can split it in binoculars if you hold them steady enough. The two components are so evenly matched that in a telescope they look like the headlights of an approaching car.

Mu (μ) Draconis – Alrakis or Arrakis – R.A. 17h 05m 02s, Dec. +54° 28' 12"

Mu Draconis is another perfectly matched pair, with both components glowing at 5.6 magnitude, but at a much closer 2.6" separation. This is a medium-tough split, but well worth the effort, especially after looking at Nu's easy divide. It looks like the same pair of headlights, only 24 times farther away.

Fun fact: Mu Draconis's common name is Arrakis, which Frank Herbert thought was

cool enough to name his desert planet in his groundbreaking science fiction novel, *Dune*.

16 & 17 Draconis – R.A. 16h 36m 11s, Dec. +52° 54' 08"

At a generous 90" of separation (1' 30") and easy 5th magnitude, 16 and 17 Draconis make a nice binocular double. Put a telescope on them and you'll see that 17 Draconis splits into a medium-tight double of 5.5 and 6.4 mag. stars separated by 3.4"

M102 – NGC 5866 – Spindle Galaxy – R.A. 15h 06m 30s, Dec. +55° 45' 48"

M102 isn't marked as such in the Pocket Sky Atlas because there's considerable debate over what galaxy Messier was actually looking at when he logged this one down. His contemporary, Pierre Mechain thought it must have been a duplicate observation of M101, but Messier's own notes make it seem likely that he was looking at the galaxy that William Herschel later designated as NGC 5866.

In any case, it's a pretty nice galaxy. It's a spiral seen edge-on, so it cuts a thin line across the darkness. For that reason it's often called the "Spindle Galaxy." It's not particularly bright (9.9 mag.) nor particularly large (6.3' long), but it's definitely there and it looks pretty good if you have some aperture and dark sky. With sufficient aperture (say 12" or more) you can see the dust lane of the galactic disk cutting across the core.

Σ 2142 – Struve 2142 – R.A. 17h 11m 40s, Dec. +49° 44' 54"

Struve 2142 isn't labeled on the Pocket Sky Atlas, but it's marked as a double star just above V940. Its components are magnitude 6.2 and 9.4 with a separation of 5.3", so they're a bit difficult to split, but they reward the attempt.

42 Herculis – R.A. 16h 38m 44s, Dec. +48° 55' 49"

42 Herculis is a very unequal (mags 4.9 and 11.8) double that's still relatively easy to split because of its 27" separation. The key is to get enough aperture to make the 11.8 star show up.

There's another medium-bright (6.6 mag.) star 4' 27" to the southwest that makes for a nice, easy binocular double.

NGC 6229 – R.A. 16h 46m 59s, Dec. +47° 31' 40"

NGC 6229 isn't the biggest, boldest globular cluster in Hercules. It's not even the second-best: that's M92 (below). But it's a pretty good third. At magnitude 9.4 it shows up pretty well, and at 4.5' diameter it's big enough to tell it's not just a bloated star. It's probably just as big as the more glorious globular clusters in the sky, but at 99,000 light-years away it's just small due to distance. This, M92, and M13, all in Hercules, make a neat study in what distance can do to an object's appearance.

This one is pretty tightly packed, so the core is nice and bright. There are two 8th-magnitude field stars just 6' away, and they're spaced just right to make the three objects look like the eyes and nose of an inquisitive dog with its head cocked to the side.

M92 – R.A. 17h 17m 07s, Dec. +43° 08' 09"

If M13 weren't so big and showy, M92 would easily be the best globular cluster in the northern summer sky. It's 6.4 magnitude and 14' across (a little more than half M13's size), which makes it easily visible in just about any scope. A little magnification busts it into individual stars. It's bright enough to be just visible to the naked eye under ideal conditions.

And there's a bonus spectacle: M92 has two chains of stars surrounding it that look like the arms of a barred spiral galaxy.

HD 162826 – R.A. 17h 51m 13s, Dec. +40° 04' 27"

In the Pocket Sky Atlas this is just an unlabeled star two stars to the right of 90 Herculis, and in the sky it doesn't look like much either, but it's worth noting for one neat fact: It's very likely a member of the same star cluster that our own Sun was born in. They have similar chemical abundances, which means they probably condensed from the same cloud of gas and dust, and their paths through the galactic disk are also similar enough that they could have remained travelling companions for the 4.6 billion years since their formation. HD 162826 is about 15% more massive than our Sun and slightly hotter, but is still a close match. It's 110 light-years away, and appears at magnitude 6.6, just below naked-eye visibility. Two other stars (including 90 Herculis) within half a degree *are* naked-eye visible, though, so you can find them easily and star-hop to the Sun's twin.

Rho (ρ) Herculis – R.A. 17h 23m 40s, Dec +37° 08' 52"

Rho Herculis is a nice double star just off the northeast corner of the keystone of Hercules. At 4.2" it's a medium difficult split, but doable in nearly any scope on a night of fair seeing. The components are magnitudes 4.5 and 5.4, so they're bright enough to see easily and different enough to be interesting. They're both white, but the magnitude difference often fools the eye into seeing the brighter one as bluish and the dimmer one as greenish.

M13 – Great Hercules Cluster – R.A. 16h 41m 41s, Dec. +36° 27' 36"

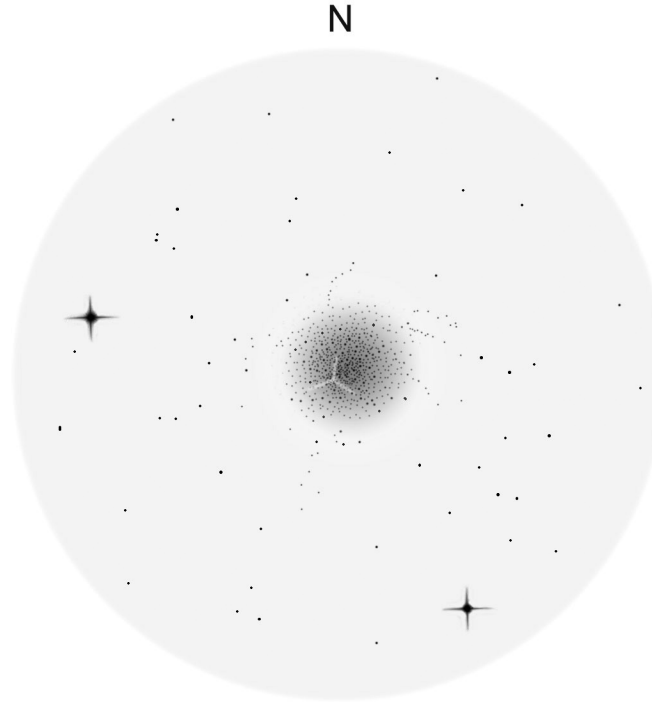
M13 is very likely the showiest globular cluster in the northern sky. At magnitude 5.8 it's naked-eye visible under dark sky, and at 20' diameter it's 2/3 the size of the full Moon. It's easy to find 1/3 of the way from Eta to Zeta Herculis (the west side of the keystone), and it has two conspicuous 7th-magnitude guide stars nearby.

The cluster itself is a stunning ball of at least a quarter of a million stars all packed into a space only 150 light-years across. It's 25,000 light-years away and still glorious. The inner core is so full of stars it's hard to see individual points, but the outer reaches easily separate out into strings and whorls of stars.

There's a very subtle trefoil of dark lanes within the cluster that look like a three-bladed propeller. I can see it on some nights, not on others. It doesn't show up well in photographs, either, but many people do see it.

There are a couple of bonus galaxies nearby. Look for NGC 6207 1/2 degree to the northeast. That's 11th magnitude and 3.5' x 1.6' so it's fairly small, but it's reasonably easy to pick out if you have dark sky. The galaxy's core is stellar, and the outer disk is an oval mist.

The other galaxy is a challenge for big scopes (18" or larger). IC 4617 lies between M13 and NGC 6207, but it's only 15th magnitude and 1.2' x 0.4', so it's a very tough find. I've seen it on rare occasions, but the seeing and transparency have to be good. It's fun to try, though, as long as you're in the area.



M13 with the propeller somewhat enhanced

Nu¹ (ν¹) and Nu² (ν²) Coronae Borealis – R.A. 16h 22m 21s, Dec. +33° 47' 57"

The Nu Coronae Borealis pair are a great binocular double. They're 5.2 and 5.6 magnitude, so you can even spot them by naked eye, but it's hard to split them without optical aid. Their separation is nearly 6', though, so just about any binoculars will do it. In a telescope, they're far enough apart to be kind of uninteresting, but they're great in binoculars.

Sigma (σ) Coronae Borealis – R.A. 16h 014m 40s, Dec. +33° 51' 39"

This is the kind of double star that makes you smile. The stars are magnitude 5.5 & 6.5, which makes them bright in any telescope, their difference in brightness gives them character, and the 7.2" separation makes for a snug but easy split even in mediocre seeing. The primary looks slightly yellower than the secondary to me, but they're within a few hundred degrees of one another in temperature (5800-6000K) so that's almost certainly an illusion borne of their differing brightnesses.

The primary is actually a very close spectroscopic binary with a period of just 1.14 days. Those two stars are only six times their radii apart! They're so close they would act as a single star in terms of their influence on their solar system, which means they could have planets orbiting the pair. Inhabitants of those planets could watch their suns go around one another over the course of a day.

Alkalurops – R.A. 15h 24m 29s, Dec. +37° 22' 38" [re-listed from p.42 because it's prominent on this page, too]

Alkalurops, a.k.a. Mu¹ Bootis, is a triple star. The A-B pair are widely separated (1.8'), so are easy in binoculars and are even technically possible by naked eye, but the B-C pair

are tight at 2.2". The A star is magnitude 4.3, B is 7.2, and C is 7.8, so all three are easily bright enough to be visible in almost any telescope, but it will take some magnification to split the B-C pair. All three stars line up in a north-south orientation at the moment. In 65 years or so the BC component will have rotated about a quarter of the way around.

Zeta (ζ) Coronae Borealis – R.A. 15h 39m 21s, Dec. +36° 38' 21"

An easily split double with magnitudes 5.0 and 5.9, separated by 6.3". The primary looks a little yellower than the secondary. Some charts list the stars separately as Zeta¹ and Zeta².

Like Sigma Coronae Borealis above, astronomers have discovered that the primary is a spectroscopic double with a fast (1.7 day) orbital period. There may even be another star orbiting the pair with a 12.6-day period, but that's not confirmed. But wait, there's more!: another companion with a 251-day period, and this one we're sure of. This isn't the 6.3" split; that corresponds to a distance of 929 AU, which would give it a period of many, many years (hundreds).

It's a busy little star system.

Σ 1964 – Struve 1964 (HD 139691) – R.A. 15h 38m 13s, Dec. +36° 14' 58"

This is a tight double-double star in Coronae Borealis. It's not labeled in the PSA, but it's the small double just to the lower right of Zeta Coronae Borealis.

The wide split is 14", and the tight splits are 1.2" and 1.5". Its components are 7.7 & 9.9 magnitude for the western pair and 7.9 & 9.0 for the eastern pair. This is a difficult double-double to fully split, but it's a nice challenge.

PSA Charts 54 & 55

NGC 6210 – R.A. 16h 44m 29s, Dec. +23° 47' 48"

NGC 6210 is a small but fairly bright (mag. 8.8) planetary nebula in southern Hercules. It's bright enough to trigger color vision, so to me it looks distinctly blue. Photos of it look turquoise green, which led to its common name: The Turtle Nebula. The central star is easily visible, which adds a little spice to this one.

Rasalgethi – Alpha (α) Herculis – R.A. 17h 14m 39s, Dec. +14° 23' 25"

This is a popular but surprisingly difficult double to split. At mags. 3.4 & 5.4 they're plenty bright, but at 4.6" separation they're just close enough to make it tough to find the secondary in the primary's glare. It's worth the trouble, though, because they're a colorful pair when you do split them. The primary is yellow-orange and the secondary looks greenish to me. Use the highest magnification that the seeing will allow on this one.

The primary is actually variable, ranging from 3.1 to 3.9 mag. When it's brightest, the double is hardest to split.

IC 4665 – R.A. 17h 46m 18s, Dec. +05° 43' 00"

IC 4665 is a classic example of why I wrote this book. With an IC designation, it's tempting to pass right over it, assuming it to be faint, sparse, and uninteresting. (Why else would three centuries of observers fail to note it? It wasn't cataloged until 1908.) But it's a beautiful cluster! You can see it by naked eye off to the left of Ophiuchus, and it's glorious in binoculars. It's big (over a degree across) and bright (4.2 mag.) and coarse,

with about a dozen bright stars easily seen and up to 30 with a little study. Several strings of fainter stars are visible, and there are many double stars in adjacent fields. This is one to memorize the position of and visit often.

Cr 350 – Collinder 350 – R.A. 17h 48m 06s, Dec. +01° 18' 00"

This is another nice open cluster to the left of Ophiuchus, about the same size as IC 4665 but more uneven in brightness. Its stars are arranged in three lobes, reminding me a little of a three-leaf clover. (One lobe is less obvious than the others, but with a little imagination you can convince yourself it's there.)

There's a nice easy double one degree to the east of the cluster.

Marfik – Lambda (λ) Ophiuchi – R.A. 16h 30m 55s, Dec. +01° 59' 02"

This is a tight double (1.4" separation) and its components are uneven enough in brightness (3.9 & 5.2 mags.) to be a difficult split, but I was able to split it at 300x in a 10" scope. It has a relatively short period for a double star, only 129 years, and its separation is getting smaller, so go for it while you still can!

Kappa (κ) Herculis – Marsic – R.A. 16h 08m 05s, Dec. +17° 02' 49"

Kappa Herculis is an easy double with components of 5.0 & 6.2 magnitude with a separation of 27". It splits in any scope, and I'm even able to split it in 15 x 70 binoculars. Even though the two stars are nearly the same temperature, they look red and yellow to me.

This isn't a true binary star; these two are just lined up so we see them close together. In reality they're 80 light-years apart.

Delta (δ) Serpentis – R.A. 15h 34m 48s, Dec. +10° 32' 20"

This is a fine but somewhat difficult double. At mags. 4.1 & 5.2 it's naked-eye visible, so it's easy to find, and at 4" separation it's a tight but rewarding split. I can't see any colors to them, but some people see the fainter of the two as bluish or greenish.

M5 – R.A. 15h 18m 33s, Dec. +02° 04' 52"

This is my favorite globular cluster of all. Why? Because I discovered it by naked eye long before I had tracked down all the Messier objects. I was looking through a gap in the trees to the right of Serpens Caput when I saw what looked like a fuzzy star. I got out the binoculars and had a look, and sure enough, a fuzzy star! In a telescope it resolved into one of the richest globular clusters in the sky.

M5 is actually brighter than M13. It has a tight core that's so packed with stars it's difficult to resolve, but the outer reaches break into thousands of stars. The cluster lies about 24,500 light years away and spans about 165 light years, making it one of the largest globular clusters known.

M5 contains a couple of bright Cepheid variable stars with periods short enough (less than a month) to follow in a single observing season. It's fun to pick them out on a map and watch them brighten and dim, and it gives you an excuse to stare at this beautiful cluster night after night. The variables are designated V42 and V84 and they have periods of 25.7 and 26.9 days respectively, with V84's period being less certain. Howard Banich wrote a great article about these variables in the June 2014 issue of *Sky & Telescope* magazine.

5 Serpentis – R.A. 15h 19m 19s, Dec. +01° 45' 56"

This is an easy double star right next to M5, so it's fun to stop by for a look while you're in the neighborhood. Its components are magnitude 5 and 10, and their separation is 11". The dim companion makes this a bit of a challenge, but I'm able to split it easily in an 8" scope and bet it would be doable even in a 4".

PSA Charts 56 & 57

M10, M12, M14, M107, M9, M80, and many, many NGC globular clusters in Ophiuchus

Ophiuchus is full of globular clusters. That's because when you're looking into Ophiuchus you're looking just over the bulge of our galaxy's core, and that's where globular clusters hang out: all around the core. Messier picked up six of the brightest ones, but there are literally dozens more with NGC designations. They range from tightly packed to loosely scattered, from large to small, from bright to dim. The Messiers are the brightest and biggest, but take some time to poke around among the rest. If you're one of those people who think all globular clusters look pretty much alike, an hour spent here will change your tune pretty quickly.

I'm not going to describe them all or list magnitudes or sizes; just poke around here and make your own discoveries. These clusters' relative degrees of BBBB will vary with aperture, sky quality, latitude, and your own opinion. I've listed below a few that I found more than just dim smudges in a medium-sized scope, but the more aperture you have, the more fun you might have with even the dim ones. This is a great part of the sky to just scan around in and see what you come across.

NGC 6356 – R.A. 17h 23m 35s, Dec. -17° 48' 47"

NGC 6356 is a nice globular cluster very close to M9. The two will fit into one wide field, and you can see the effect of distance on otherwise similar clusters. M9 is 26,000 light-years away and NGC 6356 is 49,000.

NGC 6342 is about the same distance from M9, but way fainter.

NGC 6284, 6287, 6293, & 6304 – R.A. 17h+, Dec. -20° to -30°

These globular clusters are all relatively small compared to the Messier globulars in the same region, but they're big enough and/or bright enough to show some detail.

Rho (ρ) Ophiuchi – R.A. 16h 25m 35s, Dec. -23° 26' 50"

Rho Ophiuchi is fairly dim at only 4.6 magnitude, so you'll only spot it by naked eye in relatively dark sky. In binoculars, though, it's a great sight because it has two companions of magnitudes 6.8 and 7.3 that make a beautifully symmetrical triangle that looks like a diagram of a water molecule with RhoA as the oxygen atom and its companions as the hydrogen atoms.

The bright primary splits into two components in a telescope. They're only 3" apart, so it takes some magnification, but they're magnitudes 5.0 and 5.9 so they're relatively bright and easy to spot.

Rho Ophiuchi is at the heart of a beautiful multi-colored nebula complex. It only shows up in photographs, so you won't see much of that in a binoculars or a telescope, but the stars themselves are pretty neat on their own.

M19 – R.A. 17h 02m 37s, Dec. -26° 15' 58"

This is a nice, big (17') globular cluster. Its outer regions resolve easily above 125x or so. It's a pretty tightly packed cluster, so the core blurs into a mess of stars, although there are two much brighter stars flanking the core on the north side.

M19 is the most out-of-round globular known, visibly elongated N-S.

[SKETCH? There's a rough one on original printout of PSA charts 41+, page 6.)]

M62 – R.A. 17h 01m 12s, Dec. -30° 06' 49"

M62 looks a lot like M19, only different. Where M19 is elongated, M62 is more circular, but its core is displaced from center enough to be obvious. Both M19 and M62 are fairly close to the core of the Milky Way galaxy, so their distorted appearance may be due to gravitational interactions with the galaxy's massive central bulge.

NGC 6309 – The Box Nebula – R.A. 17h 14m 04s, Dec. -12° 54' 37"

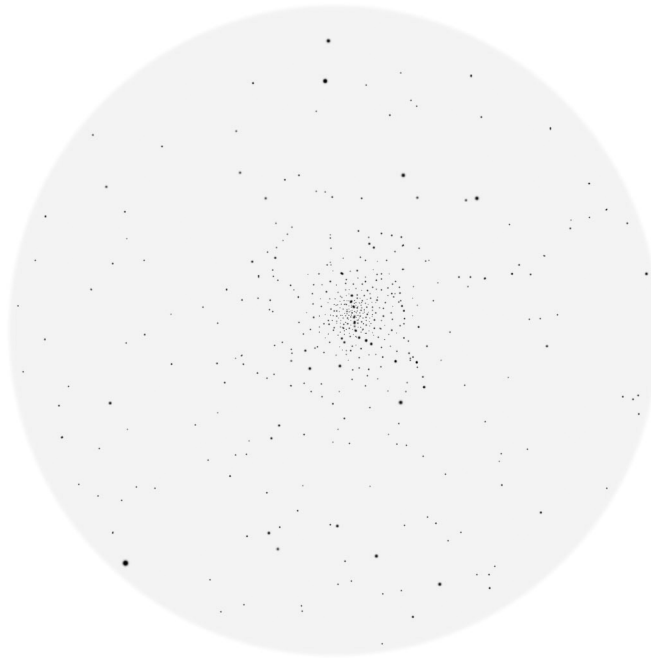
Normally I don't pay much attention to NGC planetary nebulae. The vast majority are too small or too dim to give me much enjoyment, but the Box Nebula is an exception. It's small (12" x 18"), but it's nice and bright and easy to spot with a 10th-magnitude double star (separation 23") just 11' to the west of it. I don't see it as a box — more of an oval — but it's definitely not round. There's a 13th magnitude star just to the north of it, but no central star is visible.

This object is best with some aperture and dark sky, but I can see it pretty well in an 8" scope at about 140x.

M4 – R.A. 16h 23m 35s, Dec. -26° 31' 33"

M4 is a nice globular cluster in Scorpius just 1.3° to the west of Antares. At 7,000 light-years distance, M4 is one of the closest and brightest globular clusters in the sky, but its -26° declination puts it close to the horizon for northern hemisphere observers. It's well worth a look, though, since it's probably the easiest globular cluster to resolve into individual stars all the way to the core. In fact, there's an obvious chain of stars running right through it. It's just a smidgen bigger than the Moon, so use low-medium power. M4 is disappointing in twilight or in light-polluted sky, but it's glorious in full darkness.

N



M4

NGC 6369, the Little Ghost Nebula – R.A. 17h 29m 21s, Dec. -23° 45' 27"

The Little Ghost nebula is a round planetary nebula in Ophiuchus. It's not exceptionally bright (11.5 mag) or large (30"), but with a little aperture it's fairly nice. In an 8" scope it's a distinctly annular ring with a little brightening on the northern side of the ring. Larger aperture makes this bright area even more distinctive. There's no central star visible.

Xi (ξ) Scorpii – R.A. 16h 04m 21s, Dec. -11° 22' 15"

Down at the base of Ophiuchus, below where Serpens runs through, lie two great double stars in the same field of view. Xi Scorpii is one of them, and it's actually a triple. The A and B components are only separated by one arc-second, so that's an unlikely split unless you have both aperture and good seeing, but the AB-C split is an easier 7.4". The component magnitudes are A: 4.8, B: 5.1, and C: 7.6.

Right next to them, and considered part of a larger multi-star system is the following entry, Struve 1999:

Σ 1999 – Struve 1999 – R.A. 16h 04m 25s, Dec. -11° 26' 50"

Very close (4.7") to Xi Scorpii, Struve 1999 is an even easier double. Its components are mags. 7.4 & 8.1 with a 12" separation. It's fun to see both easy doubles in one field of view.

Nu (ν) Scorpii – Jabbah – R.A. 16h 12m 00s, Dec. -19° 27' 39"

Nu Scorpii is one of the rare double-double stars. Its low declination makes it more difficult to split than the ones in Lyra, since you're looking through a lot more turbulent

atmosphere, but it can be done on a night of good seeing.

The wide pair splits in just about any scope in all but the worst seeing. It's a 41" separation, enough to pull apart in binoculars. The tighter pairs, though, are tough. The dimmer (mags 4.4 & 6.9) reddish pair to the north are 2.3" apart, and the the brighter (mags 4.4 & 5.4) white pair are only 1.3".

Beta (β) Scorpii – Graffias – R.A. 16h 05m 26s, Dec. -19° 48' 20"

Just a degree and a half from Jabbah (above), Graffias is an easy double with components of magnitude 2.6 & 4.9 separated by a generous 14".

Antares – R.A. 16h 29m 24s, Dec. -26° 25' 55"

The name "Antares" means "Rival of Mars." It's so named because it has the same distinctive red color as the planet, and similar brightness when Mars is close to Earth. It's a red supergiant with a diameter greater than Mars's orbit, and it's massive enough to explode in a supernova in a few million years when it runs out of fuel in its core. It's a double star, with components of magnitude 1.1 and 5.5, but with a separation of only 2.9" it's an extremely difficult split. I've never managed it, but I keep trying every time I get the chance. (They say the dimmer of the pair looks emerald green compared to Antares's reddish hue.) In the meantime, it's a nice, bright red giant star that twinkles beautifully low in the south.

The best time to see Antares's dimmer companion is to catch it during a lunar occultation. Every few years the Moon crosses in front of Antares, and when they reappear from behind the Moon the dimmer star appears first. You can see it by itself for a second or two before the brighter component shows up. These occultations happen in cycles, with the next one starting in 2023.

NGC 6144 – R.A. 16h 27m 14s, Dec. -26° 01' 25"

A globular cluster very near Antares. At mag. 9.0 and only 7' in diameter it's too small and faint to be really BBBB, but it does resolve into some stars with averted vision at high power. Put Antares outside the field if you try for this one.

36 Ophiuchi – R.A. 17h 15m 20s, Dec. -26° 36' 29"

36 Ophiuchi is a perfect double star. The two components are exactly matched at magnitude 5.1, and they're separated by 5.1 arc-seconds, which makes them just tough enough to be fun. Both stars are orange dwarfs, so they might look a little reddish in the eyepiece, but their color is subtle.

The stars are only 19.5 light-years away, making them the 14th closest star system to our own. Their separation will remain about the same for the next several decades, but then they will begin to swiftly close the gap. By 2150 they'll be so close together they won't be splittable. So go for them while you can!

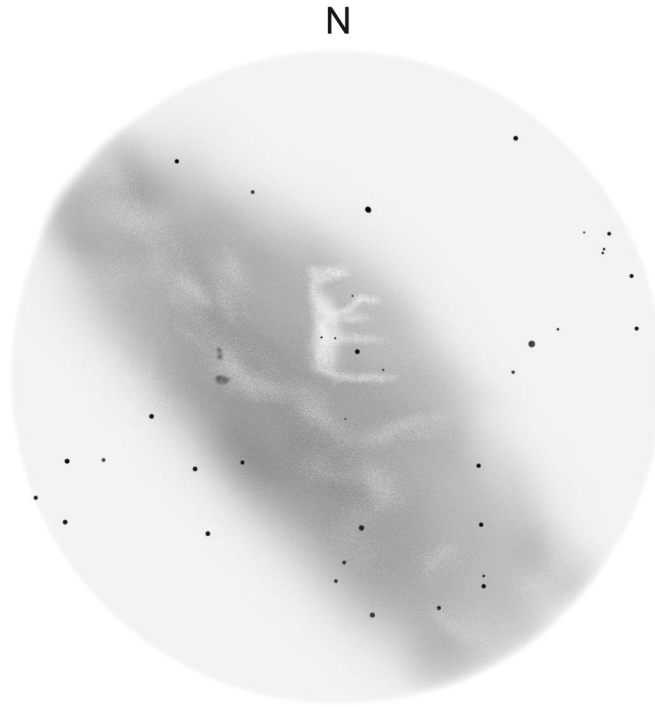
NGC 5897 – R.A. 15h 17m 25s, Dec. -21° 00' 37"

A globular cluster of magnitude 8.5. This one is quite diffuse compared to most globulars. It starts to break into stars at about 100x.

The Dark Horse Nebula

This is a very large (10-degree) complex of dark nebulae between Scorpius, Sagittarius, and Ophiuchus that looks like a dark horse rearing upward. The Pipe Nebula

makes up its hindquarters, and the various Barnard nebulae to the north of it make up its back, forelegs, and head. Barnard 63 even looks like a bent foreleg. This is only visible by naked eye (too big for binoculars or a telescope) and only under dark sky, but once you see it it's surprisingly vivid.



The Dark Horse Nebula

PSA Charts 58, 59 & 60

NGC 6302 – (Caldwell 69) – The Bug Nebula – R.A. 17h 13m 44s, Dec. -37° 06' 06"

The Hubble images of this nebula reveal one of the most interesting planetary nebula in the sky, with two lobes stretching out from a pair of curved shock waves at the center. In an amateur telescope it's a bit less impressive, but it's still interesting enough for a look. At 9.7 magnitude it's relatively bright, and with some magnification you can see the two lobes and a bright central patch that looks like the progenitor star but is actually just a brighter part of the nebula. The overall nebula is definitely elongated, measuring 0.4' x 1.4'.

V856 – R.A. 16h 08m 34s, Dec. -39° 06' 18"

This star is marked as a variable and double in the Pocket Sky Atlas. Its brightness varies from mag. 6.8 to 8.0 with an irregular period, but its real attraction is that it's part of a bright, easy double with mag. 6.6 V1027 44.2" away.

NGC 6231 – R.A. 16h 54m 10s, Dec. -41° 49' 00"

This open cluster is very bright: magnitude 2.6 overall, but it's very low in North

American skies, nestled in at the bottom of Scorpius where the stinger curves away from the body. It's worth looking for, though, since its hot blue stars punch right through the thick atmosphere and deliver a beautiful, often twinkling show. It looks a lot like the Pleiades would look if it were farther away.

This cluster is also known as Melotte 153 and Collinder 315. Ironically, it's also nicknamed the "Northern Jewel Box." Well, yeah, it's farther north than the other Jewel Box (NGC 4755, at -60° declination), but at -41° , the Northern Jewel Box isn't very far north.

It's still worth a good look, because it's so big and bright.

NGC 6397 – R.A. 1h 40m 42s, Dec. $-53^\circ 40' 27''$

This is a pretty decent globular cluster, from what I hear. It's too far south for me to see, but for those who can it shines at magnitude 5.7, so it's just discernible by naked eye. It's about the same size as the Moon, so it stands out nicely in a telescope. Plus it's one of the closest globular clusters to Earth, so it busts into individual stars nicely. It has a tightly condensed core, much like M15.

PSA Chart 61

40/41 Draconis – R.A. 18h 00m 04s, Dec. +80° 00' 03" (Repeat listing from chart 51, since these stars are prominent on both charts.)

Located right at the intersection of two main gridlines of R.A. and Dec., 40 and 41 Draconis make a nice, easy double star. It's rare for two stars this close together to receive separate Flamsteed numbers, but 40 and 41 Draconis have that honor. Maybe it's because they're such an obvious double in a telescope (and even splittable in big binoculars) and they're so similar to each other in brightness (magnitudes 5.7 and 6.0) that Flamsteed couldn't number just one of them. In any case, they do make a very nice easy pair between the body of Draco and the handle of the Little Dipper. These stars are both spectral class F, a little cooler than our Sun, so some people see them as cream colored, but I see them as brilliant white.

Kappa (κ) Cephei – R.A. 20h 08m 53s, Dec. +77° 42' 41"

This is a very uneven double star, with components of magnitudes 4.4 and 8.4, but with a separation of 7.3" it's still pretty easy. I got it at 70x in an 8" Dob with room to spare. The components look white (primary) and faintly blue (secondary) some nights, and greenish/reddish on other nights, but this color difference may be due to the difference in brightness more than actual color.

The Pocket Sky Atlas shows a 7th-magnitude star about 7' to the north-northwest. That's far enough to be uninteresting in a telescope, but it's fun (and easy) to split this one in binoculars. I've tried to split it by naked eye, but even though it's just a little dimmer and a little tighter than Mizar and Alcor (PSA page 32), I haven't been able to do it. It's a good challenge, though. Give it a try!

UX Draconis – R.A. 19h 21m 36s, Dec. +76° 33' 35"

UX Draconis is a carbon star, one of the reddest stars in the sky. It's 6.2 magnitude, so just visible to the naked eye under dark sky, but you won't see color until you use binoculars or a telescope. To me it looks more orange than red, but it's a nice, rich orange.

Σ 2452 – Struve 2452 – R.A. 18h 53m 33s, Dec. +75° 47' 15"

This double star isn't labeled in the Pocket Sky Atlas, but it's easy to find: It's between 50 and 59 Draconis, just to the right of UX Draconis (above). It's an even pair of 7.4 magnitude stars separated by 5.6", so it's a bit of a tight split but rewarding when you do it.

Psi (ψ) Draconis – Dziban – R.A. 17h 41m 56s, Dec. +72° 08' 56"

This is a good binocular double, with components of magnitude 4.6 and 5.8 separated by 30". It's nice in a telescope, too. The stars are just different enough in brightness to be noticeably different, but both are easily visible. Both components are white.

NGC 6503 – R.A. 17h 49m 27s, Dec. +70° 08' 40"

NGC 6503 is a spiral galaxy seen nearly edge on, which gives it a long, slender appearance. At 10th magnitude it isn't the brightest galaxy in the sky, but it's reasonably visible with a little aperture and dark sky. It's obvious in a 12" scope. As far as edge-on

spirals go, it's not the Needle Galaxy, but it's pretty good.

Omicron (o) Draconis – R.A. 18h 51m 12s, Dec. +59° 23' 18"

Omicron Draconis is an uneven (mags. 4.6 and 8.3) but easy (separation 37") double. The primary is yellowish and the secondary looks bluish by comparison.

39 Draconis – R.A. 18h 23m 55s, Dec. +58° 48' 03"

This is a tight (3.7") but relatively bright (mags. 5.0 and 8.1) pair that provides a good challenge after easy Omicron. I don't notice much color to this pair.

PSA Charts 62 & 63

Σ 2840 – Struve 2840 – R.A. 21h 52m 00s, Dec. +55° 47' 31"

A bright (Mags. 5.7 & 6.4), easy (17.7"), slightly uneven double with a subtle color difference. The primary looks a smidgen yellower to me. It lies on the west edge of the Milky Way, so the sky grows richer to the east very quickly as you scan your scope that direction.

NGC 7128 – R.A. 21h 43m 57s, Dec. +53° 42' 00"

An open cluster just inside the Cygnus boundary with Cepheus. Not exactly big, but definitely cute amid the thick Milky Way. It's small but distinct in the midst of a sparse (by comparison) patch. It's a lopsided oval of 7-8 stars (including a double) with more scattered outside the oval.

16 Cygni – R.A. 19h 41m 49s, Dec. +50° 31' 30"

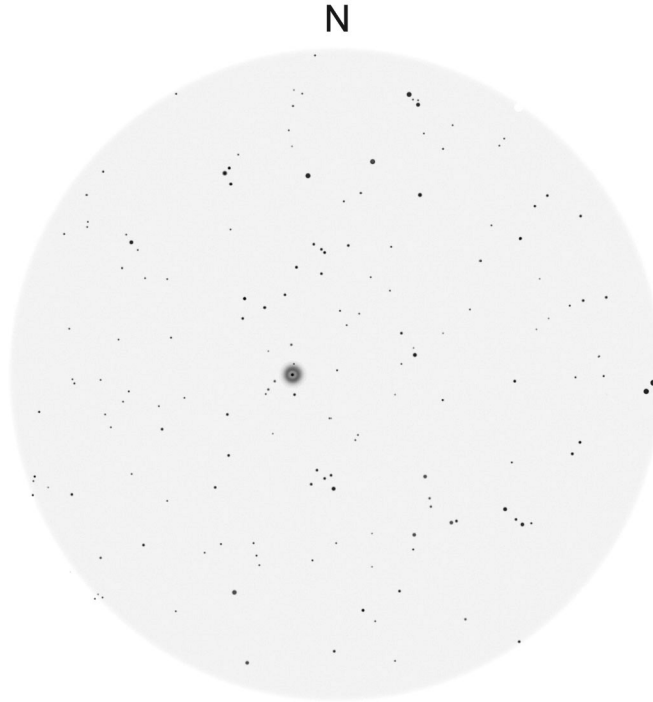
16 Cygni is an easy double star very close to the Blinking Planetary Nebula (next entry). It's naked-eye visible (mags. 6.0 and 6.2 for a combined brightness of 5.0) and easy to split (40"). It's a nice sight in itself, but it also makes a good signpost that you're close to the Blinking Planetary.

Don't confuse this double with 61 Cygni (described below), a much more famous double on the other side of the constellation.

NGC 6826 – (Caldwell 15) – The Blinking Planetary Nebula – R.A. 19h 44m 48s, Dec. +50° 31' 30"

This planetary nebula is so named because it has a bright central star and the surrounding nebula is just dim enough to require averted vision to see well. So if you look at the central star, the nebula goes away, and if you look away, the nebula returns. The nebula isn't doing the blinking; *you* are by moving your eyes away and back. It's a great effect, probably best in an 8" telescope but you can play with magnification to get it the right brightness in just about any scope.

This one is a bit small, so it's hard to find in a low-power field, but it's straight east of 16 Cygni by almost exactly half a degree. If you center 16 Cygni in your eyepiece and wait three minutes, the planetary will be centered.



NGC 6826, The Blinking Planetary Nebula

Omicron ($\omicron^1$) Cygni – R.A. 20h 13m 38s, Dec. +46° 44' 31"

This star is also known as 31 Cygni, and it's part of a very wide triple system (separation of 106" and 331"). The split is easy-peasy even in binoculars, so no challenge there, but the main attraction is the stars' difference in color. The brightest component is distinctly yellow, its closer companion is blue-green, and the distant third (30 Cygni) is white.

M39 – R.A. 21h 31m 48s, Dec. +48° 26' 00"

M39 is a large (half a degree), coarse, loosely packed open cluster. It's stars are mostly magnitude 6–9, but their combined brightness of 4.6 makes it visible to the naked eye, but in such a dense part of the Milky Way it's easily overlooked. It's good in binoculars and at low power in a telescope. It's a little too sparse to be great, but it's nice enough to warrant a look.

IC 1369 area – R.A. 21h 12m 06s, Dec. +47° 44' 00"

This open cluster is too sparse and faint to qualify as BBBB, but as I was searching around for it I ran across lots of dark nebulae all around the area. That's always an interesting contrast to the bright stuff, so I decided to include it here.

NGC 7062 – R.A. 21h 23m 27s, Dec. +46° 22' 00"

This is a small open cluster, but it's delicate and looks kind of neat nestled in among the background stars of the Milky Way. It's a distinct cluster of faint stars, but it does resolve nicely. Outside the Milky Way, it would be a showpiece, so I include it as BBBB.

NGC 7000 – (Caldwell 20) – North America Nebula – R.A. 20h 58m 48s, Dec. +44°

20' 00"

This is a huge (2 degree!) patch of emission nebula with dozens of stars embedded in it. It's most easily seen at low power with a nebula filter, but you can pick it out with binoculars or even by naked eye. Its integrated magnitude is 4.0, but it's so big that its surface brightness is pretty low. The cool thing about it is that it looks like the North American continent. The curve of Mexico around the Gulf of Mexico is the brightest part, and will nearly fill the field of view even at low power. (The nebula is right side up in the sky, so it'll look upside down in a Newtonian telescope.)

It's fun to start with Mexico and see how far up the coast you can follow the nebula before it fades into the background. There are many bright stars scattered throughout the nebula, giving it a cities-at-night sort of look. Also check out Xi (ξ) Cygni, a bright orange star, just out into the Pacific a ways.

Pelican Nebula – R.A. 20h 50m 48s, Dec. +44° 21' 00"

Just across the Atlantic Ocean from the North America nebula lies the Pelican Nebula, a dimmer, somewhat smaller (but still over a degree across) patch of additional emission nebulosity. It's harder to see, but you'll be able to pick out some of it in a medium-sized telescope with a nebula filter. The easiest parts lie between the bright stars 56 and 57 Cygni.

The North American and Pelican nebulae are actually a single emission nebula with an obscuring dark lane in front of it. The star that lights up the whole works is hidden behind this dark nebula, but has been identified in infrared studies.

U Cygni – R.A. 20h 19m 37s, Dec. +47° 53' 39"

U Cygni is a particularly interesting carbon star. It varies in magnitude from 5.9 to 12.1, so it will completely disappear from sight in a small scope at its minimum. At its maximum, it outshines its mag. 7.9 companion an arc-minute away. The color contrast between the two is intense, too, with U Cygni being a deep orange-red and HD 193700 being a yellow star much like our Sun. It's not much to look at when U Cygni is at the dim point in its 463-day cycle, but when it's bright enough to trigger color vision, this may be the most color-contrasty double in the sky after WZ Cassiopeiae.

Don't confuse this with epsilon (ε) Cygni 4.5° to the southeast of 61 Cygni. Epsilon Cygni is a hot blue star.

NGC 7027 – R.A. 21h 07m 02s, Dec. +42° 14' 10"

This is a small planetary nebula, but I include it here because it's another one (like NGC 6572, the Emerald Nebula) that's bright enough to show color when you look at it directly. It looks blue-green to me, and goes to gray when I look away.

It's only 18" across, so if you want to see more than just its color, you'll need some magnification on it. 100x starts to show its boxy appearance.

61 Cygni – Piazzi's Flying Star – R.A. 21h 06m 54s, Dec. +38° 44' 58"

61 Cygni is one of the coolest double stars in the sky. It's relatively close to us (only 11.4 light years) and bright (mags. 5.2 and 6.0), with a wide enough separation (32") to easily split in almost any telescope. What makes it so cool? Well, temperature for one thing. Both components are orange K-type dwarf stars radiating at only 4400K. (By comparison, our Sun radiates at 5800K.) They're noticeably redder than most stars in the sky. I see them as yellow-orange. Note that they're not considered red dwarfs. They're

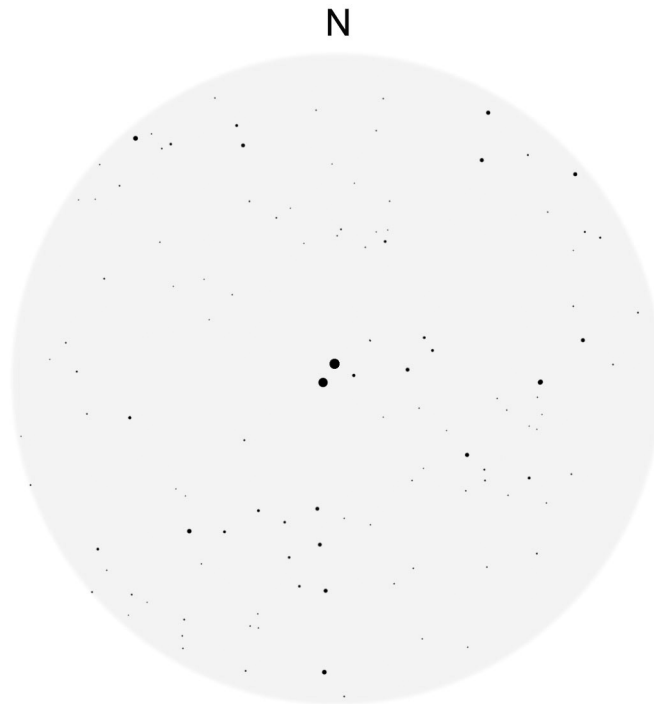
still on the main sequence as far as star types are concerned; just on the low end of the scale.

They also move really fast. They're sweeping by our solar system at 108 kilometers per second, which translates to 5 arc-seconds per year. That doesn't sound like a lot until you realize that you can easily split a double star with a 5" separation. These stars move that far in a year.

And there's a bonus: for the next several years there's a convenient background star to measure that motion against. 10.7 mag. TYC 3168-0590-1 lies right along their path, and in 2012 61 Cygni A passed right over it. Now it's moving away, but it's still close enough that if you sketch the three stars carefully and come back in a year you can definitely see their motion.

61 Cygni was named the "Flying Star" by 18th-century astronomer Giuseppe Piazzi because of its high proper motion, so nowadays we call it "Piazzi's Flying Star." It's well worth a look more than once a year, but do make an effort to sketch it at least once a year for the rest of your life. You'll be amazed at how far it moves.

The two stars move along together through space, but they do orbit each other as well with a period of 650 years. They will be at their widest separation (34") around the year 2100.



61 Cygni, Piazzi's Flying Star

Omicron¹ Cygni – R.A. 20h 13m 38s, Dec. +46° 44' 29"

O¹ Cygni is a very wide triple star. It's not a challenging split at all, even in binoculars, but it's interesting for the color contrast between its yellow, white, and blue/green stars.

Delta (δ) Cygni – R.A. 19h 44m 58s, Dec. +45° 07' 51"

Delta Cygni is a tough-splitting double. It's uneven at mags. 2.9 and 6.3, with only 2.8" separation. I can only split it on nights of good seeing, but it's a fun challenge and easy enough to find. It's the northwest bend in Cygnus's wing.

Fun fact: due to precession of the Earth's axis, for a few centuries around 11,000 A.D., Delta Cygni will be the North Star.

NGC 6811 – R.A. 19h 37m 17s, Dec. +46° 23' 00"

This is a nice, big open cluster in an already-dense Milky Way starfield. It contains many strings of stars, and a couple distinctly orange stars. It's about a quarter of a degree across, but I think it still looks best at low power so I can see it in context.

NGC 6866 – R.A. 20h 03m 55s, Dec. +44° 09' 00"

An obvious cluster, although nearly lost amid the myriad stars of the Milky Way. Even so, it's well worth tracking down just for the beautiful scenery as you hunt for it. The cluster itself is about a quarter degree across and about 7th magnitude altogether, composed of 10th and 11th magnitude stars.

AX Cygni – R.A. 19h 57m 13s, Dec. +44° 15' 40"

AX Cygni is a carbon star that varies from 7.8 mag. to 8.8, so it's not terribly bright, but it's a very deep orange. The first time I looked at it, an airplane flew right over it. Yow!

NGC 6819 – R.A. 19h 41m 16s, Dec. +40° 11' 00"

This open cluster isn't just nice, it's *very* nice! It's a tall W of coarse stars surrounded by a smattering of fainter stars, all in a rich part of the Milky Way. Even though this one is smaller than NGC 6811, it's also best at low to medium power for context.

M29 – R.A. 20h 23m 57s, Dec. +38° 30' 00"

M29 is just a small cluster of 7 or 8 bright stars, but it's remarkable in that six of the stars make up a pair of parentheses facing the wrong way, thus:) (. The period is part of the cluster, too, and when I look at it I see a nuclear power plant with the cooling tower and the reactor building next to it. Probably not what Messier thought it looked like when he discovered it in 1764.

The sky is rich with stars here, since the Milky Way runs right through Cygnus, but M29 stands out clearly against the background.

NGC 6888 – (Caldwell 27) – The Crescent Nebula – R.A. 20h 12m 30s, Dec. +38° 25' 00"

I list this for the people with lots of aperture. It's a big (1/3-degree) emission nebula with a fairly bright integrated magnitude (7.4), but because that's spread out over so much area the surface brightness is quite low (22 mags. per square arc-second). You'll probably never see it in a small scope, but if you have 10" or more of aperture, dark sky, and a UHC or OIII filter, this can be one of the best nebula in the sky.

As its name implies, it's crescent shaped. It's actually a big oval of gas being blown off by a Wolf-Rayet star, but the northwest arc is much brighter than the rest. To some, it resembles a loaf of home-baked bread. The surface is mottled, which makes it look like a brain to me. There are four bright stars embedded in the northeast end. The one closest to the middle is the Wolf-Rayet star. It's in the last throes of stellar life, and will probably

explode in a supernova sometime in the next million years or so.

Veil Nebula – NGC 6960, 6974, 6992, & 6995 – R.A. 20h 45m 40s, Dec. +30° 43' 11" (to 52 Cygni)

Like the Crescent Nebula, the Veil requires aperture and a nebula or OIII filter to really appreciate, although I've enjoyed it with binoculars on a very dark night. Binoculars are the only way you'll see the whole thing at once, because it's really big. It's a supernova remnant that has expanded to nearly three degrees across (six times the diameter of the Moon) in the 5-8,000 years since its explosion.

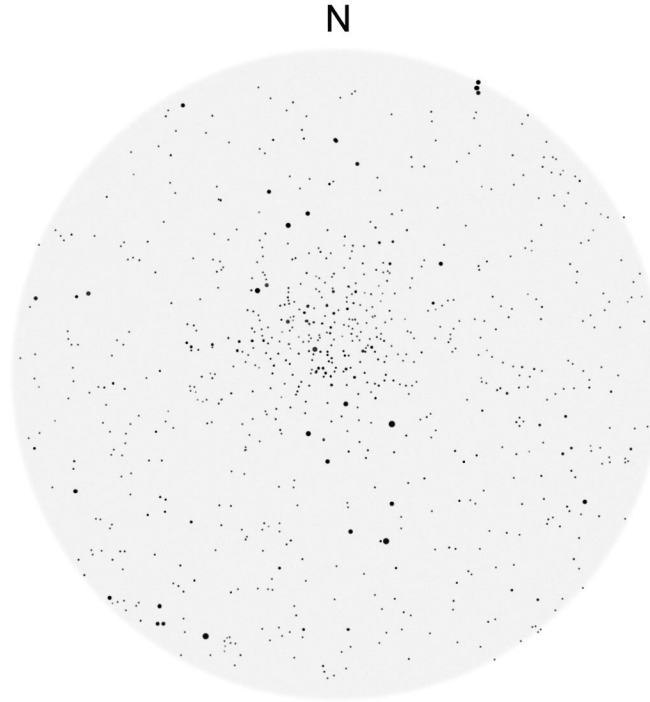
What's left of it is an interrupted circle with two main arcs to the northeast and southwest, with the southwestern arc running right over the star 52 Cygni. 52 Cygni is 4th magnitude, so easy to see in dark sky, which makes finding the Veil a snap.

Once you've found it, you can trace filaments all around the area. The southwestern part, with 52 Cygni embedded in it, is often called the "Witches Broom," although I think the eastern part looks more broom-like. There's a long filament running north-south more or less across the center, the northern section of which is called "Pickering's Triangle."

NGC 6940 – R.A. 20h 34m 26s, Dec. +28° 17' 00"

This open cluster is often overlooked, but it's Big, Bold, Bright, and Beautiful nonetheless. It's in Vulpecula, right under the body of Cygnus, below the Great Rift in the Milky Way. There are dozens of open clusters in the area, but this one stands out for me because of its size (nearly as big as the Moon) and the relative uniformity of its stars. There are a few bright stars, including a nice red giant near the cluster's center, but most of the 50-100 stars that you can see easily are about 11th to 12th magnitude. That makes for a soft, delicate, yet very definite concentration amid the general glow of the milky way. If most clusters look like salt on velvet, this looks like powdered sugar sifted over chocolate ice cream.

You'll want low power for NGC 6940. Give yourself at least a degree of field, more if you can, so you can see it in context. It looks great in binoculars, too.



NGC 6940

NGC 6882 and 6885 – (Caldwell 37) – R.A. 20h 12m 01s, Dec. +26° 28' 00"

NGC 6882 and 6885 are two clusters that intermingle so completely that they look like a single cluster. It's not exceptionally showy, but it's nice enough to reward tracking it down. Centered around the 6th-magnitude star 20 Vulpeculae, the cluster spans about a third of a degree and comprises maybe 50 stars from 9th magnitude on down.

There's a squat triangle on the southwest side of the cluster that has a nice double at its outermost apex. They're magnitude 9 and 11 and are separated by about 20". They're not listed as a true double any place I've been able to find, so they're probably just a chance alignment, but they're still a pretty sight.

Epsilon (ε) Lyrae – R.A. 18h 44m 20s, Dec. +39° 40' 12" (to Epsilon¹)

This is the famous "Double double." With two tight (2.2" and 2.4") pairs separated by a generous 208", this is a favorite test of telescope optics. The two pairs split in opposite directions, so you know you're not making it up when you see them truly split. The tighter pair splits in the same direction as the line between pairs, and the wider pair splits perpendicular to that.

Even though there's only 0.2" difference in the separations between the two pairs, the tighter pair is noticeably more difficult to split. That may be due to the imbalance in brightness between those two stars (mags. 5.0 and 6.1). The other pair is much closer in brightness (5.2 and 5.4), while being slightly farther apart.

The wide split between pairs is enough to see easily in binoculars, and even by naked eye under good viewing conditions.

Σ 2470 and 2474 – Struve 2470 and 2474 – R.A. 19h 08m 45s, Dec. +34° 45' 37" (to

Struve 2470)

Epsilon (ε) Lyrae, the famous double-double mentioned above, gets all the glory, but Lyra holds a second double-double that I think is even prettier: Struve 2470 and 2474. These pairs are separated by a very generous 10', and the individual pairs are separated by 16" and 14". Both of them split east-west, and both have the brighter component to the east. They look like a double and its reflection in still water. This is a great object for star parties; they're much easier to split than Epsilon, and more beautiful.

M57 – The Ring Nebula – R.A. 18h 53m 36s, Dec. +33° 01' 40"

The Ring Nebula is one of the best planetary nebulae in the sky. At magnitude 8.8 and measuring 1.4' x 1.1' across, it's big and bright enough to see in almost any telescope.

Planetary Nebulae are the remnants of red giant stars that have thrown off their outer envelopes and shrunk back down to become white dwarfs, their intense light energizing the surrounding gas until it fluoresces. The 16th-magnitude white dwarf is just barely visible in large scopes at high magnification on nights of steady seeing, but is usually not possible to see in modest aperture scopes.

It's tempting to think of the Ring as the edge of a spherical bubble, and indeed that's what I thought it was until I did the research for this book. Instead I found that it's a hollow cylinder of gas seen end-on. Many planetary nebulae have a cylindrical or bi-lobed appearance, presumably from the influence of a companion star or solar system orbiting the primary.

Compare the Ring Nebula to the Dumbbell Nebula (PSA page 64, below) and the Helix Nebula (PSA charts 76 & 77) for an example of progressively larger, closer, and dimmer planetary nebulae.

M56 – R.A. 19h 16m 36s, Dec. +30° 11' 01"

People often overlook poor M56, because it's surrounded by so many other cool objects. It's a worthy object in its own right, though: A globular cluster a long ways from the cluster of them around Sagittarius. This one is medium-bright at 8.3 magnitude, and medium-sized at 8.8', but it's a beautiful sight against the background of the Milky Way's multitude of stars. It's hard to bust into individual stars, but its soft glow is a definite bright spot in the general glow of the galaxy.

Albireo – R.A. 19h 30m 43s, Dec. +27° 57' 35"

Albireo could very well be the best double star in the sky. It's magnitude 3.1 and 4.7 components are bright enough to see in any telescope in any sky, and their generous 34" separation makes them easy to split at almost any magnification. I've even split them in binoculars.

They're also easy to find: they're the head of Cygnus the swan.

Their real attraction isn't their ease of finding or of splitting, though; it's their beautiful color contrast. The primary is a distinct golden yellow, while the secondary is an equally distinct blue. You seldom see color in deep-space objects, but these two stand out wonderfully. This is one of the best objects to show people at star parties. People truly love to see this two-color gem.

For hundreds of years we didn't know if they were a true double star or just a chance alignment, but the European Space Agency's Gaia spacecraft settled the matter in 2018 by determining that their individual proper motions, their movement through space, were too different to allow them to be in orbit around one another. So this is just a chance

alignment. Enjoy it now before they move too far apart to be interesting anymore!

PSA Charts 64 & 65

95 Herculis – R.A. 18h 01m 30s, Dec. +21° 35' 43"

95 Herculis is a nice evenly-matched double star way over on the east side of Hercules. The components of magnitudes 4.9 and 5.1 are spaced 6.4" apart, making them a fairly easy split on a night of good seeing.

M27 – NGC 6853 – The Dumbbell Nebula – R.A. 19h 59m 36s, Dec. +22° 43' 01"

The Dumbbell Nebula is one of the most interesting planetary nebula in the sky. It's almost as bright as the Ring Nebula (above), but larger and much more interestingly shaped. In reality it's shaped like an hourglass surrounded by a more spherical shell of fainter nebulosity, and we're seeing it from the side so we see two distinct lobes embedded in a more tenuous general glow.

In small aperture telescopes the lobes are most prominent, so it does look a bit like an old-style dumbbell with the wide rings of weights on the end. As you increase in aperture, though, or use a nebula filter, you start to see more of the surrounding gas, which transforms it into more of a football shape.

It's in a rich part of the Milky Way, so you'll also see a lot of background and foreground stars within the nebulosity. The central star that created the whole works is visible in large scopes.

The Dumbbell is easy to spot in binoculars, too.

NGC 6905 – The Blue Flash Nebula – R.A. 20h 22m 22s, Dec. +20° 06' 18"

NGC 6905 is a smallish (0.8 arc-minute) planetary nebula in Delphinus. It's relatively bright, though, bright enough to trigger color vision and reveal its light blue hue. (It's 11th magnitude listing is deceptive — it's much easier to see than you'd expect.) It's nestled in a triangle of 10th, 11th, and 12th magnitude stars, and its 14th-magnitude central star is visible with enough aperture and magnification. With a big scope you'll also see some annularity.

This is one of those objects where the numbers seem discouraging, but the reality is much better than you'd expect, especially if you have a large scope to enjoy it with.

Gamma (γ) Delphini – R.A. 20h 46m 39s, Dec. +16° 07' 28"

This is one of my favorite double stars, probably because it's so easy to remember and so easy to find. It's the nose of Delphinus the dolphin, and of course a nose has two nostrils. They're not quite evenly matched; one is magnitude 4.3 and the other 5.0. They're separated by 8.9", which makes them an easy split in just about any scope.

They look to be the same color at first, but more careful examination shows that the primary is distinctly more golden than the secondary, which looks green in comparison.

Gamma Delphini is only 104 light-years away, and its components are true pair with an orbital period of about 3,200 years. They're drawing closer together at the moment and will continue to do so until about the year 2300, when they will be only 1.4" apart. Catch them now while they're still an easy split!

Struve 2775 – R.A. 20h 46m 13s, Dec. +15° 54' 27"

Struve 2775 isn't labeled in the Pocket Sky Atlas, but it's marked as a double right below Gamma Delphini, just a smidgen down the lower body from the dolphin's nose. It will fit in the same field of view of a medium-power eyepiece, making the two pairs a double-double of sorts. (Struve 2775 is about 15-20 light-years farther away, so they're unlikely to be a real double-double.)

This pair is considerably dimmer at magnitudes 7.6 and 8.2, and their separation is tighter at 6.2", so this is a little tougher pair to split than Gamma Delphini, but it should be pretty easy in most scopes.

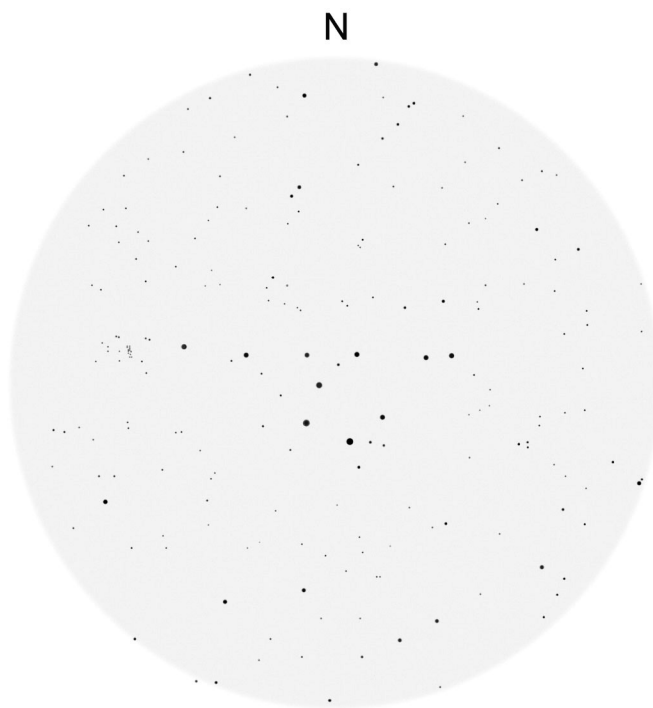
Collinder 399 – The Coathanger – R.A. 19h 25m 23s, Dec. +020° 11' 03"

Another great binocular target is **Collinder 399**, also known as **Brocci's Cluster** and **The Coathanger**. It's an asterism, a chance alignment of stars that in this case looks like a coathanger. It's upside-down in binoculars, but upright in a telescope. You'll want your widest field possible for this one; it spans a degree and a half.

NGC 6802 – R.A. 019h 30m 34s, Dec. +20° 15' 03"

Just to the east of the coathanger, straight in line with the bar, you'll find a small open cluster, **NGC 6802**, whose stars are arranged in an oblong oval that looks a little like a figure 8 or a helix. Plus it has a bonus to the north: yet another double-double.

Bonus: Work your way back into the Coathanger from NGC 6802. The second Coathanger star inward from that side has another couple of tight doubles nearby.



Collinder 399, the Coathanger, with NGC 6802 to the left

M71 – R.A. 19h 53m 46s, Dec. +18° 46' 45"

M71 is a smallish globular cluster in Sagitta, the arrow. It shines at 8.2 magnitude and it's 3' across, so it's easy enough to spot just below the shaft of the arrow. Its stars are

packed relatively loosely for a globular cluster, so when you get enough aperture and magnification on it, you can resolve it all the way to the core. It's so loosely packed that it was long thought to be an open cluster rather than a globular, but spectroscopic study of its individual stars revealed its true nature.

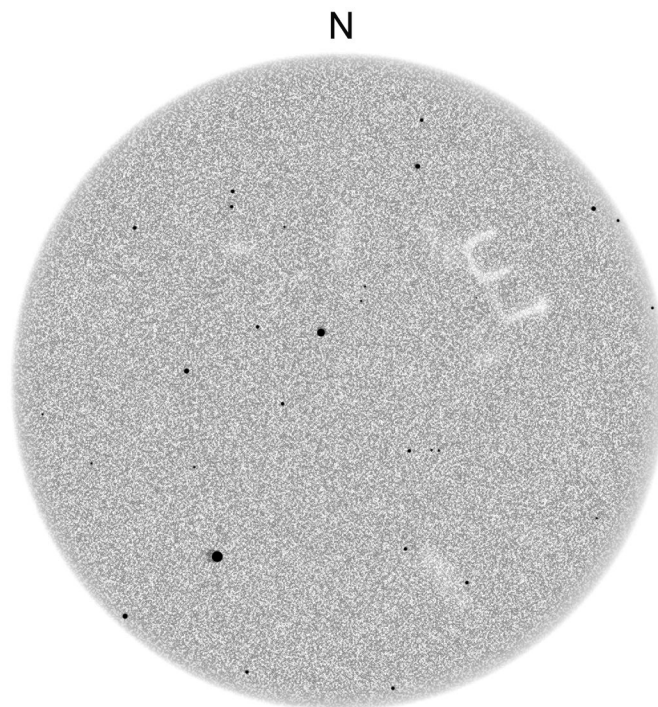
This cluster is relatively close to us at 13,000 light-years, which means it's pretty small as far as globular clusters go (about 27 light-years across).

NGC 6934 – (Caldwell 47) – R.A. 20h 34m 11s, Dec. +07° 24' 16"

NGC 6934 is a globular cluster down below the tail of Delphinus, the dolphin. It's not the biggest nor the brightest globular in the sky, but it's the biggest and brightest in Delphinus, and it's worth stopping by on your way through. In 8" or larger scopes you can break it into stars.

Barnard's E – The Triple Cave Nebula – R.A. 19h 40m 00s, Dec. +10° 31' 00"

Barnard's E is a Big, Bold, Dark, and Beautiful nebula in Aquila, just to the west of Tarazed, the bright star just above Altair. It's officially two separate dark nebula, B142 and B143, and in photographs they do seem distinct enough, but in binoculars or a telescope at lowest power they look like a great big capital letter "E" in the sky. The upper part of the E has a more distinct connection between the bars, while the lower part is mostly the horizontal bar, but it's definitely a big E. Dark nebulae always seem best in binoculars and this one is no exception. You'll need good dark sky to appreciate it, but it's a great sight when conditions are right.



Barnard's E, the Triple Cave Nebula

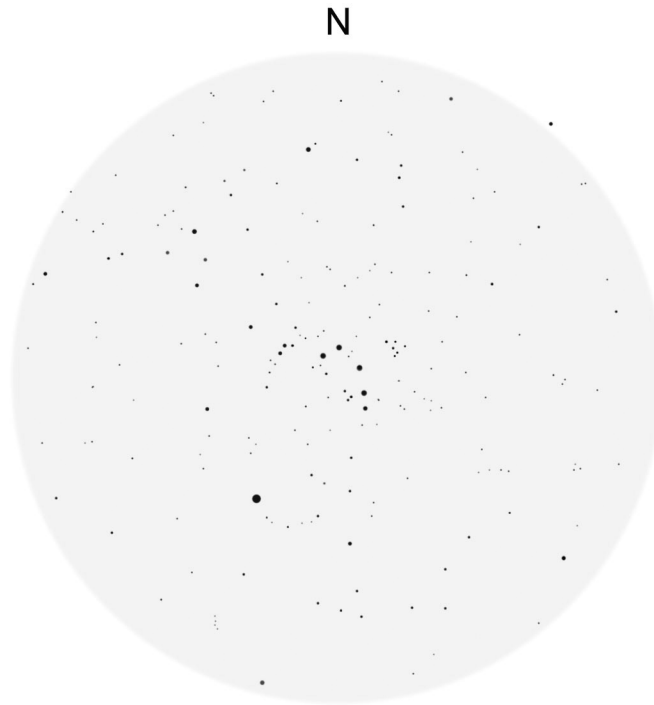
Alya – Theta (θ) Serpentis – R.A. 18h 56m 13s, Dec. +04° 12' 13"

Also known as Struve 2417, this is an easy double star of magnitudes 4.6 and 4.9

separated by 23". This one can be split in binoculars if you brace them on something.

NGC 6633 – R.A. 18h 27m 15s, Dec. +06° 30' 00"

A nice open cluster that's all four B's. At 4th magnitude it's easily visible by naked eye, and in binoculars or a telescope it's beautiful. It's elongated northeast-southwest with a scattering of bright (7th-9th magnitude) stars, with many more faint ones mixed in. On the western edge is a mini asterism that looks like a tiny Cassiopeia.

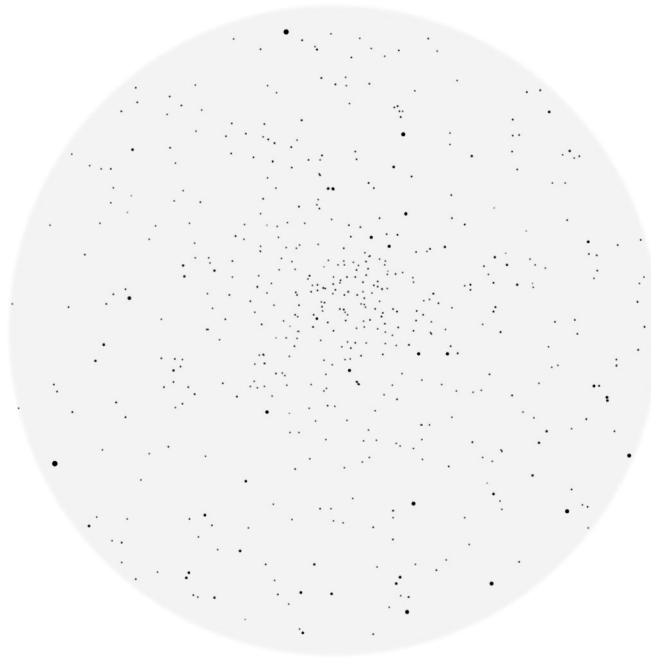


NGC 6633

IC 4756 – R.A. 18h 39m 00s, Dec. +05° 27' 00"

This is another open cluster that's visible by naked eye under dark sky, and even bigger (although a little sparser) than NGC 6633 next door. It spans over half a degree and looks great in binoculars or at low power in a telescope.

N

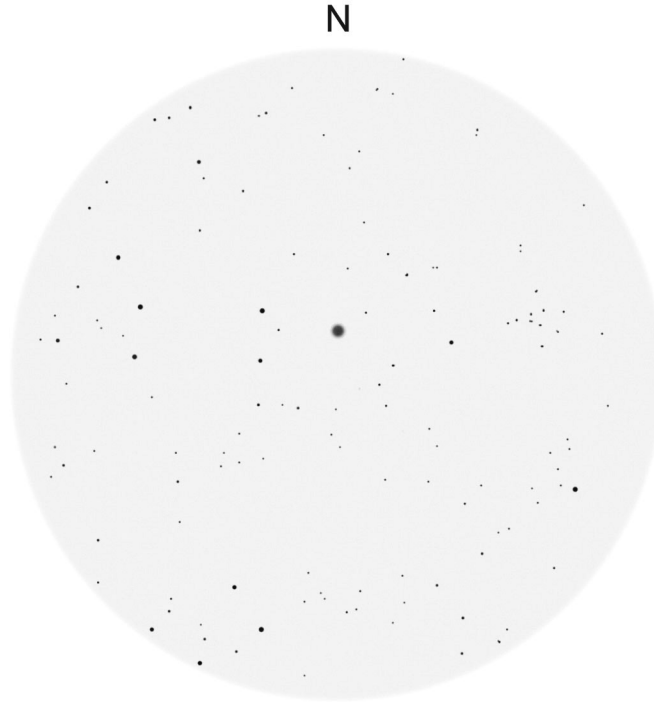


IC 4756

NGC 6572 – The Emerald Nebula – R.A. 18h 12m 07s, Dec. +06° 51' 25"

This is a small planetary nebula, but it's bright enough (mag. 8.0) to see in any telescope, and if you have even a little bit of aperture (say 4" or better) it'll be bright enough to trigger color vision. And when that happens, it's amazing! This is one of the most brilliant green objects in the sky. You only have color vision when you're looking directly at an object, so it's green when you look straight at it, and it fades to gray (but it gets brighter) when you look away.

Its surface brightness is 100 times greater than the Ring Nebula, so it will handle magnification well, but I've found that it looks brightest and greenest with just enough magnification to make it bigger than a point source. Somewhere around 80-90x seems to be ideal.



NGC 6572, the Emerald Nebula

PSA Charts 66 & 67

If I listed every Big, Bold, Bright, and Beautiful object on these two pages, this book would be twice as long. Why? Because we're looking toward the core of the Milky Way galaxy when we look into this part of the sky, and there's just a lot of stuff out there. I've covered the highlights that I visit regularly, plus a few others that are notable for other reasons, but there's so much here I am still making discoveries myself. So don't take the following as an exhaustive list. Poke around in this part of the sky and make a few discoveries of your own. But here are some of my favorites:

57 Aquilae – R.A. 19h 54m 38s, Dec. -08° 13' 38"

This one isn't labeled on the Pocket Sky Atlas, but it's the double just to the left of the globular cluster Palomar 11 (which is not BBB or B, so is not listed here). 57 Aquilae is a nice, easy double in binoculars or a telescope with components of magnitude 5.7 and 6.4 separated by 36".

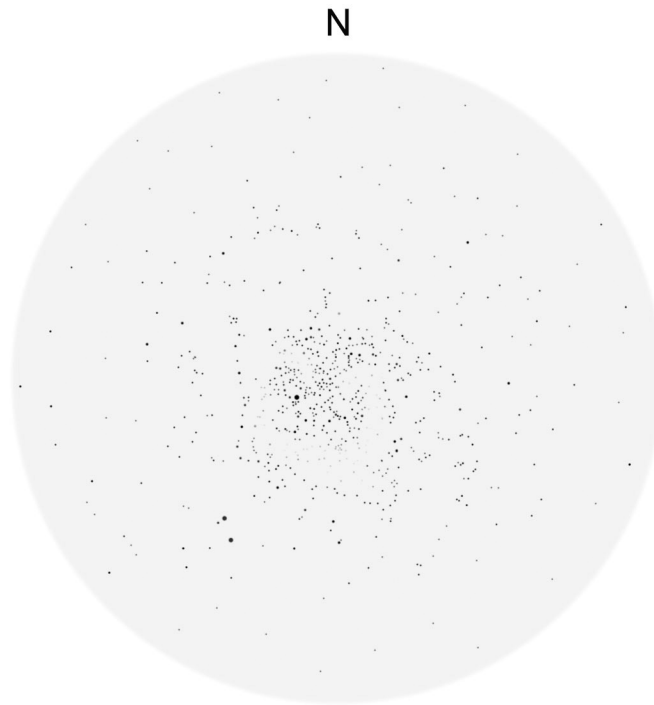
V Aquilae – R.A. 19h 04m 24s, Dec. -05° 41' 05"

V Aquilae is a deep red carbon star, and is one of the easiest to find since it's right in the arc of stars at the bottom of Aquila. It's between the leftmost two of the arc, and is 6th magnitude so it's an easy catch. You'll know it when you see it; it's a deep orange-red.

M11, the Wild Duck Cluster – R.A. 18h 51m 05s, Dec. -06° 16' 00"

The Wild Duck Cluster is a beautiful open cluster nestled into a curve of bright stars at the border of Aquila and Scutum. Composed of several hundred visible stars (and many more fainter ones) all packed into a space smaller than the Moon, this is one of the most impressive open clusters in the sky. A single bright star dominates the field, and the rest are arranged in a rough square whose V-shaped edges apparently led 19th Century astronomer Admiral Smyth to declare that it resembled “a flight of wild ducks.”

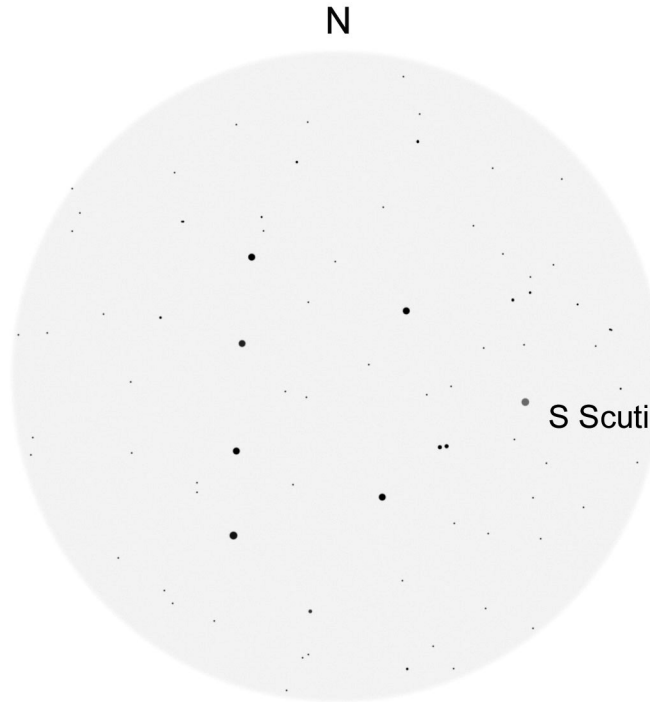
I’ve seen a lot of geese fly in V-formation, but not so many ducks. But who wants to go off on a wild goose chase? So the “wild duck” it is. I return to this cluster nearly every night it’s visible. It’s beautiful in any telescope. I sometimes think if this were the only object in the night sky, it would still be worth it to own a telescope just to look at it.



M11, the Wild Duck Cluster

A Neat Triangle, with Carbon Star – R.A. 18h 50m 20s, Dec. -07° 54' 27"

A little over a degree and a half south of M11 you’ll come across a large triangle of stars that’s unlike most of the other triangles in the sky: This one has three stars in each side of the triangle. Actually the southwest side has four stars, and the most westerly of all, making up the western point of the triangle, is a deep red carbon star, S Scuti. I always drop down for a look after I’ve looked at M11.



S Scuti triangle

NGC 6712 – R.A. 18h 53m 04s, Dec. $-08^{\circ} 42' 22''$

Just another degree to the southeast of S Scuti (above) lies a pretty good globular cluster. NGC 6712 shines at magnitude 8.1 and is 10' across. It's not one of the biggest or the brightest globulars in the region, but it's one I go to fairly often as I work my way down the steam coming out of the Sagittarius teapot.

M26 – R.A. 18h 45m 18s, Dec. $-09^{\circ} 23' 00''$

M26 is a group of about 30 stars that aren't all that bright (mag. 11-13) but they stand out nicely from the background. The middle of the cluster looks sparser than the outskirts, probably due to obscuring gas and dust between us and the cluster.

M16, the Eagle Nebula – R.A. 18h 18m 48s, Dec. $-13^{\circ} 47' 00''$

This nebula looks sort of vaguely eagle-like in photographs, but in a telescope you're just going to see a patch of nebulosity at the northern end of an S-shaped asterism of stars, the upper half of which is the true cluster NGC 6611. Under any kind of light-polluted sky, you might see only the cluster until you put on a nebula filter.

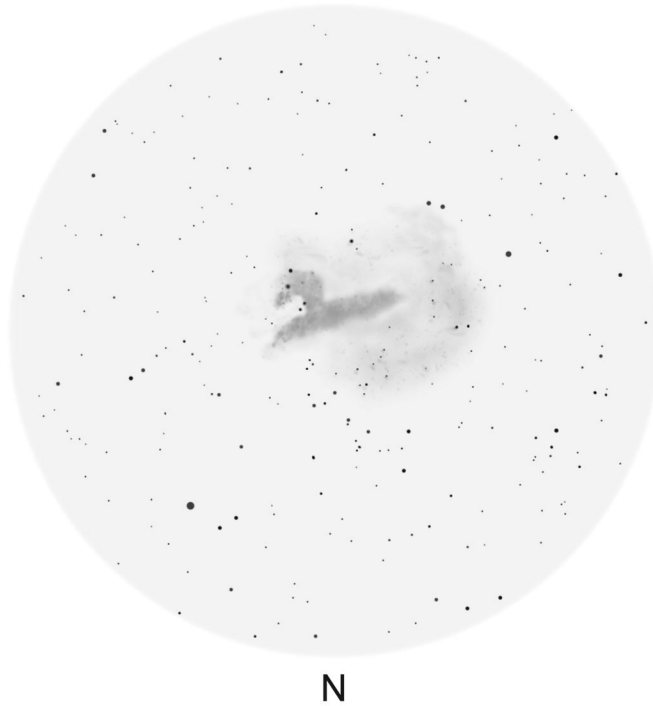
The famous "Pillars of Creation" Hubble image was taken here, just at the southern edge of the cluster. I've tried to see it in a telescope, but it has proven elusive even in my 20".

M17, The Swan Nebula – R.A. 18h 20m 48s, Dec. $-16^{\circ} 11' 00''$

The Swan Nebula is a large, obvious swatch of brightness against the rich stellar background with a curved extension rising from one end, and in a Newtonian telescope it looks for all the world like a duck floating on a pond. Wait — a duck? Not a swan? Nope. The neck is too short to be a swan. It's a duck. But we call it the Swan Nebula,

because...just because. (The Pocket Sky Atlas calls it the “Omega Nebula,” which I think is even less descriptive.)

Put a nebula filter on this one and you’ll see a lot more nebulosity surrounding it. Now it’s a duck in a fog bank.



M17, the Swan Nebula

NGC 6645 – R.A. 18h 32m 37s, Dec. -16° 52' 53"

NGC 6645 is a very nice open cluster in Sagittarius, about two degrees north of M25. It consists of several dozen 10th-13th mag stars with a conspicuous hole in the middle. What’s more, the hole is ringed by relatively bright stars. It looks like a dark well rimmed with light stones, or a dark window ringed with Christmas lights.

M18 – R.A. 18h 19m 58s, Dec. -17° 06' 00"

M18 is a relatively sparse (for the area) open cluster in northern Sagittarius. It’s composed of about 30 stars of 9th magnitude and fainter, and looks to be about 5-10' across depending on your aperture. It’s a very coarse-looking cluster amid the fog of millions of background stars in the Milky Way.

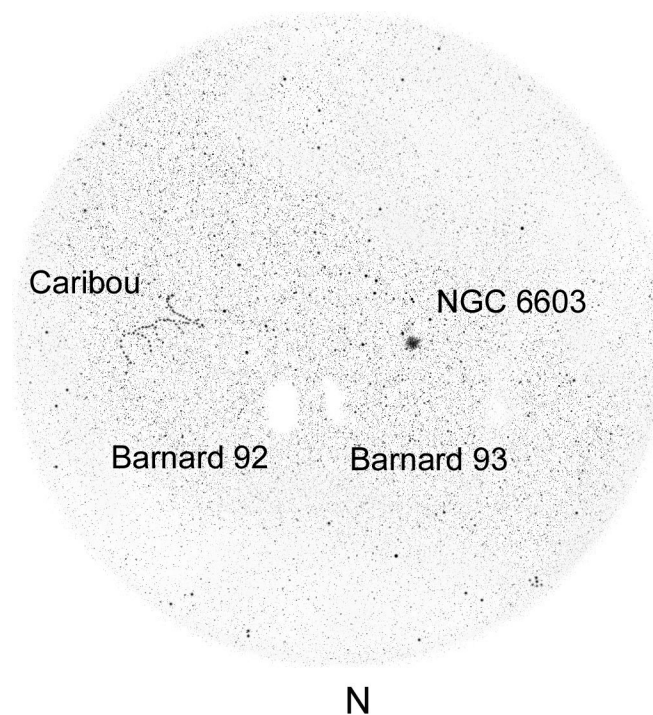
M25 – R.A. 18h 31m 47s, Dec. -19° 07' 00"

M25 is another bright (mag 4.6), large (29') open cluster in Sagittarius. It contains about three dozen bright stars and probably hundreds of fainter ones. The bright ones are scattered in two east-west streams, with several outliers. This cluster is best at low power, and is great in binoculars.

M24 Star Cloud – R.A. 18h 18m 48s, Dec. -18° 33' 00"

M24 isn't an object like an open cluster or a nebula; it's a huge patch of Milky Way that stands out through a gap in the intervening dust and gas. It's easy to spot with the naked eye, and is glorious in binoculars. In all but the widest-field telescopes it extends beyond the field of view, but that's okay; it's great fun to drive around through this thick cloud of stars. You'll find two distinct dark nebulae, Barnard 92 and 93, making what I call the "coal miner's lungs," and a tiny cluster within the cluster, NGC 6603.

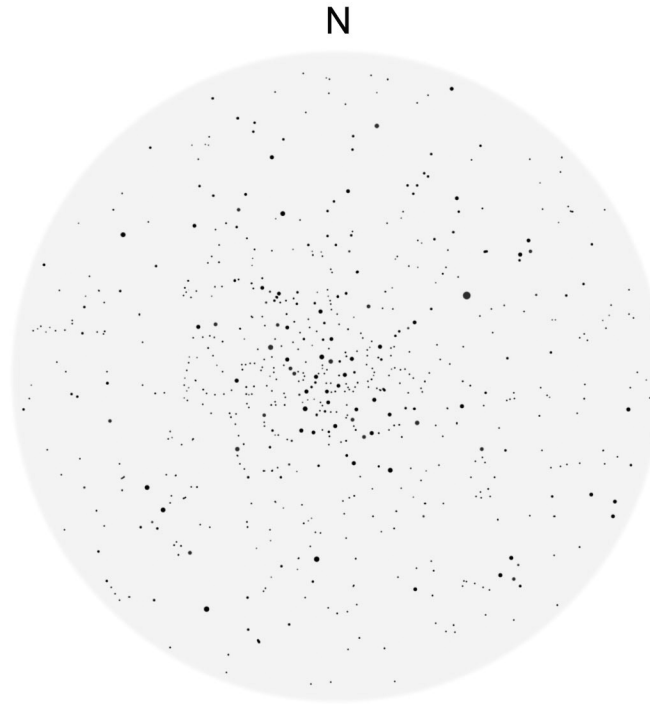
You'll also find an asterism that I call the **Caribou**. It's made up of a couple of obvious arcs of stars that form the rump and back and neck of the animal, with its head down as if cropping grass, and another distinct arc of stars with forward-facing spurs that looks for all the world like a rack of antlers. This is one of those asterisms you can't un-see once you've seen it. It's not just a deer; it's a caribou!



M24, with the Caribou, the Coal Miner's Lungs, and NGC 6603

M23 – R.A. 17h 57m 04s, Dec. -18° 59' 00"

M23 may be one of the most under-appreciated open clusters in the sky. With all the other spectacular sights in Sagittarius, M23 is often overlooked, but in any other part of the sky it would be the showcase object, and I believe it should be here, too. M23 is a beautiful open cluster, filled with streams of stars, including one stream that leads to a 6.5-magnitude star at the northwest edge of the cluster. M23 is about the same size as the Moon, so it's great in binoculars or in a telescope at low power, but this cluster continues to reward every step in magnification until it overfills the field of view. Spend some time here!



M75 – R.A. 20h 06m 05s, Dec. -212° 55' 016"

Way off to the east of the long string of Messier objects and other delights in the steam rising from the Sagittarius teapot lies one outlier Messier object: M75. It's another globular cluster just on the Sagittarius side of the border with Capricornus. It's not especially bright (8.5 mag.) nor especially large (7'), but it's easy enough to see in even a modest telescope and it's one of the Messier objects, so I mention it here. It's a tightly packed cluster — in fact it's one of the most densely packed globular clusters known, plus it's 68,000 light-years away — so you need some aperture and magnification to bust it into individual stars.

M21 – R.A. 18h 04m 13s, Dec. -22° 29' 00"

M21 is an open cluster just 2/3 of a degree northeast of the Triffid Nebula (below). It's a fairly tightly packed, bright cluster with about 50 stars up to 7th magnitude packed into an area about 14' across. It's an easy find in binoculars as well as a telescope, even with the bright Milky Way behind it.

M22 – R.A. 18h 36m 24s, Dec. -23° 54' 17"

M22 is one of the biggest and brightest globular clusters in the sky, but that's due to its relative closeness rather than intrinsic size. At 10,000 light-years it's less than half as distant as M13, which is often considered the best globular cluster in the northern sky. M22 is brighter, though (Mag 5.1 versus 5.8) and larger (32' vs. 20'). Its only problem is its declination: at -24° it's down on the horizon for most northern hemisphere observers.

Even so, it's still easily naked-eye visible in dark sky as a fuzzy patch to the upper left of the Sagittarius teapot's lid, and in a telescope it's glorious. It's not a perfect sphere, but slightly oval in a NE-SW direction. Its nearness and loose packing makes

resolving its individual stars fairly easy. It contains about half a million stars, and is about 100 light-years across.

M28 – R.A. 18h 24m 33s, Dec. -24° 52' 11"

M28, just off the tip of the teapot's lid in Sagittarius, is considerably smaller and dimmer than M22, but at magnitude 6.8 and 14' across it's no slouch. Charles Messier found it in a 4" scope, and in a 6" or larger it's pretty impressive. It doesn't bust into individual stars as easily as M22, but it's still one of the bigger and brighter globulars in the sky.

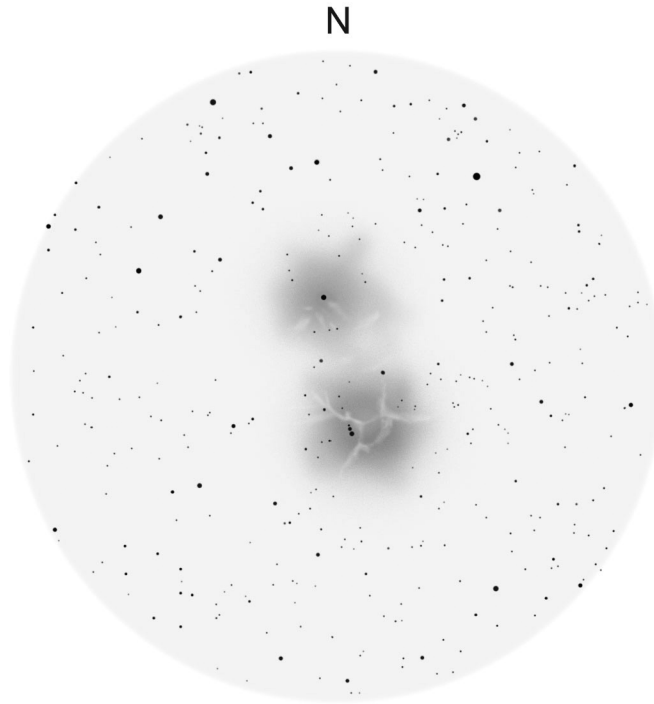
M20 The Trifid Nebula – R.A. 18h 02m 36s, Dec. -23° 01' 54"

The trifid nebula's listed magnitude of 6.3 is deceiving; this nebula is spread out enough to have a fairly low surface brightness, but with a little aperture and/or a nebula filter it stands right out. It comes in two parts: the emission nebula with the three-vented dark lane in front of it that gives it its name, and a reflection nebula just to the north of that. In photographs the emission nebula is bright red while the reflection nebula is pale blue, yet to the eye in a relatively large-aperture telescope, it looks just the opposite.

Why is that? I have a theory: Because our eyes are much more sensitive to blue-green than to red light, when we just barely begin to perceive color, we see it as green. The red emission nebula is brighter than the blue reflection nebula, so our brains interpret it as the green one, which makes the other one red in comparison.

There's a bonus at the heart of the emission nebula: The central star is a triple. Another reason to call it the Trifid! Yet it gets better: It's actually a multiple system of up to six elements. I can see three in my 12.5" scope under steady skies, and others have seen up to seven in a 28" scope.

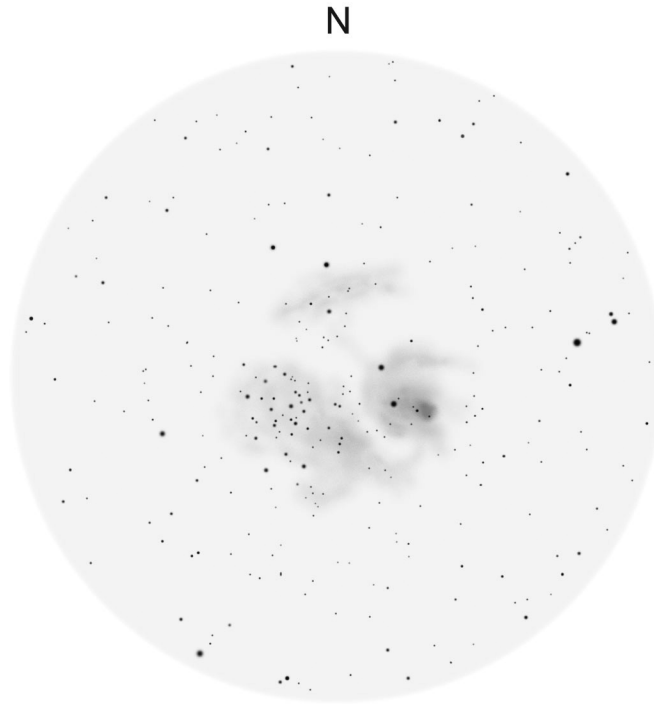
For an in-depth study of the Trifid Nebula, see Howard Banich's excellent article in the June 2016 issue of *Sky & Telescope* magazine.



M20, the Trifid Nebula

M8 – The Lagoon Nebula – R.A. 18h 03m 48s, Dec. -24° 22' 54"

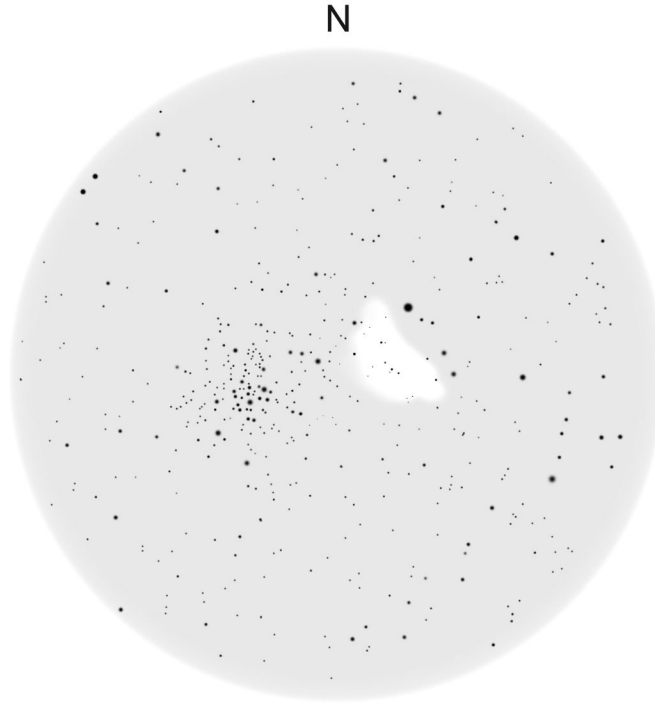
If the Orion Nebula is the luminary of winter, the Lagoon is its summer counterpart. It's easy to spot by naked eye, and is glorious in binoculars. With the Lagoon you get a twofer: There's a large, bright emission nebula and an associated open cluster embedded within it. A nebula filter greatly increases the extent of the glowing gas, at the expense of the cluster. The nebula is split in two by a dark lane, which is the "lagoon" in its name. Stars are being formed here, so stick around a few dozen millennia: it will only become more impressive with time.



M8, the Lagoon Nebula

NGC 6520 and Barnard 86 – R.A. 18h 03m 24s, Dec. -27° 53' 00" (to NGC 6520)

NGC 6520 is a nice open cluster above the spout of the Sagittarius teapot. While this is a nice cluster in its own right, with its young blue stars standing out against the yellower stars deeper toward the galactic core, the main attraction here is Barnard 86 just a smidgen to the west. B86 is a dark nebula that's so dense that no stars are visible through it. What few stars you see against the blackness are in the foreground. It's so easily visible against the galaxy's central bulge that it's called the "Ink Spot" nebula. It's clouds like this at varying distances that mask the core of the galaxy from our view in all but Baade's Window (below).



NGC 6520 and Barnard 86

NGC 6522 & 6528 – R.A. 18h 03m 34s, Dec. -30° 02' 02"

These two globular clusters are unremarkable on their own, but they're so close together (16') that they make a nice pair in a medium-power eyepiece. One (6522) is relatively bright at mag. 8.3, while the other is dimmer but still visible at 9.6. There's a little Christmas tree asterism between them. They're just off the tip of the Sagittarius teapot, so they're easy to find. These two clusters are 11-12 billion years old, which makes them two of the oldest globular clusters known.

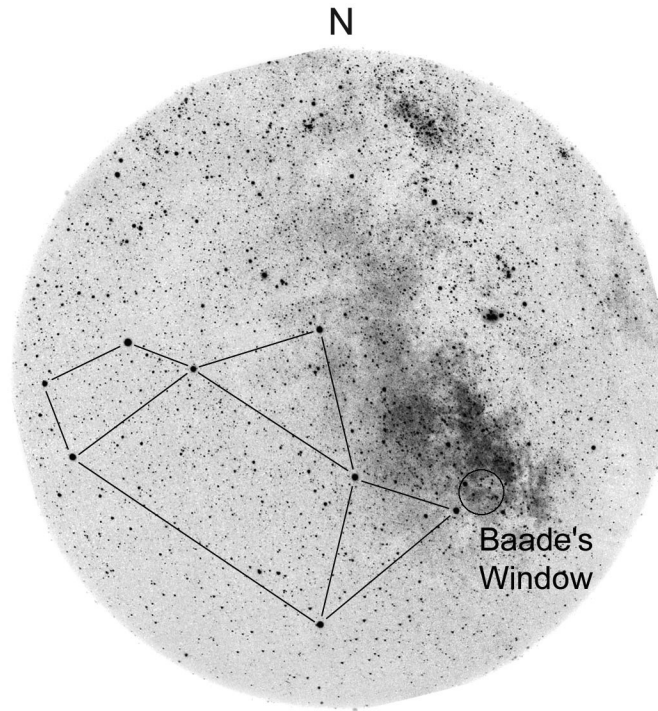
Baade's Window – R.A. 18h 03m 34s, Dec. -30° 02' 02"

The whole region around the Sagittarius teapot is full of stars, but when you look for the above two globular clusters, you might notice that it seems like there are even more stars than usual in that area, not just as visible dots but as a whole fog of unresolved light that seems to stretch off practically forever. That's because it more or less does: When you're looking into this region of the Milky Way, you're looking right into the nuclear bulge of the galaxy 26,000 light-years away.

Normally we wouldn't be able to see that far through all the intervening gas and dust, but Walter Baade discovered in the 1940s that there was a small gap in the clouds that let him peer all the way to the core. That gap is called Baade's Window in his honor.

Baade's Window is easy to find. It's just off the spout of the Sagittarius teapot, centered on globular cluster **NGC 6522**. The window is about a degree across, but you won't see any obvious boundaries; what you'll see is a field of view so thick with stars that if NGC 6522 weren't there for scale, you'd swear you were looking at a high-magnification view of a globular cluster. The stars that you can resolve are mostly nearer than the galactic core, residing in our own Orion Spur or the Scutum-Centaurus Arm that sweeps across between us and the core, but the hazy glow that doesn't resolve is the light

from the millions of stars in the core itself.



Baade's Window

NGC 6451 – The Tom Thumb Cluster – R.A. 17h 50m 41s, Dec. -30° 12' 00"

This at first seems to be an unremarkable open cluster amid the rich background of the Milky Way in Sagittarius, but I like it because it has two opposing arcs of stars and a rectangular bridge between them at their bases that taken together look like a radio telescope. It's a miniature version of the constellation Crater.

When you're looking at the Tom Thumb cluster, you're looking very close to the center of the Milky Way galaxy. The cluster is way in the foreground, of course, but the center is out there beyond it by about 20,000 light-years.

NGC 6425 – R.A. 17h 47m 01s, Dec. -31° 31' 00"

This is a coarse open cluster, a little bigger than the Tom Thumb cluster with 2-3 dozen easily seen stars making a ragged semicircle or U shape with a tail.

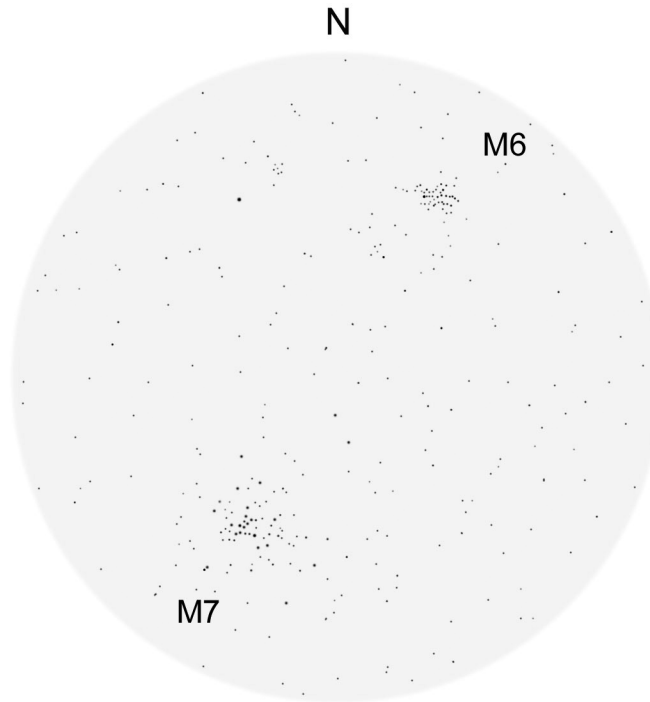
M6 – The Butterfly Cluster – R.A. 17h 40m 20s, Dec. -32° 15' 00"

M6 is one of the most stunning clusters in the sky. It's naked-eye visible in the already-rich star field between Sagittarius and Scorpius. It's dimmer than its neighbor to the east, M7, but more showy in a telescope. The stars appear bright blue and conspicuous, arranged in a wide oblong that suggest the wings of a butterfly. There's even a fairly obvious V of stars that might be the butterfly's antennae.

M7 – Ptolemy's Cluster – R.A. 17h 53m 51s, Dec. -34° 47' 00"

M7 is bigger and showier than M6. It's so bright that it's easily spotted by naked eye, and it was mentioned as early as 130 AD by the Alexandrian astronomer Ptolemy, who

described it as “A little cloud following the stinger of Scorpius.” Its stars are brighter and more widely spaced than M6, but similar in number (about 80). The reason for that is distance: at 800-1000 light-years, M7 is only half as far as M6.



M6 and M7

PSA Charts 68, 69 & 70

M54, M55, M69, M70

Down at the base of the Sagittarius teapot, and off to the east of it in the case of M55, lie several globular clusters. None of them are especially big or bright, but they're big and bright enough to have caught Messier's attention and wound up on his list of not-comets. If you're picking up Messier objects, then these are a few you won't want to miss. If you live very far north, catch them when Sagittarius is due south so they'll be as high as possible in the sky.

Of these four M55 is the brightest and showiest.

NGC 6723, 6726, 6727, and 6729 – (Caldwell 68) – R.A. 18h 59m 33s, Dec. -36° 37' 56"

NGC 6723 is a globular cluster in the bottom reaches of Sagittarius. At 7th magnitude it's fairly bright, and at 13' in size it's pretty big, but it's so far south for North American observers that few people look for it. It's worth the trouble, though, not only for its own beauty but for the complex of reflection nebulae less than half a degree away just over the border into Corona Australis, the Southern Crown. NGC 6726 and 27 surround a pair of bright stars, while 6729 stands off to the side and is much less showy. 6729 is the one to

watch, though, because it has a comet-like appearance and the star at the tip of its “head” apparently has large clouds of obscuring gas orbiting it relatively close-in. The clouds cast shadows into the nebula, and the nebula changes brightness on very short intervals, sometimes as short as a single day. Because of its shape, NGC 6729 is often called the “Comet Nebula.” (For another very similar variable nebula, check out NGC 2261, “Hubble’s Variable Nebula” on PSA chart page 25 (described above).

NGC 6752 – R.A. 19h 10m 52s, Dec. -59° 59' 04"

NGC 6752 is a 5th magnitude globular cluster about the same size as the Moon. It’s densely packed and far enough from the band of the Milky Way to stand out nicely from the background. Plus it has a bonus bright star embedded in its outer fringe: 7th magnitude HD 177999 shines to the southwest just outside the cluster’s dense core. It’s a foreground star seven times closer to us than the cluster (which lies about 13,000 light-years away).

Melotte 227 – R.A. 20h 17m 19s, Dec. -79° 02' 00"

Melotte 227 is a relatively bright (5th magnitude) and quite large (70') open cluster far south between Pavo and Octans. It’s outside the plane of the Milky Way so it stands out nicely in binoculars or a telescope even though it’s somewhat sparse. Distance and velocity measurements have shown this to be a chance alignment of stars rather than a true cluster.

PSA Chart 71

Rho (ρ) Cephei – R.A. 2h 26m 49s, Dec. +78° 46' 51"

This is a very wide (9') double of nearly even-brightness components (5.4 and 5.8 mags). It's way too wide to be interesting in a telescope, and not much of a challenge in binoculars (although it's pretty), but the real fun comes with trying to split it by naked eye. You'll need relatively dark sky, but when you can see down to 6th magnitude or beyond, have a look. Like Mizar and Alcor over in the handle of the Big Dipper, these stars can be split with a little concentration.

21 and 23 Cassiopeiae – R.A. 00h 47m 47s, Dec. +74° 50' 26"

This is another very wide (12') double of nearly even-brightness components (5.4 and 5.7 mags). It's a little easier to split than Rho Cephei, but still a bit of a challenge for the naked eye. Try these versus the split on Mizar and Alcor (also 12', but both components are brighter).

Pi (π) Cephei – R.A. 23h 07m 58s, Dec. +75° 22' 54"

This is a pretty tight (1.1" separation) double star of 4.4 and 6.4 magnitude components, so it's a bit of a challenge, but I've split it with an 8" scope at 400x. Give this a try on a night of good seeing.

NGC 40 – (Caldwell 2) – R.A. 00h 13m 03s, Dec. +72° 30' 56"

This is a surprisingly nice planetary nebula. At magnitude 10.6 and 48" across you might expect the surface brightness to be too low to see much, but that's not so. There's a definite smoke ring, a little bit oblong, with a conspicuous (mag 10.7) central star. This one works like the Blinking Planetary nebula in Cygnus: if you stare straight at the central star, the nebula dims.

With big apertures you can see brighter areas along the eastern and western edges, but usually this looks like a pretty even ring. Under light polluted skies a skyglow filter might help pull it out, but under dark sky I think the nebula looks brighter with no filter at all. OIII and NPB filters just dim it down.

I was observing this object one night at the Oregon Star Party with a 20" scope when word started to spread that I had a good view of it. People started coming over to my camp from surrounding camps, and eventually I wound up with a line of people at my scope — at about 2:00 in the morning, all waiting patiently for a look at this little smoke ring. That was the moment when I was absolutely sure that I had found my people.

Σ 3053 – Struve 3053 – R.A. 00h 02m 39s, Dec. +66° 05' 39"

This is another uneven double star, at 5.8 and 7.3 mags not quite as uneven as Kappa Cephei, but pleasingly mismatched even so. With a separation of 15.2" it's an easy split in any scope. The primary looks yellow-white, and the secondary is distinctly blue. It should be; it's nearly twice as hot (9,000K) as the primary (4,800K).

Beta (β) Cephei – R.A. 21h 28m 40s, Dec. +70° 33' 39"

Also known as "Alfirk" (meaning "the flock" [presumably of sheep]) the top right corner of the pointy house of Cepheus is a nice double star. With magnitudes of 3.2 and 8.6 they're wildly different in brightness, but with a generous 14" of separation they're relatively easy to split. The primary is bright white, while the secondary looks distinctly

greenish by comparison.

NGC 7142 – R.A. 21h 45m 12s, Dec. +66° 45' 49"

This is a large but somewhat soft open cluster in Cepheus, reminiscent of Caroline's Rose in Cassiopeia. I include it because it looks nice under dark sky with some aperture. There are a few easily visible stars that define a large, elongated S-shape, while the rest look like a light fog until you study it a while and see individual sparkles. There are three bright stars flanking the northeast side of the cluster.

NGC 7129 – R.A. 21h 43m 02s, Dec. +66° 05' 49"

This is an open cluster in Cepheus very close to 7142. It's marked as a nebula on the Pocket Sky Atlas, and I do see a faint glow around two of the half dozen or so easily visible stars. I think the star field to the southwest is actually more interesting. It looks more like a coarse, somewhat sparse cluster.

NGC 7160 – R.A. 21h 53m 42s, Dec. +62° 35' 48"

This is another open cluster in Cepheus. It's fairly sparse, maybe a dozen or so medium bright stars, but it's still relatively pretty, easy to find, and bright. It reminds me a little of a footprint, with the brightest stars outlining the main part of the foot and an arc of fainter toes to the northeast.

This whole area of the sky is nice in binoculars because of the many long strings of stars.

PSA Charts 72 & 73

M52 – R.A. 23h 24m 48s, Dec. +61° 35' 00"

M52 is a bright, somewhat coarse open cluster with a scattering of bright stars providing a little spice within it. It's fairly easy to spot in binoculars, but for some reason I find it much more difficult to find in a telescope. It's right in the thick of the Milky Way, so maybe it gets lost amid the billions of other stars out there, or maybe I'm just a klutz, but I wind up scanning around all over the area before stumbling upon it.

That's a good thing. No kidding; the whole area is beautiful, and when the cluster finally drifts into view, your breath will catch.

Don't bother looking for the Bubble Nebula right next to it on the star chart. You need a big scope, dark sky, and a nebula filter to even hope to see that one.

NGC 7510 – R.A. 23h 11m 03s, Dec. +60° 34' 00"

NGC 7510, also called the "Dormouse Cluster," is an 8th magnitude open cluster in Cepheus not far from M52. It looks like a small, narrow V, but it's nice and bright and resolves into three strings of stars under dark sky. Well worth a look when you're in the neighborhood.

The Lucky Seven – R.A. 23h 03m, Dec. +59° 30'

Between Cassiopeia and Cepheus lies a really big (2°) asterism that looks like the numeral 7. It's upright when Cassiopeia is above Polaris. This is a binocular object; a telescope will just show you a bunch of Milky Way stars.

The 4.8 mag. star 1 Cassiopeiae lies near the top of the 7, just below the flat top. The

other stars are 5th and 6th magnitude, making this just a little too difficult for naked eye, but it's great in binoculars.

Mu (μ) Cephei – Herschel's Garnet Star – R.A. 21h 43m 30s, Dec. +58° 46' 48"

Herschel's Garnet Star is, not surprisingly, a brilliant orange-red star discovered, or at least cataloged, by William Herschel. It's one of the largest and most luminous red giant stars in the galaxy. If it were placed where our Sun is, its surface would be somewhere between the orbits of Jupiter and Saturn. That's really big!

It's a variable star, ranging from 3.6 to 5.0 magnitude, and like most deep red variables its color is reddest when it's dimmest. It will eventually go supernova, probably sometime in the next million years or so. So keep an eye on it; you never know if you'll catch it during its last moments. And in the meantime, it's a nice visual treat just as it is.

Σ 2816 – Struve 2816 – R.A. 21h 38m 57s, Dec. +57° 29' 21"

Struve 2816 is a triple star in the middle of a huge nebula complex (IC 1396) that's just barely visible with a nebula filter and some serious aperture under a dark sky. The triple star is pretty neat, though. It has a bright yellow mag. 5.7 primary flanked by two blue/white mag. 8.0 companions. Their separations are 12" and 20", easily splittable in even a modest telescope. The triple isn't labeled in the Pocket Sky Atlas, but it's the star in the middle of IC 1396.

Σ 2819 – Struve 2819 – R.A. 21h 40m 21s, Dec. +57° 34' 54"

Struve 2819 is a double just 12' to the northeast of Struve 2816, with components of magnitude 7.4 and 8.6 and a separation of 13". It should be splittable in just about any telescope. In the PSA it's just marked as an unlabeled double a smidgen to the upper left of Struve 2816 (above).

NGC 6946 (Caldwell 12) and NGC 6939 – The Fireworks Galaxy plus cluster – R.A. 20h 34m 53s, Dec. +60° 09' 13" (to NGC 6946)

NGC 6946 is a face-on spiral galaxy on the border between Cepheus and Cygnus. At magnitude 9.0 it's relatively easy to pick out, although its spiral arms will be difficult to resolve unless you have aperture and dark sky. What you may be able to see, though, if your timing is right, is a supernova. The Fireworks Galaxy is so named because it has been the site of no fewer than 10 supernovae in the last 100 years. When one blows, it shines nearly as brightly as the entire galaxy for a few months. It's well worth keeping an eye on this one. You never know; you could be the one to discover the next blast.

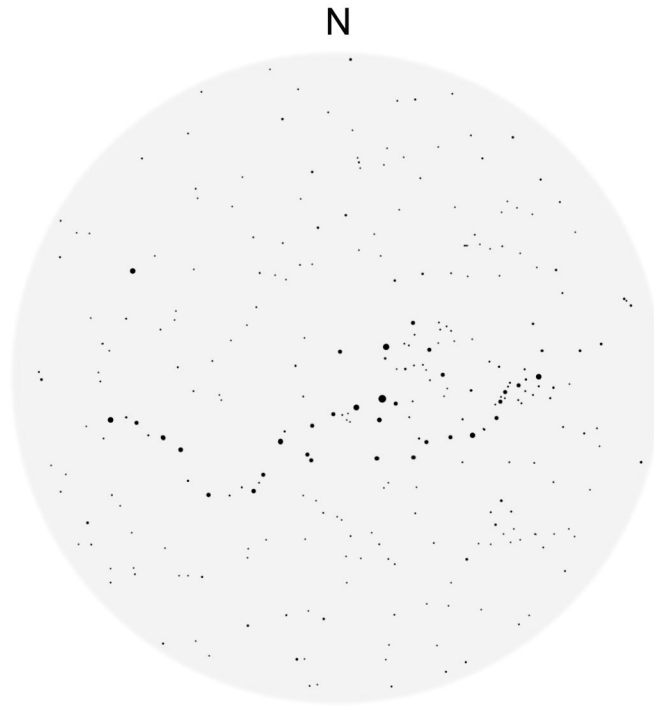
Right next door (about 2/3 of a degree to the northwest) is a nice open cluster, NGC 6939. It's about the same diameter as the galaxy (about 10' across), so it provides a neat pairing of two objects in the same field. The galaxy is about 20 million light years away, and the cluster is about 4 thousand light years away, which makes you pause and consider the definition of "far."

The open cluster looks a little like a W to me. Both objects reward magnification with more detail.

NGC 7235 – R.A. 22h 12m 25s, Dec. +57° 16' 00"

NGC 7235 is a neat open cluster in Cepheus about 4° to the east southeast of Herschel's Garnet Star. It's a long string of stars rather than a ball of them, and to me it looks like a snake slithering westward. The head and body are both well defined. It looks

like a miniature Serpens Caput. Well worth looking at.



NGC 7235

NGC 7008 – The Fetus or Starchild Nebula – R.A. 21h 00m 33s, Dec. +54° 32' 29"

NGC 7008 is a planetary nebula just on the Cygnus side of the border with Cepheus. Its magnitude is only 11, so you would expect it to be too dim to see easily, but it's surprisingly easy with a little aperture. A nebula filter doesn't seem to help this one much. Its central star is obvious, and the nebulosity around it extends outward in an oval, encompassing another foreground star. Just outside the nebula is another pair of stars that point to the extra interior star. With enough aperture and dark sky the nebula itself looks mottled. It's called the Fetus Nebula or Starchild Nebula because in photographs it looks a little like a fetus curled up in the womb, which was the image of the Starchild at the end of the movie *2001 A Space Odyssey*.

NGC 7296 – R.A. 22h 28m 01s, Dec. +52° 19' 00"

This 9.7 magnitude, somewhat sparse open cluster wouldn't be BBBB except for one peculiarity: It blinks on and off. Like the Blinking Planetary Nebula (NGC 6826) described quite a ways above, its brighter stars are just bright enough to kill your night vision temporarily when you look straight at them, so the cluster grows dim and you see just a few stars. But when you avert your eyes just a little bit you regain that night vision and the dimmer stars in the cluster pop out of hiding. You need relatively dark sky and some aperture for this, but it's a neat effect.

NGC 7686 – R.A. 23h 30m 07s, Dec. +49° 07' 55"

This is a loose open cluster loosely scattered around a 6th magnitude foreground star (HR 8925). It may not be a genuine cluster at all, since many of its stars lie at different

distances from us, but it certainly looks like one. It spans about a quarter of a degree, or half a full Moon's diameter. Its maybe-members include several nice maybe-doubles. At high power you can see what looks like a fog of unresolved stars in and around the cluster.

NGC 7243 – (Caldwell 16) – R.A. 22h 15m 08s, Dec. +49° 52' 58"

This open cluster is relatively bright at magnitude 6.4 overall, and its stars range from 9th magnitude on down, so you'd expect it to be bright and showy, but it's actually kind of lost in the general glow of the Milky Way. What's neat about it is the double star in its center, Struve 2980, described below.

Struve 2980 – R.A. 22h 15m 10s, Dec. +49° 52' 29"

Struve 2980 is a neat little double star in the middle of open cluster NGC 7243. Its components are magnitudes 9.3 and 9.7 with a separation of 9.4", which makes me think of this as "The nines double."

NGC 7331 – (Caldwell 30) – R.A. 22h 37m 04s, Dec. +34° 24' 56"

NGC 7331 is all four B's: Big, Bold, Bright, and Beautiful. It's a spiral galaxy on the Pegasus-Andromeda boundary, just a little ways above the northmost forleg of the upside-down horse. People with large-aperture scopes use it as a jumping-off point to find Stephan's Quintet, a group of five fainter galaxies nearby, but 7331 is well worth a look in its own right. It's tilted about 20° or so from edge-on, so it shows up as a wide oval in the eyepiece. It's a little difficult to see its spiral arms, but they show up nicely in photographs.

NGC 7331 was long considered to be a near twin to our own Milky Way galaxy, but the discovery of a bar in the Milky Way's core has reduced the similarity somewhat (7331 has no bar). In photographs there's a distinct warp to the disk, and spectroscopic studies have shown that the core of the galaxy rotates in the opposite direction from the disk, indicating a galactic collision millions of years ago. (M64, the Black Eye Galaxy in Coma Berenices is another example of a galaxy with a retrograde core.)

NGC 7331 is accompanied by four fainter galaxies to the east. Together these five galaxies are called the "Deer Lick Group," for Deer Lick observatory. The four faint galaxies are often called "The Fleas."

Stephan's Quintet – NGC 7317, 7318A, 7318B, 7319, and 7320 – R.A. 22h 35m 58s, Dec. +33° 57' 56"

Stephan's Quintet has no business being in this book. It's a group of five extremely faint (14th magnitude) and small (about 1 arc-minute each) galaxies near NGC 7331, but I include it here because it's still one of the easiest galaxy groups to see. So if you're looking for a knot of galaxies in a tight little space, and you have some aperture (12" or better) and good, dark sky, give this one a try.

Four of the five galaxies are the same distance away (about 200-300 million light years), while one of them, NGC 7320, is much closer at 39 million light years. In photographs, 7320 is distinctly bluer than the others, indicating that the others are redshifted due to their greater distance. In high-resolution photographs it looks like there might be some tidal distortion to 7320, which led some people to doubt that it was closer than the others despite its difference in redshift. If that were true, however, the entire concept of redshift and the expanding universe would be cast into doubt, so very few astronomers give any credence to that theory.

PSA Charts 74 & 75

NGC 7814 – (Caldwell 43) – R.A. 00h 03m 15s, Dec. +16° 08' 44"

NGC 7814 is an edge-on spiral galaxy with a fairly prominent dust lane running across it. It's not as bright as NGC 4565 in Coma Berenices, nor even NGC 891 in Andromeda, but if you have some aperture and dark sky it's worth a look. It's one of the better galaxies in Pegasus...but that's not saying much.

Mu (μ) Cygni – R.A. 21h 44m 09s, Dec. +28° 44' 34"

Mu Cygni is a challenge object. It's a really tight (1.5") double of unequal magnitude stars (4.8 and 6.2). It's a target for a night of steady seeing and with a medium-large telescope, but when you do finally split it you feel like you've accomplished something, so it's definitely worth a try.

Enif, the Pendulum Star – R.A. 21h 44m 11s, Dec. +09° 52' 30"

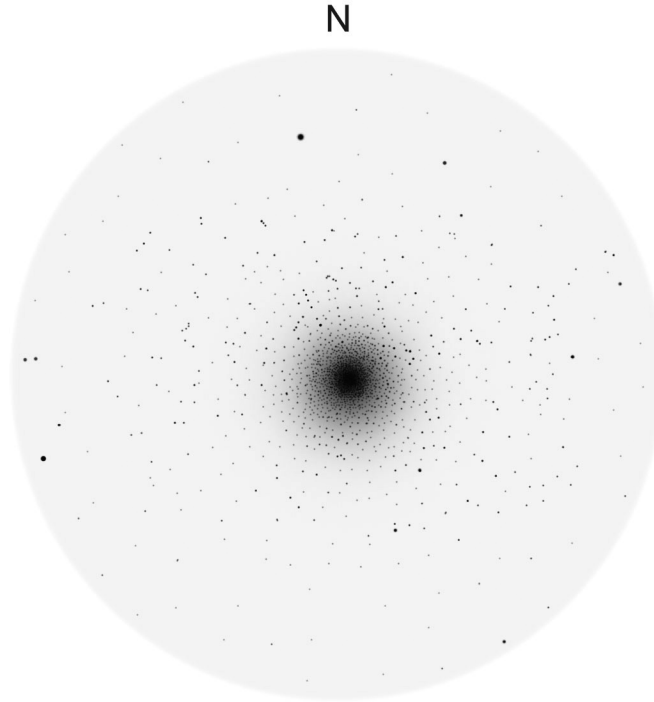
Enif, Epsilon (ε)Pegasi, is the nose of Pegasus the horse. It's a wide double star with enough difference in brightness between its components (2.4 and 8.6 magnitude) to play a neat trick on your eye. If you wiggle the telescope in a direction perpendicular to the binary split, you'll see the bright component move back and forth just as you would expect, but the dim component lags behind, looking for all the world like a glittering diamond at the end of a string attached to the primary. For this reason, Enif is called the Pendulum Star.

What's happening here? It's a latency effect: Your eye takes a moment longer to register a dim star than it does a bright one, so when the stars are in motion the dim one lags behind.

M15 – R.A. 21h 29m 58s, Dec. +12° 10' 01"

While you're in Enif's neighborhood, you might as well move 4° to the northwest and have a look at M15, a tight, bright, globular cluster that's spectacular in any scope. This is one of the most tightly packed globulars in the sky, with half its mass concentrated in the central 10 light years of its 175 light year expanse. You can really see that when you crank up the magnification and try to split the core into individual stars. There are just too many to do it!

If you're in for a real challenge, there's a planetary nebula called Pease 1 that's buried in the globular cluster, but it's possible to see it with a medium-large telescope under steady, dark sky. Look online for finder charts, and "blink" the nebula on and off with a nebula filter passed between your eye and the eyepiece. The "star" that doesn't dim out when you look through the filter is the nebula. (Hint: it's in the same direction from the core as the relatively bright star just to the north of the globular cluster.)



M15

TX Piscium – R.A. 23h 46m 24s, Dec. +03° 29' 13"

TX Piscium is a carbon star, one of the reddest type of stars in the sky. (See the description of La Superba on PSA page 33 for more on carbon stars.) At 5th magnitude it can be seen by naked eye just to the east of the circlet of Pisces, but it takes binoculars or a telescope to see the deep red color.

Like most carbon stars, this one is variable, ranging from magnitude 4.8 to 5.2. It's reddest when it's at its dimmest. When it's bright, it's more orange. In either stage, I think this is one of the nicest carbon stars in the sky.

M2 – R.A. 21h 33m 27s, Dec. -00° 49' 24"

M2 is an often overlooked globular cluster to the right of the Aquarius water jar, but it's definitely Big, Bold, Bright, and Beautiful. It rivals M15 13° to the north in that both of them are tightly packed and about the same size. They actually are about the same size, both of them huge: 175 light-years across. M2 is a little farther away (38,000 light-years to M15's 34,000), so it's a bit harder to resolve its stars, but a little magnification will bust it apart.

M2 and M15 are a couple of the last major globular clusters visible in the autumn after all the ones that hover around the core of the galaxy have set for the season.

PSA Charts 76 & 77

Zeta (ζ) Aquarii – R.A. 22h 28m 50s, Dec. -00° 01' 14"

Zeta Aquarii is one of my favorite double stars. Located right in the center of the

“peace sign” of Aquarius (more popularly known as the water jar), it’s easy to find and hard to split. Its stars are plenty bright, at magnitudes 3.7 and 4.3, but their separation is just 2.4". Even so, it’s a rewarding split, and a good test of the seeing. If you can split this one, you’re in for a good night.

The two stars are slowly drawing away from each other as they circle slowly clockwise around their center of gravity, so they’ll get easier as the centuries progress, but they’ll never get much farther than 3.5" apart.

They’re moving in another interesting way, too: The above figures for right ascension and declination are adjusted to the year 2000, when Zeta Aquarii was just a smidgen below the celestial equator. Precession of the Earth’s axis has since brought it north. It crossed the equator in 2003, and as I write this in 2020 it’s at R.A. 22h 29m 50s, Dec. +00° 04' 48"

Σ 3008 – Struve 3008 – R.A. 23h 23m 45s, Dec. -08° 27' 36"

Struve 3008 is an unlabeled double just to the east of NGC 7606, which is itself just to the east of the obvious triplet of stars Psi (ψ) 1, 2, and 3 Aquarii. The components of this double are magnitude 7.1 and 7.7, so they’re visible in just about any telescope, and their separation is 6.8", just enough to be challenging but easy enough to succeed even on a night of so-so seeing.

Σ 2993 – Struve 2993 – R.A. 23h 14m 07s, Dec. -08° 56' 28"

Struve 2993 is a smidgen dimmer double than Struve 3008 above (mags 7.5 and 8.2) but with a much more generous 25" split. Like Struve 3008, it’s not labeled on the Pocket Sky Atlas, but it’s marked as a double star just to the west of that same obvious triplet of stars Psi (ψ) 1, 2, and 3 Aquarii. It’s not bright, but it’s an easy split in most any scope.

94 Aquarii – R.A. 23h 19m 07s, Dec. -13° 27' 31"

About 5° south of Struve 2993 lies a much brighter pair of stars (Mags. 5.2 and 7.0) with about half the split distance (12"). This is a showcase double, easily split in just about any telescope and pleasingly different in brightness. People have described their colors as pale rose and light green.

NGC 7009 – (Caldwell 55) – Saturn Nebula – R.A. 21h 04m 11s, Dec. -11° 21' 57"

The Saturn Nebula is a planetary nebula that’s technically in Aquarius, but I always think of it in Capricornus because it’s right above that recognizable triangle. It’s just a degree to the west and a little south of Nu (ν) Aquarii, a bright (mag. 4.5) star, and it’s relatively bright itself (mag. 7.8) so it’s an easy find.

The cool thing about this planetary nebula is its “ansae,” or extensions that stand out from the sides of the main body like the rings of Saturn. You need a medium-sized scope and dark sky to see them well, but they’re definitely worth looking for.

The nebula itself is pretty neat, too. It’s an oblong patch of light about 30 arc-seconds across, so not really very big, but it’s bright enough to take magnification well. The central white dwarf star is relatively bright at magnitude 11.5, but the nebula itself is bright enough to make spotting it difficult.

M73 – R.A. 20h 58m 55s, Dec. -12° 38' 00"

M73 is the oddball of the Messier objects: It’s just a Y-shaped asterism of four stars. But they’re just the right distance apart to look like a fuzzy blob in a small telescope,

which is what Messier had. He saw the four stars clearly enough, but he thought they were surrounded by nebulosity, which they aren't. It's still a cool little asterism, though. (It's not a true quadruple star or a cluster, since the stars are at different distances.)

M72 – R.A. 20h 53m 28s, Dec. -12° 32' 14"

M72 is a bit more exciting than M73. It's not the biggest or brightest globular cluster in the sky, but it's still worth a look. It's about 55,000 light-years away, so its stars are difficult to resolve, but the outer area starts to bust into individual points of light in an 8" scope or larger. It's approaching us at a pretty good clip (255 km/sec), so in a few million years it should be a lot brighter.

107 Aquarii – R.A. 23h 46m 01s, Dec. -18° 40' 42"

107 Aquarii isn't labeled in the Pocket Sky Atlas, but 106 and 108 are, and 107 is right between them. It's a nice double star with components of 5.6 and 6.5 magnitude and a separation of 6.9". That gives it enough variation in brightness to be interesting and enough separation to make it fairly easy to split them.

99 and 101 Aquarii to the west look like enticingly bright doubles on the chart page, but 99 isn't actually a double and 101 is too tight and too unequal to be split in any but the largest scopes.

NGC 7293 – (Caldwell 63) – Helix Nebula – R.A. 22h 29m 39s, Dec. -20° 50' 15"

The Helix Nebula is the largest and closest planetary nebula in the sky. It's over half as big as the full Moon, and at magnitude 7.3 it's fairly bright, but that brightness is spread out enough to make it difficult to spot. You can sweep right over it if you're in light-polluted sky, because the nebula glows at about the same brightness as the background. Under dark sky, however, it's a big, diffuse donut of light, probably most easily seen in binoculars. Use your lowest power, widest field eyepiece in a telescope, and use a nebula filter if you have one.

What you'll see is a big circle of light with a few background or foreground stars scattered within it. The outer part of the ring is much brighter than the middle. The central star is visible in medium-large telescopes, but it's a challenge.

Since the Ring Nebula, the Dumbbell Nebula, and the Helix Nebula are all visible in the same summer sky, it's fun to go from one to the next to the next, checking out a fairly distant Ring at 1500-2000 light-years (It's hard to get an accurate distance to a fuzzy planetary nebula), then a mid-range Dumbbell at maybe 1000 light-years, then the Helix at 650 light years. They start out small and bright and get progressively larger and dimmer as we get closer, which is a little counterintuitive but demonstrates the effect of surface brightness versus total light output. The Helix is so much bigger, its light is spread out more and its surface brightness is the lowest of the three.

41 Aquarii – R.A. 22h 14m 18s, Dec. -21° 04' 28"

41 Aquarii is a decent double star about 3.5° to the west of the Helix Nebula. It has components of magnitude 5.3 and 6.7 with a separation of 5.2".

M30 – R.A. 21h 40m 22s, Dec. -23° 10' 48"

M30 is a great globular cluster just to the east side of the big triangle of Capricornus. It's considerably brighter (mag. 7.2) and larger (12') than M72 above. It looks somewhat elongated from east to west, and under magnification it busts into individual stars almost

all the way to the tightly packed core.

If you're running a Messier marathon (trying to see every Messier object in one night, which is possible in mid March when the Sun is in a part of the sky with no Messier objects), M30 is likely to be your last target of the night, picked up just before morning twilight washes out the sky. My most successful Messier marathon, which I did in Arizona in 2016, was a complete run until I got to M30, which was hidden behind a distant hill until too late for me to see it in the dawn glow.

Fomalhaut – Alpha (α) Piscis Austrini – R.A. 22h 57m 39s, Dec. -29° 37' 20"

If you see a bright star out in the middle of nowhere, chances are it's Fomalhaut. Of all the first-magnitude stars, it's the farthest from any others. It's sometimes called "The Lonely Star of Autumn" because it's so isolated.

Fomalhaut is a fairly young star, still surrounded by a disk of gas and dust out of which planets are forming. The first exoplanet ever imaged directly is Fomalhaut b, now called Dagon. Photos of the Fomalhaut dust disk look eerily like a big eye staring back at us.

You won't see any of that in a home telescope, of course. But Fomalhaut is one of those bright stars that hangs out low in the south for most northern-hemisphere observers, and as such it twinkles nicely in turbulent air. It's only 25 light-years away, which is quite close in astronomical terms.

PSA Charts 78, 79, & 80

NGC 55 – R.A. 00h 14m 54s, Dec. -39° 11' 48"

NGC 55 is the second-brightest galaxy in the Sculptor group (after NGC 253, the Silver Coin Galaxy). At magnitude 7.8 and with a long dimension of 30' (one full Moon), it's both brighter and larger than M82, which it resembles in photographs. It's a more or less edge-on spiral with a lot of mottling and dust lanes all through it, so it looks like a patchy slash of light against the background.

Theta Indi – R.A. 21h 19m 52s, Dec. -53° 26' 58"

Theta Indi is a nice double star with components of magnitude 4.5 and 6.9 with a separation of 7.3", which makes it uneven enough and close enough to be both challenging and interesting.

The Solar System

The Moon and planets aren't listed in the *Pocket Sky Atlas* (because they move around too much to put in a chart!), but a list of Big, Bold, Bright, and Beautiful objects would be grievously incomplete without mention of them. So here's a brief accounting of what the solar system has to offer:

The Moon

Most astronomers think of the Moon as a pest, a natural street light that spoils the rest of the sky. It is when you're on a quest for faint fuzzies, but when you're hunting BBBB objects, the Moon is the Biggest, Boldest, Brightest, and arguably the most Beautiful object in the sky (except for the Sun, which we'll get to in a moment.) So savor it when it's out. Learn to love it, and learn your way around its many amazing features. In terms of bang for your buck, it's hard to beat the Moon.

The most obvious features are the lava-filled *maria*. That's where huge asteroids crashed into the surface billions of years ago, cracked the mantle, and let lava flow up and flood the immense impact craters. The maria are relatively devoid of big craters, but there are enough to be interesting.

The highlands (mostly in the southern half) are way more rugged. This is the original surface of the Moon, hammered again and again by smaller asteroids and meteors until it's a mosaic of overlapping craters. Some of the newer craters have obvious white rays radiating outward from them. That's the debris blasted out from the impacts. (Incoming asteroids hit really hard, vaporizing both the asteroid and much of the surface they hit.) The streaks eventually fade over time (millions of years), so you can tell the newer craters by their bright rays. Tycho is the biggest, newest crater in the far south. Copernicus is another new one with lots of rays just to the south of Mare Imbrium. Its rays are kind of ragged and splotchy, looking (to me, anyway) like an ice cream cone accidentally dropped on the pavement.

The large craters usually have central peaks, and some of them have terraced rims where the slope was too steep to stay put and material slumped down into the crater after the explosion that created it. I used to think that the central peaks were bits of the original terrain that survived the explosion, but it turns out they're the result of sloshing of the molten ejecta. When it all rushes back toward the center it rises up in a big bulge, just about the time it freezes solid again. Then landslides and later, smaller impacts shape the hump into jagged peaks.

The line of high-contrast terrain between the shadowed side and the sunlit side of the Moon is called the *terminator*, and that's the place where most of the cool sights are. That's because sunlight is coming in at a low angle along the terminator, casting deep shadows from crater rims and central peaks and faults and the like. The Moon rotates slowly (29.5 days from full moon to full moon), so we get to examine a new section of the Moon in high detail each night as its phase waxes and wanes. We can even see motion on a single night as shadows shrink or lengthen and mountaintops begin to glow in morning sunlight. Often you'll see single peaks standing out by themselves well into the otherwise dark side of the Moon.

When I say "dark side," I mean whatever part isn't currently lit by the Sun. The Moon has no permanent dark side. It rotates at the same speed that it revolves around the Earth, so it keeps one side pointed permanently at us (a phenomenon known as tidal locking, which is very common among the moons of all the planets), but as it goes around the

Earth it exposes all sides to the Sun just as the Earth does from day to day. So the “dark side” is just whatever half of the Moon is dark at the moment.

Of course after you’ve looked at the Moon for a while, you have favorite craters. Clavius is one of mine. It’s a big crater in the southern highlands, and it has a perfect arc of smaller craters within it, all of diminishing size as you work your way around the arc. It looks to me as if a big asteroid was rotating as it came in and tidal forces pulled it apart just before impact, with the largest piece coming straight in and the other pieces striking farther away as the rotation flung them outward. That’s not a widely held theory, since crater counts within the main craters supposedly show them to be of different ages, but to me the arc looks too perfect to be an accidental alignment of unrelated impacts.

I’ve already mentioned Tycho, just north of Clavius. To the left (east) of Clavius from Tycho is Schiller, one of the few oblong craters. It even has an oblong central peak. Most of the asteroid impacts on the Moon happen at such high velocity that the asteroid and much of the surface are vaporized upon contact, so most craters are round no matter what angle the asteroid hit at, but occasionally the angle was so shallow that the asteroid plowed a trench as it blew up. Schiller is one of those.

Volcanism has also left easily discernible faults and rilles (collapsed lava tubes). These are best seen near the terminator. One of my favorites is the Hyginus rille, almost dead square in the middle of the Moon and best seen around first quarter. There’s a great fault scarp called the Straight Wall in Mare Nubium that’s best a day or so after first quarter.

Oh yeah, quarters. Why is it called “first quarter” when half the surface is lit? Because it’s one fourth of the way from new Moon (all dark) to the next new Moon. A full Moon is technically second quarter, or a half Moon. (Yeah, it’s confusing.)

When the Moon is full (completely lit), surface detail is difficult to see. But the rays from fresh craters stand out well. Look for Tycho’s and Copernicus’s rays, but also look for rays from smaller craters. Messier A and B, two diminutive craters in Mare Fecunditatis, cast easily spotted twin rays eastward.

The Moon can occupy you for days at a stretch. And a month later it’s all new and different because the rotation period isn’t exactly 29 days, so you see new stuff along the terminator that wasn’t well lit last month. Plus the Moon nods upward and downward and eastward and westward with *libration*, so you’re always seeing new features. You don’t get an exact repeat for 18 years, so keep an eye on that bright spotlight in the sky. It’s way more interesting than most people think.

The Sun

You need special equipment to look at the Sun safely. Either a solar filter that fits over the front of your telescope or a dedicated solar telescope with the filter built in. But when you’re so equipped, the Sun is a fascinating subject. With a white light filter you can see sunspots, gigantic magnetic storms that are often bigger than the Earth. (The Sun is 100 times bigger than the Earth, so a sunspot that’s only 1/100 of the Sun’s diameter is about the size of our whole planet.) Sunspots are black spots on the grainy surface, and they often have striated areoles around them where the intense magnetic fields are pulling hot plasma into radial lines. They usually come in pairs, often with dozens of smaller spots scattered nearby.

Sunspots are best seen with a white-light solar filter, usually made of a special reflective mylar material that rejects most of the incoming light and only lets a safe

amount through to the eyepiece.

Dedicated solar scopes use a completely different system. They have what's called an *etalon* down inside. There's an energy rejection filter that does the same job as a white light filter, but then the etalon filters out all but one wavelength of light. It's the wavelength that ionized hydrogen radiates at, and since the Sun's surface is mostly ionized hydrogen, an H-alpha scope, as it's called, lets you see that surface in great detail. You can see the granulation of the convection cells that carry the heat from the interior to the surface, and you can see filaments of hot plasma being held up above the surface by magnetic fields. You can see filaments sticking out the sides, making what we call *prominences*. You can see plages, which are brighter spots where the convection cells are disrupted (often seen around sunspots). With a crisp enough view you can even see the tiny gap between the photosphere and the chromosphere, the two surface layers of the Sun.

And all this stuff changes from hour to hour. I've watched blobs of super-hot plasma rise up and arch over in a prominence and drop back to the surface. I've watched prominences writhe around like snakes, and I've watched them expand and drift out into space.

Very rarely you might spot a solar flare. That's what happens when the magnetic fields around a sunspot become so entangled that they break, and the release of energy blasts plasma out into space at a rate that makes prominences (themselves pretty impressive) look like wet firecrackers. Flares only last for a few minutes, and they're almost impossible to predict, so you have to be watching at exactly the right time. I've been watching the Sun with an H-alpha scope since 2016 and I haven't seen a flare yet. One of my friends has, though, in his first year of observing. I only hate him a little.

The Sun goes through 11-year cycles of activity. During the low part of the cycle sunspots are rare and prominences and filaments and plages are few and far between. During the active phase, however, it's a rare day that doesn't present at least one or two spots and several other features. It's well worth building or buying a white light filter for observing sunspots during the active half of the cycle, and it's well worth buying an H-alpha scope if you can afford one. They're not cheap, but they're certainly amazing.

Eclipses

Sometimes the Moon and the Sun line up with respect to the Earth. When that happens, we get an eclipse. When the Moon goes between the Earth and the Sun, we get a solar eclipse, and when the Earth goes between the Moon and the Sun we get a lunar eclipse.

Oddly enough, we get more solar eclipses than lunar eclipses. Why is that? Because the Earth is 8,000 miles across, so it presents a big target for the Moon's shadow to hit. The Earth's shadow, on the other hand, is only 6,000 miles across at the distance of the Moon, so it's actually a smaller target for the Moon to pass through.

The reason you'll see way more lunar eclipses than solar eclipses in your lifetime, though, is because anyone on the night side of the planet can see a lunar eclipse while it's happening, but a solar eclipse is only visible in a very narrow band as the Moon's shadow (which is quite small after crossing the distance from the Moon to the Earth) works its way across the planet.

Everyone should make an attempt to see at least one solar eclipse in their life. It's something you'll never forget, and never regret. The sky grows dark, stars come out,

Venus and Mercury become visible, often very close to the eclipsed solar disk, prominences stand out from the edge, and the etherial corona, the hazy outer atmosphere of the Sun that you can only see during a total eclipse, shines out in silvery-white glory. All that stuff surrounds the blackest black hole in space that you'll ever see: the night side of the Moon with the Sun directly behind it.

This only happens in a narrow path of totality that's just a few miles wide. If you're outside that path by even a few hundred yards, the Moon won't quite cover the Sun and you won't see any of the above. When even a tiny sliver of the Sun's surface is visible, it washes out the sky. So don't settle for a partial eclipse if you can get into the path of totality.

In one of those amazing cosmic coincidences that boggle the mind, the Moon is 1/400 the diameter of the Sun and the Sun is 400 times farther away, so they appear almost exactly the same size in the sky. And the Moon doesn't pause in its orbit to let you savor the spectacle, so total eclipses only last for a few minutes at best, and sometimes they don't become total at all. The Moon's orbit isn't perfectly circular, so if it happens to be at the most distant point in its orbit (its *apogee*) when it crosses in front of the Sun, it won't quite cover the solar disk. What we get then is an *annular* eclipse (not because it happens once a year — it doesn't — but because there's an *annulus* of sunlight around the Moon). The Moon is also drifting farther away from Earth at the rate of an inch and a half per year, so eventually (in about 600 million years) it will become too distant to create any more total eclipses. So enjoy them while you can!

Lunar eclipses are a different breed of cat. They happen when the Moon slips into Earth's shadow, and because the Earth's shadow is 6,000 miles across at that distance and the Moon is only 2,000 miles across, they last a while. The longest possible total lunar eclipse would be 1 hour and 47 minutes if the Moon passed directly through the center of Earth's shadow. But the geometry seldom lines up that perfectly, so the Moon usually cuts a shallower chord through the shadow. Even then, totality often lasts more than an hour.

During the approach phase, Earth's shadow takes a bigger and bigger bite out of the Moon. It's always a full Moon, because the Moon is always directly opposite the Sun during an eclipse, but as the shadow covers more and more of the surface it starts to look like a crescent Moon. But the size of the arc is all wrong! And the shadowed side doesn't go completely dark. It takes on a reddish hue, lit by a ring of sunsets and sunrises all around the perimeter of the Earth (as seen from the Moon). The deeper the Moon moves into the Earth's shadow, the redder it becomes, until when the last sliver of Moon drops into shadow, the Moon becomes a coppery red disk with still plainly visible maria and craters. Examining it with a telescope during totality is great fun.

Lunar eclipses are safe to watch without any eye protection. Solar eclipses, however, require eye protection and filters on telescopes right up to the moment of totality. You can only look at a total solar eclipse without eye protection during totality. Failure to heed this warning will fry your eyeballs all the way back to your cowlick.

Seriously, take the proper precautions whenever viewing the Sun. Your eyesight is far more easily damaged than you might think, and far too valuable to risk.

Mercury

Mercury is the closest planet to the Sun. It's well inside Earth's orbit, so consequently

it never strays far from the Sun in the sky. It orbits fast, only 88 days, so it pops into the morning sky for a month or so, then into the evening sky for a month or so, but only becoming visible for a week or two at the farthest reaches of its orbit.

Mercury is too small to show any surface detail, but you can make out phases (just like lunar phases) as it moves around the Sun. It's easiest to see when it's half lit, because that's when it's farthest off to one side or the other. These times are called *elongations*.

The *ecliptic*, the path that the Sun and planets take across the sky, rises up from the horizon most steeply in evenings during the springtime, so an eastern elongation (when Mercury is farthest to the east of the Sun, and hence sets after the Sun does) in the springtime is your best chance for spotting it.

Venus

Venus is a little farther from the Sun than Mercury, but its orbit still lies inside ours, so it also remains tethered to the Sun. It strays quite a bit farther, up to 48° away, but you'll never see it on the opposite side of the sky. Its orbit takes considerably longer, too (225 days), so it stays in one part of the sky much longer than Mercury. In fact, due to the way Earth's orbit and Venus's orbit interact, Venus stays in the morning sky for most of a year, then crosses behind the Sun and stays in the evening sky for a year before crossing in front of the Sun and repeating the process. That's why Venus is often called the "morning star" or the "evening star." It's both, depending upon where it is in its orbit.

Venus gets really bright. It's the third brightest thing in the sky after the Sun and the Moon. And it shows phases, too, as its angle with respect to the sun changes. It doesn't show any surface detail, though. Its surface is covered by thick clouds that never part. We've mapped the surface with radar, but nobody has ever seen it through a telescope.

Venus is fun to look at in the daytime. If you know just where to look, and put the Sun behind a building or a tree to block its glare, you can often spot it by naked eye. It's relatively easy to spot in binoculars, but make absolutely sure you can't accidentally look at the Sun while you're hunting for it. And once you've found it, you can often put it in the field of view of a telescope. Venus is especially beautiful when it's in its crescent phase.

Mars

Mars orbits the Sun farther out than Earth, so it can appear high in the sky even at midnight. It takes 1.88 of our years to complete an orbit, and we both orbit in the same direction (all the planets do — counter-clockwise when viewed from the north), so we only catch up with each other every 26 months. When we do, Mars becomes very interesting in a telescope, showing light and dark patches on its surface, polar ice caps, clouds, and dust storms. Mars's surface is rust-red, so it's pretty easy to tell from a star. Only Antares, Aldebaran, Arcturus, and Betelgeuse glow as bright and anywhere close to as red.

Sometimes the dust storms expand to envelop the entire planet. When that happens we just see a reddish-orange blob, which is frustrating because it can sometimes stay dusty for the entire time it's close enough to observe well. But when we get lucky and have a clear view of the planet, it can be very fun to examine its surface from night to night.

Mars's day is 24 hours and 40 minutes long, just $\frac{2}{3}$ of an hour longer than our day. That means if you look at Mars for most of a night, you'll see it rotate partway around but you won't see the entire planet. The next night you'll be looking at nearly the same features, just 40 minutes later. So to see all of Mars, you have to watch it for several weeks until the difference in our day lengths have presented the entire planet to us.

Mars has two moons, Deimos and Phobos. They can be seen in a large telescope under near-perfect conditions, but it's really difficult. They're both small and they orbit close to the planet, so Mars's glare makes it hard to see those two tiny specks. I've tried and tried, but even with a 20" scope I haven't managed it yet.

During close approach, Mars can get up to 25 arc-seconds across. When Mars swings around to the other side of the Sun it becomes too small (about 4 arc-seconds) to see any detail. So catch it within a month or two of opposition for its best show.

Asteroids

In between Mars and Jupiter lies the asteroid belt. The asteroids are small rocky bodies that never coalesced into a single planet. Science fiction movies would make you think that they're as thick as birds in a flock, but the reality is a bit less exciting: They're separated by millions of miles, and most of them are only a few feet across. There are only a couple dozen relatively big ones (Ceres, at 580 miles diameter, is by far the biggest), and together the entire asteroid belt only masses about 4% of our Moon's mass.

Being small, they just look like stars in a telescope. That's why they're called "asteroids" they're star-like points of light that don't behave like stars.

And that's what makes them fun to observe: You can watch them move from night to night. Use a planetarium program or go online to Heavens-above.com and look for whichever relatively bright asteroid is up on any given night, track it down, and sketch the star field. Go back a day or two later and look at the same star field, and one of the "stars" will have moved. That's your asteroid. With a planetarium program or a printout of the asteroid's position from Heavens-above.com, you can often tell which one it is with your first observation.

There's another population of asteroids with eccentric orbits that bring them close to Earth from time to time. These near-Earth asteroids are usually too small to see, but sometimes a big one sweeps past. When that happens, if you can track it down and get it in the eyepiece you can watch it move in real time across several degrees of sky in a night. It's like watching the minute hand of a clock; you don't see it move much, but within a couple of minutes its position has obviously changed.

Jupiter

Beyond the asteroid belt lies the king of the solar system: Jupiter. It's by far the largest planet, fully ten times the diameter of Earth. It's a giant ball of hydrogen and helium and various other gases with a rocky core that we never see because the gaseous outer layers are so thick and cloudy. The cloud tops offer spectacular viewing, however. They're arranged into bands that divide the planet into layers from pole to pole. There are two main bands that appear reddish brown on either side of a white equatorial belt, and numerous minor bands. The poles have caps like yarmulkes.

The Great Red Spot, a huge storm that has persisted for hundreds of years and maybe longer, lies nestled into the southern edge of the south equatorial belt. It's bigger than the

Earth, although it has begun shrinking in recent years. Its color varies from deep brownish red to a light salmon, making it stand out easily sometimes and blend into the background at others. Jupiter rotates once in 10 hours, so the red spot (and all of Jupiter's other surface features) moves across the face of the planet pretty quickly. Because the face of the planet that we can see well is really only a quarter or so of its entire surface (the rest being off to the sides and around back), we can only see the Red Spot for a couple of hours out of that 10-hour rotation. It's really easy to discern its movement in as little as 10 minutes or so.

As if Jupiter itself weren't cool enough, it has four large moons: Io, Europa, Ganymede, and Callisto. They orbit Jupiter in 1.77 days, 3.55 days, 7.15 days, and 16.69 days, which means you can watch the innermost ones move in real time. The plane of their orbit is pretty much edge-on to us, so we don't see them go round and round; instead we see them move back and forth from side to side. Sometimes they pass one another, either going in the same direction or opposite, and sometimes they pile up in a bunch before breaking apart and going their separate ways. They often cross in front of Jupiter, which is cool enough, but they cast dark shadows on the cloud tops and that is seriously cool. The shadow transits last a couple of hours and are always exciting to watch.

Another fun game is to see if you can guess by just looking at them which moon is which. Io is yellower than the others (it's covered with sulfur volcanos!) and it never strays far from Jupiter, so it's usually fairly easy to spot. Ganymede is the largest and brightest. Callisto is the farthest away from the planet, so when it's off to one side or another of its orbit it's the only one out there. Europa is second closest and second dimmest (Callisto is a tiny bit dimmer), so when it's farther out than Io gets and Callisto is farther still, it's fairly easy to discern, too. But when they're all huddled together it can be a real trick.

It can be fun to chart their orbits, too. Observe them from night to night and see if you can calculate their orbital periods from your observations. See if you can predict where they'll be before you look.

If you examine their orbital periods mathematically, you'll see that the innermost three are locked in a 1:2:4 resonance. Io makes two orbits for every one of Europa's, and four orbits for every one of Ganymede's. Callisto, the outlier, is at 1:9 resonance right now, but tidal forces are still at work tugging the moons around, so in another billion years or so the system will probably settle into a neat 1:2:4:8 resonance and predicting their positions will be simple.

Saturn

Of all the planets, Saturn is the one that always gets an "Oh my God!" when someone sees it in a telescope for the first time. The rings are every bit as stunning in real life as they look in photographs. The planet itself is smaller than Jupiter and kind of bland, but those rings are so crisp and detailed that they hardly look real. (I've had people at star parties look down the tube of my telescope to see if I've hidden a photo down there.)

To give you a sense of scale, those rings would fill most of the space between the Earth and the Moon. The Cassini division, that tiny little gap that you can see about 1/3 of the way in from the edge on nights of steady seeing, is about as wide as the United States.

Saturn has five moons that can be seen in modest telescopes: Titan, the largest and brightest, Dione, Tethys, and Rhea all about the same, Iapetus sometimes dimmer and

sometimes not, and Enceladus bringing up the rear. Mimas and Hyperion can be spotted in large scopes, but not easily. Saturn's orbital plane is tilted quite a ways with respect to the ecliptic (the plane of the solar system), so the Moons make oval paths around the planet most of the time. Every 15 years, though, Saturn's orbital plane intersects the ecliptic (the equivalent of our spring and autumn equinoxes) and the moons shift left-right like Jupiter's.

During those equinoxes, the rings do something bizarre: They completely disappear. The rings are so thin (only a few dozen feet) that when they're oriented edge-on to us, they become invisible. That happened to Galileo in 1612 and it nearly drove him nuts. He'd been telling everyone about these odd protrusions sticking out from the sides of Saturn, and now everybody was saying, "Yeah, right" and swirling their fingers around beside their heads.

When the rings are visible, another cool thing to look for is their shadow on the planet, and the planet's shadow on the rings behind it. Saturn is a long way from the Sun, so we always see it with sunlight hitting it nearly straight on, but there's enough of an angle due to our own distance off to one side or the other to let us peek around the side at the shadow.

Iapetus is an interesting moon. It plows through dust spiraling inward from Phoebe (a moon too small to see in an amateur telescope) and that dust coats its forward facing side, but much brighter ice coats the trailing side. So when Iapetus is heading toward us in its orbit (on the eastern side of Saturn) it's much dimmer than when it's moving away from us. When we're looking at the icy side, Iapetus is as bright as Tethys (mag. 10.2), but when we're looking at the dusty side it's 11.9, dimmer than Enceladus.

Saturn itself has bands like Jupiter, but they're much more subtle. You might notice the difference in color between the polar caps and the rest of the planet, and you might see the occasional white storm system swirling around, but they're never as spectacular as the cloud patterns on Jupiter. So look to Jupiter for cool planetary detail, but look to Saturn for those fabulous rings.

Uranus

Saturn was the most distant planet known for millennia. It wasn't until 1781 when William Herschel noted that a star in Gemini "appeared visibly larger than the rest" that our knowledge of the solar system expanded to include a seventh planet. Like Jupiter and Saturn, Uranus is mostly gas rather than rock. Its atmosphere contains predominantly hydrogen, helium, methane, and ammonia, the latter of which gives it a distinctly blue appearance.

Uranus is quite large, about 1/3 Jupiter's diameter, but it's so distant (19 times farther from the Sun than the Earth is) that we only see a small blue dot in a telescope. It's definitely larger than a star, though, as Herschel discovered. It shines at magnitude 5.6 to 5.9 depending upon its distance, so it's visible to the naked eye if you're under dark sky and you know just where to look. It's an easy find in binoculars, and in a telescope if you have a finder chart to help you out.

Uranus has several moons, three or four of which can be seen in large telescopes but it definitely takes some aperture and steady seeing.

Uranus takes 84 years to orbit the Sun, so it doesn't move much against the background stars from year to year.

Neptune

Neptune is almost the same size as Uranus, but it's half again farther away from the Sun (and from us), so it appears considerably smaller and dimmer. It's about 8th magnitude, so still bright enough to see in binoculars, but it will just look like a star unless you put a telescope on it. It can just be made out as a disk at high power. To me it looks greenish blue rather than the straight blue of Uranus, although the difference is subtle.

Neptune has one large moon, Triton, that can be seen relatively easily in scopes of 16" aperture or larger. I've seen it in my 12" scope, but it was right on the border of visibility.

Pluto

Yeah, yeah, Pluto is no longer considered a planet, and at 14th magnitude (and growing steadily fainter for the next few decades) it's certainly not BBB or B, but it's still part of the solar system and it's fun to track down. It's probably the most distant solar system object you'll ever see. When you find it it'll just be a faint speck, so you'll need a good finder chart and you'll probably need to look for it several nights in a row to make sure you're seeing it and not one of the myriad background stars nearby.

Comets

Our solar system extends way out beyond Pluto. And out there in the cold and dark, where the Sun is just a bright star, the primordial building blocks of the Sun and planets still lurk in deep freeze. Small planetesimals made of water ice and frozen carbon dioxide and other frozen gases still float around out there, taking thousands of years to orbit the Sun. But every now and then a close encounter swings one inward, tossing it down into the gravity well where it warms up under the increasing heat of the Sun. Its frozen surface begins to melt and to *sublime*, to change directly from solid to gas, and that gas drifts away from the parent body, often carrying dust particles away with it. When that happens, the *coma*, as it's called, catches sunlight and begins to glow. Sunlight and the solar wind also push it out away from the nucleus, creating a tail of gas and loosened dust that streams out behind it.

That's a comet. If a comet comes close enough to the Sun, the surface becomes really active and the tail grows huge, sometimes millions of miles long. If it also swings by close to the Earth, then we call it a Great Comet and go a little bit nuts over it. People used to think they were bad omens (some still do). People name household cleaners and automobiles after them. People buy telescopes just to look at them, even though they're too large to fit into the field of view.

The thing about comets is that we can seldom tell how much gas and dust they're going to expel until they've done it, so predicting how bright they're going to get is tricky business. In 1973, a few astronomers predicted that comet Kohoutek would become a Great Comet. Others said "Maybe not," but guess who the media listened to. The news was full of predictions that it would be "the comet of the century," and people eagerly awaited a glorious show. But the comet fizzled, and the entire field of astronomy got egg on its face due to the hype.

Other comets, like West, Hyakutake, Hale-Bopp, McNaught, and Neowise proved spectacular.

Sometimes when a comet drops into the inner solar system, encounters with one or more planets will bend its trajectory into a tighter orbit, and then it becomes a periodic comet, swinging inward on a regular schedule. Comet Halley is probably the most famous periodic comet. It has an orbit of 76 years, so it's possible to see it twice in your lifetime. Next time around won't be until 2061, though, so we've got a bit of a wait yet.

We get a decent one every few years. Keep an eye out, and an ear to the news. Predictions will be greatly exaggerated (or more accurately the most exaggerated predictions will get the most press), but sometimes a comet even exceeds the predictions. The really good ones are so big and so bright (and bold and beautiful) that they're best appreciated with the naked eye. As with solar eclipses, you'll find yourself just standing there, mouth agape, unable to articulate more than "Oooh! Oooh! Oooh!"

OBJECTS NOT INCLUDED:

NGC 147 & 185: (Caldwell 17 & 18). Too faint.

NGC 278: Too small and dim.

NGC 6426 - Globular cluster between Beta and Gamma Ophiuchi. Too faint to be BBBB.

NGC 6144 - Globular cluster near Antares. Too faint to be BBBB.

38 Lynceis - 3.8 & 6.0, 2.7" [Not worth including]

57 Ursa Majoris - 5.4 & 8.3, 5.5". [too tight and uneven]

Alula Borealis – Nu Ursa Majoris: 3.5 & 10.1, 7.3" (Too tight and companion is too faint.)

IC 3568 - Too small and dim, looks stellar

OΣ 235 – Otto Struve 235: 5.5 & 6.9, 0.9" Too tight to split in 10" even with good seeing (5/22/17)

NGC 7023 – Iris Nebula – Caldwell 4: A bright central star lights up the reflection nebula but also interferes with seeing it. Definitely something there, but not very impressive. Nor are the supposed clusters nearby. In fact, this area of the sky seems more barren than the general background around it. Nebula blocking background stars? Not BBBB.

NGC 7538: Small and distinct nebula just north of 7510, in same field at low power, but not BBBB.

NGC 7790: A relatively bright (magnitude 8.5) open cluster of about 30 stars in an elongated east-west orientation, separated into three clumps of stars. [Most of the stars are 11-12 mag, so this may be too faint to include] [My observing notes: "Too small. Nice with aperture & high mag., but not BBBB.]

Hind's Variable Nebula: too faint, may not even be visible at all nowadays.

88 Tauri: too wide to be interesting.

47 Tauri: too tight.

Σ 2118 – Struve 2118: 1.1 arc-second, too tight.

Σ 2218 – Struve 2218: 1.4 arc-second, too tight.

Σ 2924 – Struve 2924: 0.3 arc-second, too tight.

Zeta Herculis: Double star with 34.5-year period. Mags. 2.8 & 5.4. Separation ranges from 0.5" to 1.5" (Too tight to include)

75 Draconis: Too wide and uneven to be interesting

NGC 6217: [My notes: Surprisingly visible in 12.5" scope with 14mm eyepiece. Stellar core, elongated disk. Probably too dim for BBBB, though.]

NGC 7008: Fetus/Starchild. Nice in a big scope, but too faint for BBBB.

IC 342: (Caldwell 5). Too small & faint.

NGC 7048: Planetary nebula. Too small & faint. Stellar, and not in the exciting way.

NGC 7039: Open cluster, lost amid the Milky Way. Hard to tell when you're on the cluster.

NGC 7082. Open cluster near M39. Lost in the Milky Way.

Cocoon Nebula. (Caldwell 19). Not BBBB

NGC 7044. Small & faint. Not BBBB (Called "Starfish Cluster")

Medusa Nebula. Large, but very low surface brightness.

U Cygni. Carbon star, but nothing exciting.

26 Draconis. Too tight (0.3")

52 Herculis. Couldn't split

68 Herculis. Couldn't split

69 Hercules. Too tight, too different in mags
90 Hercules: Too tight, too different in mags
99 Hercules: Too tight, too different in mags
NGC 6340. 11 mag galaxy. Too faint & small.
NGC 6342, 6325, 6355, 6316: Globular clusters in Ophiuchus. Too faint and/or small
UGC 10822: Draco Dwarf Galaxy. Too faint.
NGC 2395: Open cluster. 8th magnitude, about 45 stars. Hard to distinguish from the background.
NGC 6652: (near M69 & M70 in Sag.), too dim
Collinder 96 Not BBBB (Doesn't stand out from background.)
Cone Nebula (way too dim)
NGC 2254: Open cluster (Faint arc of stars. Not BBBB.)
Collinder 111: Not BBBB (nothing visible there)
Collinder 106: Coarse and large, hard to pick out from rich background. Not BBBB.
Collinder 97: Doesn't stand out. Not BBBB.
Collinder 107: Doesn't stand out. Not BBBB.
NGC 2186: Doesn't stand out. Not BBBB.
NGC 2414: Too small and sparse.
NGC 4236: Caldwell 3, but too faint to include.
NGC 7635, Bubble Nebula, Caldwell 11: Too faint
IC 405 – (Caldwell 31): Flaming Star Nebula: too dim.
13 Lacertae: Companion is too faint.
72 Pegasi: too tight
78 Pegasi: too tight and uneven
NGC 7006: Caldwell 42. Too small and dim
Sigma Aquarii: couldn't split (too uneven)
99 Aquarii: not double
101 Aquarii: too tight and uneven
NGC 7606: too small and dim. Tau (τ) and 63 Arietis and star to lower right of them: too tight to split.
132 Tauri: couldn't split. Too much difference in mag.
Caldwell 9, Cave Nebula: too faint.
NGC 1275, Perseus A, Caldwell 24. Too faint.
NGC 4889, Caldwell 35, too faint.
NGC 4559, Caldwell 36
NGC 3626, Caldwell 40, too faint and small
NGC 2775, Caldwell 48, too faint and small
IC 1613, Caldwell 51, too faint
NGC 6822, Caldwell 57, Barnard's galaxy, too faint
NGC 1097, Caldwell 67, too faint and low declination (-30 in Fornax)
NGC 6729, Caldwell 68, too faint and low declination (-37 in Corona Australis)
NGC 300, Caldwell 70, too low in sky (-37 in Sculptor)
NGC 4147, Globular. Too faint. (10.3 mag.)

GREEK ALPHABET

Alpha = α

Beta = β

Gamma = γ

Delta = δ

Epsilon = ε

Zeta = ζ

Eta = η

Theta = θ

Iota = ι

Kappa = κ

Lambda = λ

Mu = μ

Nu = ν

Xi = ξ

Omicron = $\omicron$

Pi = π

Rho = ρ

Sigma = σ

Tau = τ

Upsilon = υ

Phi = φ

Chi = χ

Psi = ψ

Omega = ω