Touring the Trumpler Classes

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Robert Trumpler (1886-1956) was a Swiss astronomer (he became a naturalized American citizen in 1921) who contributed greatly to our understanding of open star clusters in his 1930 paper, "Preliminary results on the distances, dimensions and space distribution of open star clusters.[i]" In writing his paper, he created a cluster classification scheme that is still in use today.

Trumpler's system makes use of three codes to describe a cluster (later there were additions of other codes, but that need not concern us here). The first code was a Roman numeral from I to IV to denote how detached the cluster was from the background/foreground stars. A cluster of type I is well-detached—it almost seems isolated in the sky, with very little clutter around it distract the eye. A type IV is virtually indistinguishable from the background.

The second code was a numeral from 1 to 3 to denote the general spread in magnitudes. A rating of 1 means there is little difference in the magnitudes of the members—they all appear to be nearly the same magnitude (plus or minus a magnitude or two). A type 3 has a very wide range of magnitudes, often with one very bright member dominating a dim background of lacey haze.

The third code was a richness code, using r, m, and p (for "rich," "medium and "poor"). A rich cluster had over 100 stars in it; a medium cluster between 50 and 100; and a poor one less than 50.

So as you can see, there are 4 codes for "detachedness", 3 for magnitude spread, and 3 for richness—or, altogether, some 4 x 3 x 3 = 36 different Trumpler classes.

This paper will take you on two guided tours of those classes, one for the summer skies and the other for the winter skies. (Summer and winter, of course, are the best seasons for open clusters for these are the seasons when the Milky Way lies high in the sky.) I have culled my observation logs (listing 509 Trumpler class clusters for the best of each class in each season. I have tried as much as possible to use clusters that are easy to identify and stunning to look at—but, alas, this criterion will not always be possible to meet!

Class I 1 r—Well-detached, uniform and rich clusters

The summer cluster I offer is **NGC 6819**, a beautiful gem of moderate difficulty located in Cygnus, located SW of γ Cyg at 19h 41m RA and +40d 11m declination (from this point forward, I will abbreviate positions as HHMM±DDMM). The cluster is about 5 minutes in diameter and contains 150 stars— quite a sight on a dark night in almost any telescope! It has an integrated magnitude of 7.3. My observing log says that in my 8-inch SCT, it was a nebulous cluster with a cigar shape dominated by two Vees that point to the northwest, with voids between the legs of each Vee. In my 11-inch SCT, I noted, "Beautiful, tight little knot of sparkly stars. At 193x, it was very grainy. It boasts two columns of stars, the east one being a little richer and brighter. At 339x, there is a trace of nebulosity in the eastern column. I counted 27 stars. It lies 8 min SW of a 7m star." The cluster is 7,700 light years away and a whopping 3.5 billion years old—an ancient cluster by open cluster standards (since they usually get torn apart by gravitational tidal forces as they orbit the galactic nucleus, most not lasting more than 5 revolutions). NGC 6819 has survived at least 15 trips around the galaxy, but this may be in part because it lies 1,000 light years *above* the Milky Way's plane and so avoids a lot of the tidal forces that may disrupt a cluster closer to the plane. 929 stars have been identified as members of this group, the brightest star of which is 11.5 magnitude. If we built a scale model of NGC 6819, using a scale where a baseball equals the Sun, the cluster would be 3,370 miles in diameter with stars 303 miles apart.

The winter offering is **NGC 2420**, located a little over 4^{o} east of Wasat (δ Gem), at 0739+2134. This treasure packs 100 stars into a plot of sky only 10 minutes across and has an integrated magnitude of 8.3. It lies a little farther out than NGC 6819, some 10,060 light years. My observing log shows, "8-in SCT at 206x. Rich and misty at low powers, it was resolved at high powers. Since it lies near the ecliptic, it often gets occulted by Solar System members. It is well-seen with averted vision. Steve Coe, a good friend and fellow member of the Saguaro Astronomy Club, says it is reminiscent of Corona Borealis… 11-in SCT at 115x. A small dense knot of 16 stars in a "7" shape." What does your imagination conjure up when you see this delightful little morsel? Using our "sun as a baseball model", its diameter would be 7,680 miles with stars 830 miles apart, so it is about twice the size and ¼ the density of 6819. It is 1.1 billion years old and contains one Ba supergiant. It lies 33,500 light years from the galactic center and 2,100 light years above the galactic plane.

Class I 1 m—Well-detached, uniform and moderately-rich clusters

The summer "chocolate" from my sampler is **NGC 6756**, a nice but somewhat demanding cluster to observe. It is in Aquila, 4½° west (and slightly north of) δ Aql, the star where the eagle's wings attach to its torso. The coordinates are 1909+0441. The integrated magnitude is 10.7, rather dim for an open cluster. There are 40 stars packed into a parking space only 4 minutes across, so even though it is smaller and "poorer" than the two I 1 r clusters we have looked at so far, it is still a rich and dense sight on a good dark night. My log shows, "8-in SCT at 206x. Semi-resolved, it magnifies well and looks a little like a globular cluster. Note the wall of 11m-12m stars to the SE." It is young, only about 62 million years old, and is not destined for a long life since it is only 150 light years below the galactic plane. So far, it has completed less than ½ of a revolution around the Galaxy. The brightest star is 13th magnitude. It is fairly close to us (4,900 light years away). A model (using our now-familiar scale) makes it to be 2,020 miles in diameter with stars 282 miles apart. So it is quite a bit smaller than either of the I 1 r clusters, but much denser than either! (Note as you go through this cluster survey how the younger clusters are denser in terms of stars per cubic light year than the older ones—time does indeed tend to dissipate these stellar nurseries!)

For the winter season, try **NGC 2254**, an easy but disappointing object. Located in Monoceros 10° east of Betelgeuse, it lies in those fabulous open cluster fields of the southern winter Milky Way. There are seven clusters within a Telrad's outer circle, so take your time to identify the correct candidate. NGC 2254 offers 50 stars in a 4 minute field and has an integrated magnitude of 9.1. My log has a surprising entry: "8-n SCT at 206x. It resembles a planetary nebula; I could only resolve 6 stars at high power. It has a "U" shape and is small and dense." What does it suggest to you? This cluster is 203 million years old and is 34,000 light years from the galactic center and lies right on the galactic plane. At least 93 stars are known to be members of the group. The brightest star is 11.9 magnitude (60 times brighter than the Sun). [1.5° SW is Plaskett's Star (at 0637+0608), one of the most massive known, discovered by J. S. Plaskett at Victoria Observatory in 1922. It is actually a close pair of O8 giants, each about 55 Suns in mass. They orbit one another every 14.3961 days. Their surface temperatures are about 28,000° K each and the total magnitude is 6.05. The secondary is actually underluminous for its mass and may be smaller than the primary.] At a distance of 7,710 light years, our scale model works out to be 2,700 miles in diameter with stars 370 miles apart.

Class I 1 p—Well-detached, uniform and poor clusters

My summer selection is **NGC 6425**, a 7.2 magnitude gaggle of 35 stars some 2,540 light years away, technically in Scorpius but very near the "spout" of the Teapot in Sagittarius (1747-3132). My log shows, "8-in SCT at 83x. Faint and misty. High power is a good idea here." (I thought about using Ruprecht 36 or NGC 6540 for the summer I 1 p case study, but neither of them overwhelmed me either.) According to the website, http://www.seds.org/~spider/spider/MWGC/n6540.html, NGC 6540 was discovered by William Herschel in 1784 and cataloged as H II 198. While Herschel classified it as a "faint nebula," indicated by his classification in the second group of deep sky objects, this object was long listed as [an]

open cluster, e.g. by Collinder who designated it Cr 364. S. Djorgovski independently "rediscovered" it in September 1986 without noting its identity, when looking for obscured globular clusters in the IRAS Point Source Catalog, labeled it Djorg 3, and suspected it to be a globular cluster (Djorgovski 1987). It was finally Bica et.al. (1994) who identified it with the NGC object, and confirmed its nature as a globular cluster." So what do we have here? A true (but faint and dense) open cluster, or a sparse globular? The NGC/IC Project web source cites it as an open cluster, so that is how I will use it here. Our scale model has its diameter at 1,130 miles with stars 1,240 miles apart. It is a very loose group, and hardly seems to be classable as a globular to me!

For the winter, try **Berkeley 94**, a pleasing (but not easy) cluster in Cepheus, at 2223+5551, 2½° SE of ζ Cep. With an integrated magnitude of 8.7, this nebulous bouquet has only 10 stars in it is 4 minute diameter, and is not an exciting object to observe. My log shows, "8-in SCT at 104x. This is a nebulous patch with a N-S axis that is helped greatly by high power. Is there nebulosity here too? The Trumpler code says there is, and there seems to be a hint of it in the 8-in." It is pretty far away (8,600 light years) but only 6 light years in diameter. It just came out of the oven, being only about 10 million years old. It is so loose and spread out (the scale model has it 3,221 miles across with stars 748 miles apart) that I don't think it will survive even one circuit around the Galaxy, so enjoy it while you can!

Class I 2 r—Well-detached, small magnitude range and rich in stars

With this group, we now get to enjoy some of what many of us love open clusters for—the dazzling range of brilliance among the gem-like members! In the richest category, my summer choice is **NGC 6705**, a 5.8 magnitude zinger packing 870 stars into a 13-minute space. (You may better know this cluster as M11 or The Wild Duck cluster! It is in Scutum at 1851-0616.) My notes record, "8-in SCT at 104x. An awesome and glorious sight! Note the dominant yellow star (8th magnitude) at the center, and by all means, use high power! A dark streak in the S is the dark nebula Barnard 318. The "Wild Duck" name was coined by William Henry Smyth because he felt the appearance of the cluster resembled a flock of ducks in flight. William Herschel claimed to have seen it with the naked eye… 14x70 Binos. Mottled, triangular shape, with 9th magnitude star about 10 min south (makes it look like a double star)." It was first discovered by G. Kirch in 1681. Halley included it in his list of 1715, as did John Bevis (1786 *Celestial Atlas*). De Mairan (1733) included it in a paper he published in 1733 and described it as "a very dense, small cloud and very similar to the Andromeda Nebula, were it not for the star which is seen close to the center." Cassini wrote of it (in 1740) that "one might imagine that they [nebulous stars] are formed of a great number of extremely small stars, so close to one another that they cannot be resolved even by our best telescopes. It is the combined light of these which gives them their irregular shape and whitish color." De Cheseaux listed it in 1746, calling it "a prodigious cluster of small stars". Le Gentil listed it in 1759, as did Koehler in 1782. Bode included it in his 1777 catalog. Messier added it to his list on May 30, 1764. He described it as a "cluster of a large number of small stars... which can only be seen in a good instrument; with an ordinary telescope... it resembles a comet: this cluster is mingled with a faint glow; in this cluster is a star of 8th magnitude." It is 15 light years in diameter and 550 million years old. Our scale model has the cluster 7,550 miles in diameter with stars 395 miles apart, very dense for such a

large group. (It has a density of 83 stars per cubic parsec. Robert Trumpler calculated that an observer at the center of M11 would see several hundred 1st magnitude stars— 40 or more would be brighter than Venus!!)

The winter cluster is **NGC 2099**, a 5.6 magnitude spread of 170 stars in a 23 minute field of view. Located in Auriga at 0552+3233 (it is 5° SSW of θ Aur), it lies 4,600 light years away and is also known as M37. My notes show, "8-in SCT at 65x. Dense, and a moving sight! Note the 9th magnitude yellow-orange star at the center and the arrowhead shape. Smythe called it 'a magnificent object.' Webb said 'the whole field being strewed, as it were, with sparkling gold-dust; and the group is resolvable into about 500 stars from 10th magnitude to 14th magnitude, besides the outliers. Even in smaller instruments, extremely beautiful, one of the finest of its class.' Steve Coe calls it 'a winter version of M11.' In 14x70 Binos, easy, small, grainy." It was discovered by Messier on September 2, 1764. He described it as a "cluster of small stars.... the stars are very small, very crowded and containing nebulosity." It is 25 light years in diameter and 347 million years old. Up to 1,800 stars have been counted as members of this cluster. There are a dozen red giants in this cluster, one of which dominates the center. It lies 32,000 light years from the galactic center and 230 light years above the galactic plane. The scale model is 9,910 miles in diameter with stars 895 miles apart. It is not nearly as tightly packed as M11 and being so close to the galactic plane, it probably won't survive too many orbits.

Class I 2 m—Well-detached, small magnitude range and moderately rich in stars

I had a difficult time deciding which cluster to use for the summer case: Collinder 316 or NGC 6704, so I'll include both so you can give your spotter scope a workout (on Collinder 316).

Collinder 316 is a member of John Herschel's "Table of Scorpius" group, an area which is unusually rich in stellar objects. The double stars ζ Scorpii 1 and 2 can be identified with the unaided eye in the Table. Just above them lies a particularly brilliant open cluster, NGC 6231, which includes about 120 stars. Exploration with a telescope or binoculars in this region of Scorpius reveals several other clusters as well as nebulae, including NGC 6242 (a thin but bright open cluster), IC 4628 (a large and faint nebula), Trumpler 24 (a stunning open cluster, a subset actually of Collinder 316), NGC 6227 (a large and bright open cluster), and SL 17 (a small dark nebula). An email from Michael Bakich at *Astronomy* magazine to A. J. Crayon of the Saguaro Astronomy Club says, "The region around and between μ Scorpii and ζ Sco, including NGC 6231, received the nickname "False Comet" from John Herschel while observing at the Cape of Good Hope from 1834 to 1838. He named it, however, not so much because it was a "fake" or "faux" or "false" comet (as, indeed, it so appears), but in honor of his landing site, False Bay. That's why we spell "False" with a capital F. Indeed, we also now call the slightly larger region around the False Comet the Table of Scorpius for the same reason. Herschel's observatory looked out toward Table Mountain, above which the Scorpion often perched. Both False Bay and Table Mountain still exist on maps of the area." Collinder 316 is large (105 minutes in diameter!) and is a stunning sight in a rich field telescope or a good spotter. My notes show, "Spotter (10x)-- It fills half the spotter's FOV! It is very rich, very large, and with a large spread in magnitudes. It is well detached from the field. 11-in SCT at 80x-- The center

1/3 of the cluster fills the FOV! It is a WOW! Object. Many groupings of stars, chains, knots. Some variety in color, but mostly subtle. The background is very grainy, suggesting very distant stars behind this beautiful cluster." The cluster's distance is not well-known. It is located at 1656-4050, about 8° west of the "stinger" stars.

The other summer cluster, **NGC 6074**, is located at 1851-0512, in Scutum, and is 9,700 light years away. It glows at 9.5 magnitude and packs 60 stars into a 5 min diameter field. Tight and nebulous, it takes high power very well. It has a "J" shape and stands out starkly against the background. A dark nebula, B320, lies behind it. Rich field here! It is 73 million years old, with the earliest spectral class being B2. The brightest star is 12.2 magnitude. 71 stars are known to be members. It lies 22,000 light years from the galactic center and 250 light years below its plane. Our scale model shows a group of stars 2,760 miles in diameter with stars 329 miles apart.

For the winter, try **NGC 2489**, a nice group of 45 stars in an 8 min field of view. Located in the stunningly rich star fields of Puppis about 7° east of the tail of Canis Major (at 0756-3004), the cluster is a whopping 12,900 light years away. In my 8-in SCT, it was delicate, tight and rich! 30 stars were resolved. The very red star PX Pup is 12 min south of the cluster. It is 184 million years old. The brightest star is 11th magnitude (50 times brighter than the Sun). This cluster lies 29,000 light years from the galactic center and 50 light years below the galactic plane. Our scale model shows a fairly dense group 2,920 miles in diameter with stars 410 miles apart.

Class I 2 p—Well-detached, small magnitude range and poor in stars

In the summer, set your eyes upon **Trumpler 27**, a dismal (9.1 magnitude) little group (but of all my summer choices for a I 2 p, it was about the best available; Dolidze 32 is better at high powers, but a difficult object). Located in Scorpius at 1734-3326 (about 3½° north of the Stinger Stars), it is 3,950 light years away and has 35 stars in an 8 minute field of view. Sparse and open, I counted only 12 of its stars, the rest being a grainy background. This cluster is 11 million years old. The brightest star is 8.4m. It is reddened 3 to 8 magnitudes. This dimming is called "extinction" in astronomy and is measured by what is called the "color excess" of the stars in question. It was this extinction that puzzled Trumpler early in his research; it seemed to him that the more distant the cluster, the larger it was, and there was no reason to suspect this would be the case. He gradually hit upon the idea that the light from distant clusters was being absorbed by interstellar dust and gas. When he applied the corrections to his statistical measures, he found that distant clusters were just like the nearby ones—and made a very important contribution to modern astronomy in the process!

The winter sample is in Cassiopeia and is **NGC 7788**, a 9.4 magnitude glob of 20 stars in a 9 minute field. It is 7,740 light years away and is 39 million years old. It might be in the Cas OB5 association. Its earliest stars are B1 and B4 types. It lies 32,000 light years from the galactic center and 100 light years below the galactic plane. My log shows it to be small, rich and dense; it looks nebulous at low powers. A 9th magnitude star dominates the center. It is a rather sparse cluster as shown by the scale model: 6,660 miles in diameter with stars 1,190 miles apart.

Class I 3 r—well-detached, wide magnitude range and rich in stars

Here are my favorite open clusters! Rich, dazzling jewel boxes of great beauty and delicacy, they are what come to the minds of most amateurs when we think of great open clusters.

The summer example was difficult to select (there are so many good candidates), but I settled on **NGC 6475** in Scorpius. This great cluster is located at 1754-3449 and is better known as M7! It is 80 minutes in diameter, but being only 980 light years away, that makes sense. It has 80 visible members (and several beyond the range of most amateur scopes). In my 8-in SCT at 83x, it contains mostly B and W stars arranged along two bars, with a nice doublet at the center. A deep orange star is SW of the center, and a sideways "K" patter is obvious. A dark nebula appears to lie in the background. In my 14x70 Binos, it was much poorer than M6, but still a fair view. It was known by Ptolemy (in the *Almagest*), as well as being shown by the Tatar Ulugh-begh (grandson of Tamerlane) in a star atlas he created in 1437. De Cheseaux put it on his 1746 list, and Bode his 1779 list. It was cataloged by Messier on May 23, 1764. He described it as "larger than the preceding [M6]; this cluster appears to the naked eye as a nebulosity." It is his southernmost object. This cluster is 300 million years old; the earliest spectral type is B5. (The B stars are just beginning to leave the Main Sequence.) It lies 27,000 light years from the galactic center and 60 light years below the galactic plane. It is sparser than its eyepiece view would suggest; our model is 5,990 miles in diameter with stars 1,420 miles apart.

In the winter, I prefer **NGC 2287** (also known as M41), a stunning cluster in Canis Major. Located almost 4^{o} due south of Sirius (0647-2044), it packs 100 stars into a 38 minute field. Lying some 2,350 light years away, it is like 6475 in being so close and so large. My notes show that in the 8-in SCT at 47x, it was very rich but spread out. Note the large number of red stars, and a few blue ones. I thought a keystone pattern was dominant. In my 14x70 Binos, I noted two bright stars, ten fainter ones, and much glitter behind it all. It was known to Aristotle in about 325 BC. Flamsteed observed it on February 16, 1702, and Le Gentil included it in his 1759 list. Messier added it to his list on January 16, 1765. It is 20 light years in diameter and 243 million years old. Its youngest stars are B3 and B5 types, and it contains four Ap stars, 3 magnetic stars, and one helium star. (Helium stars are a rare class of stars, excluding white dwarfs, with outer layers that contain more helium than hydrogen. They are ancient stars and may be the progenitors of Type I supernovae.) The brightest star is the golden 12 CMa (6.9 magnitude, K3 III, 700 times brighter than the Sun). It lies 29,000 light years from the galactic center and 370 light years below the galactic plane. Its model is larger than the earth with a diameter of 8,360 miles and stars 900 miles apart.

Class I 3 m—well-detached, wide magnitude range and moderately rich in stars

For your summer viewing, go to **NGC 6910**, a stunning object in Cygnus located at 2023+4047just a degree north of Sadr (γ Cyg). It is 3,700 light years away and shines with an integrated magnitude of 7.4. 66 stars are stuck into a phone booth only 7 minutes across! In my 8-in SCT at 65x, the cluster is curved,

and a 9th magnitude right triangle dominates. Note the two 7th magnitude yellowish-orange stars. It stands out well from the background. In my 11-in SCT at 115x, it is a nice bright group, shaped like a miniature Monoceros! I counted 14 stars. In Steve Coe'sC11-in SCT at 140x, from a dark desert location, I counted about 20 stars in a 10m x 5m lozenge. Higher magnification does not improve the view, but it does not degrade it either. It is 13 million years old. It is part of the Cyg OB9 association. The earliest spectral types are hot young O8 stars. The scale model has it with a diameter of 3,540 miles with stars 438 miles apart.

In the winter, you may want to try **NGC 2422**, a rich little morsel in Puppis. Also known as M47, it is located at 0737-1430 and is only 1,600 light years away. 30 stars are to be found in a 30 minute field. In my 8-in SCT at 104x, it was bright, large and rich. It contains mostly white stars. Note Σ 1121 just south of the center, and Σ1120 on the west edge. Webb said, "Grand broad group… A fiery 5th magnitude (star) leads the region." William Schaart (an observer in Columbia, MO who uses an 8-in SCT) writes: "This has almost a butterfly shape, with the eastern wing being larger and having more stars. The western wing is primarily defined by two rows of stars, one having three close stars and then a further one." Steve Coe, using a 13" Newtonian, says the cluster "shows a bizarre round section in the center with NO stars." In my 14x70 Binos, it shows three bright stars and 15 fainter ones, plus background sprinkles. It was discovered by Messier on February 19, 1771. It is 78 million years old and contains several unusual stars (3 Ap types, one magnetic variable, and a Be star). The youngest spectral class is B3. The brightest star is 5.8 magnitude (890 times as bright as the Sun). This cluster lies 28,700 light years from the galactic center and 80 light years above the galactic plane. Its model is 4,330 miles across with stars 700 miles apart.

<u>Class I 3 p—well-detached, wide magnitude range and poor in stars</u>

Despite the Trumpler class, the two examples I have are both wonderful views in a small telescope.

For the summer, let's go with **NGC 7160**, a cluster in Cepheus some 4° east of Alderamin (α Cep) at 2154+6236. (Okay, it is really a late summer or early fall cluster.) It is only 2,570 light years away and has 25 stars in a seven minute field. My 8-in SCT at 104x shows two white stars 40" apart that dominate the center. Note the triangle (8th magnitude, 8th magnitude, 9th magnitude) at the center. In the 11-in SCT at 115x, it is an oblong group of 21 stars dominated by an acute isosceles triangle in the east end. There is a smaller triangle in the west end. The brightest star is a golden yellow. It is 19 million years old. It is part of the Cep OB2 association and its earliest stars are B1 and B2 types. 61 stars belong to it. It lies 28,500 light years from the galactic center and 300 light years above the galactic plane. Its model would be 1,970 miles across with stars 330 miles apart, fairly dense for an open cluster (but then , it is quite young too).

In the winter, I prefer **Trumpler 1**, not an easy cluster, but offering 25 stars in a tight 4.5 minutes of field. It is centered at 0136+6117 in Cassiopeia 1½° northeast of Ruchbah (δ Cas). It is 8,350 light years away and has an integrated magnitude of 8.1, but don't let that lull you into thinking it is an easy object. In

my 8-in SCT at 206x, it was still nebulous, with a 4-star chain on the NW side; dense, and best seen in clear skies. It is only 26 million years old.

Class II 1 r—Fairly well-detached, little range in magnitudes, rich in stars

As we begin our survey of the II class clusters, note how they are not quite as sharply defined against the background. They still stand out fairly well, but now there is a little more background glitter to compete with the view.

For the summer, I am going with **NGC 6939**, another cluster in Cepheus at 2031+6038 about 6° WSW of α Cep (Alderamin). It has an integrated magnitude of 10.2, but you'll find a group with 100 members in a seven minute field. In my 8-in SCT at 65x, it was semi-resolved, like a globular cluster. Use averted vision. It is very rich, faint, small and delicate. An 11th magnitude star lies to the north, and another to the east, and a third to the west. In the 11-in SCT at 115x, it shows a small knot of faint stars; 14 counted. Dominated by a 12m triangle. Steve Coe writes that "many lovely chains of star meander out into the Milky Way." He also points out a "beautiful, delicate blue-gold binary pair to the NE of the cluster.... (and) ... a dark lane on the south side really cuts off the stars on that side." This seen with a 13" Newtonian in desert skies! It is 1.8 billion years old. 301 stars have been counted as part of this group, which lies 28,000 light years from the galactic center and 850 light years above the galactic plane. Its model would be 2,690 miles across with stars 277 miles apart, very dense for an open cluster (and probably why it is so old even though it is relatively close to the galactic plane).

In the winter, I like **IC 361**, a difficult but rich group in Camelopardalis. This is a faint region of the sky so it would be a real challenge to star hop from α Per (Mirfak), 11½° away to the SW; you may want to use your setting circles and go to 0419+5818. It shines at a feeble 11.2 integrated magnitude but you'll be rewarded with 40 stars in a 7 minute patch of sky. In the 8-in SCT at 104x, it was very faint, and I could not resolve it. But it was a stirring sight nonetheless! It is about 52 million years old and 16 light years in diameter. The scale model is 5,310 miles in diameter with stars 750 miles apart—it won't last long as a cluster with this low density.

Class II 1 m—Fairly well-detached, little range in magnitudes, moderately rich in stars

I could not find a II 1 m cluster in the summer skies, so can only offer you a winter cluster—**NGC 1513** in Perseus. At 9.0 magnitude and 4,300 light years away, it has 40 stars in a 9 minute field. This cluster is 129 million years old. It lies 30,000 light years from the galactic center and just below its plane. My 8-in SCT at 83x shows a delicate group— use averted vision. The rich field competes fiercely with it. It has a "C" shape, and a 10th magnitude star lies a few minutes north. The 11-in SCT at 115x shows a faint ringlet of six stars plus 3 or 4 outliers. As clusters go, it is small but very dense, its model being 1,260 miles across with stars 188 miles apart.

Class II 1 p—Fairly well-detached, little range in magnitudes, poor in stars

I could not find a II 1 m for the summer skies, so I'll toss up two clusters for this class for the summer. Berkeley 90 is a tough little nut and IC 1434 is easy but not as impressive.

Berkeley 90 is located at 2036+4648 almost 2° NNW of Deneb. It has a feeble magnitude of 14.0 and is 5 minutes in diameter. From the Okie-Tex Star Party in 2005, my 11-in SCT at 107x revealed a teardrop shaped bag of very faint stars, 14th magnitude and fainter. The east edge is dominated by a wide (60") pair of faint stars.

IC 1434 is in Lacerta at 2211+5250 2° WNW of the lizard's nose. It is 9.0 magnitude and has 40 stars in an 8 minute field. In the 8-in SCT at 104x, it was a slight condensation of the faint but rich field. There are 7 bright stars (10th magnitude) with many fainter ones forming a grainy background. The 11-in SCT at 56x shows a very rich and oblong group dominated by five stars, including a 9th magnitude triangle on the south edge. Approximately 40 stars noted. It does not stand out well in the field. This open cluster is contained in Johann Elert Bode's list of 75 nebulous objects as Bode 1. While Bode doesn't give details on its discovery or any observations, it seems that this may be his own discovery, in particular as he lists it with source "Bode" in his 1782 Atlas, *Vorstellung der Gestirne* (*Introduction of the Luminaries*). The few treatments of Bode's list usually presume that Bode 1 is non-existent. The nearest NGC clusters are NGC 7226 (RA 22:10.5, Dec +55:25, magnitude 9.6, 2' diameter) and NGC 7243 (RA 22:15.3, Dec +49:53, 21' diameter, 6.4 magnitude), but both are several degrees off from Bode's position, RA 22:09.1, Dec +52:55 (2000.0). The present author [hf] has found the proximity to the cluster IC 1434 (RA 22:10.5, Dec +52:50) some time ago, and Ronald Stoyan has proposed the identity of these objects. However, after observing IC 1434, Ronald again doubts this identification, as it might have been too difficult for Bode to find, but see the modern Observing Reports for IC 1434 from the IAAC Netastrocatalog. J.L.E. Dreyer included this cluster in the (first) IC catalog of 1895 on the ground of its discovery or rediscovery by Espin. [Source: http://www.seds.org/messier/xtra/ngc/i1434.html]

The winter cluster is **NGC 1220**, a delicate tight knot of stars at 0312+5320, in Perseus (4° NNW of Mirfak or α Per). It shines with an integrated magnitude of 11.8 but packs 25 stars into a 1.6 minute postage stamp! With the 8-in SCT, it was semi-resolved using averted vision. It is only 60 million years old.

Class II 2 r—Fairly well-detached, wider range in magnitudes, rich in stars

It was difficult to settle on two clusters for this class as there are many that are beautiful to observe in both seasons. For the summer, it's a toss-up between NGC 6494 (150 stars in a 27 minute field) or NGC 6866 (80 stars in a 6 minute field). I'll go with the latter.

NGC 6866 is located at 2004+4400 in Cygnus about 7° WSE of Deneb. It is 4,730 light years away (over twice as far as 6494) and is 377 million years old, with the earliest classes being A2. 129 stars are known to be members, and it lies 27,000 light years from the galactic center and 500 light years above its plane. My notes show that in the 8-in SCT at 65x, it is rich and elongated. The cluster definitely has two main

clumps to it, one north and the other south. In the 11-in SCT at 115x, it is a very rich, tight little group in a pentagon shape. 32 stars were counted. In A. J. Crayon's 14-inch Dob, about 30 stars were counted, with a long stringer off to one side. Its model suggests a very tight little group, being 2,190 miles across with stars 254 miles apart.

For the winter, I had to select from *six* candidates and settled on **NGC 7789**. (If you voted for NGC 654, 752, 1647, 1912, or 2324, I could see them as equally good choices.) This stunning cluster has 1,000 stars in a 15 minute field! Lying 7,620 light years away, it is only 10.0 magnitude. My notes show that in the 8-in SCT at 65x, it shimmers, like the Wild Duck (M11). Use low powers. Higher powers suggest two curving dark lanes cutting into the cluster. The 11-in SCT at 115x shows a grand sight! Many, many stars, mostly faint, and with a moderate spread in magnitudes. Too numerous to count; the field looked grainy it is so rich. It was discovered by Carolyn Herschel. It is 50 light years in diameter and 1.6 billion years old, so its earliest stars are B9 types. It lies 31,000 light years from the galaxy's center and 560 light years below the galactic plane. Its model is larger than the earth, 8,710 miles across with stars 434 miles apart.

Class II 2 m—Fairly well-detached, wider range in magnitudes, moderately rich in stars

I had another difficult time deciding which of three outstanding examples of II 2 m to use for the summer (NGC 6834, NGC 7086, and NGC 7243), but settled on **NGC 6834** due to its wonderful visual density. Located at 1952+2925 (in Cygnus, 5^{o} ENE of Albireo, β Cyg), this great little gaggle of stars shines with an integrated magnitude of 9.7 in from a small 5 minute field and boasts 50 stars for the small telescope. In the 8-in SCT at 65x, it has four stars across the center. It is rich and dense. A tight knot to one end of the line of four makes it look like a lapel pin. The cluster is 79 million years old. The earliest stars are B2 types, and there are 128 known members. The brightest star is a 9.7 magnitude red one. The cluster lies 25,600 light years from the galactic center, 6,740 light years from us, and 150 light years above the galactic plane. Our scale model would be 3,510 miles across with stars 480 miles apart.

In the winter, let's take a look at **NGC 2266**. Similar to NGC 6834 (same magnitude, same size, same star count), this winter jewel is located in Gemini some 2^{o} north of ε Gem (Mebsuta) at 0643+2658. At a distance of 11,000 light years, it is actually physically larger than NGC 6834. This cluster lies 38,500 light years from the galactic center and 2,000 light years above the galactic plane. The brightest star is 11th magnitude(380 times brighter than the Sun). It is 631 million years old. In the 8-in SCT at 83x, it is small and rich; use high powers to get the most out of this triangular group. Note the 8^{th} magnitude chain on the SE edge. At low powers it appears nebulous but begins to resolve around 100 power. Its model has a diameter of 6,180 miles with stars 840 miles apart.

Class II 2 p—Fairly well-detached, wider range in magnitudes, poor in stars

In the summer, aim your scope to **NGC 6281**, a modest group of 25 stars some 1,560 light years away. Located in Scorpius almost 6^{o} due west of Shaula (the brighter "stinger" star) at 1705-3754, it shines brightly at 5.4 magnitude. In the 8-in SCT at 83x, it is very rich; it is in the shape of an acute triangle with the vertex pointing S. High powers don't help a lot. This cluster is 314 million years old. At least 70 stars are known to be members. The brightest member is 7.9 magnitude. It lies 26,000 light years from the galactic center and 60 light years above the galactic plane. The scale model would be 1,500 miles in diameter with stars 220 miles apart.

For the winter object, use **NGC 2343**, a knot of 20 or so stars in a 9 minute field located at 0707-1037 (in far south Monoceros, about 8^{o} ENE of Sirius). At magnitude 6.7, it is fairly bright although it is in a pretty rich part of the sky. In the 8-in SCT at 104x, it is a small grainy knot framed by a triangle of 9-10-10 magnitude stars (the 9^{th} magnitude star is in the south vertex). High powers are good, showing 7 stars and haze. It gets lost in the very rich field. A yellow and deep blue pair (10" separation at a position angle of 315^{o}) sits on the east edge. It is 13 million years old. This cluster lies 30,000 light years from the galactic center and 60 light years below the galactic plane. The brightest star is 8.4 magnitude (360 times brighter than the Sun). The model is 1,850 miles wide with stars 343 miles apart. Some authorities think the cluster may actually be an asterism.

Class II 3 r—Fairly well-detached, wide range in magnitudes, rich in stars

For the summer, I really like **NGC 6405**, aka M6 or "The Butterfly", a stunning object in Scorpius near the stinger at 1740-3213. At a distance of 1,590 light years, the cluster has an integrated magnitude of 4.2 and contains at least 132 stars in a 14 minute field. It was discovered by de Cheseaux in 1745 or 1746 who described it as a "fine cluster". Lacaille included it in his list of 1755, having observed it in 1752. Messier added it to his list on May 23, 1764. He said, "To the naked eye, it appears as a nebulosity without a star, but even the smallest instrument reveals it as a cluster of small stars." This cluster is 100 million years old and 9 light years in diameter and lies 26,000 light years from the galactic center and just beneath its plane. The brightest stars (other than BM Sco) are all B types just ready to leave the Main Sequence. In the 8-in SCT at 104, it is exquisite! The "butterfly" is obvious. The brightest star is the orange giant variable BM Sco (6.2 magnitude) in the NE quadrant. (The second brightest star, HD 160202, is a flare star that had a 5-magnitude increase in 40 minutes in 1965!) Steve Coe adds that two streamers of stars seem to form the "antennae" of the butterfly. In my 14x70 Binos, it is a wonderful object! Although small in the binos, but the "butterfly" is still evident. It's a very dense open cluster as its model suggests: diameter of 1,700 miles with stars 168 miles apart.

The winter cluster I like for this class is **NGC 2682**, a 500 star stunner about 29 minutes in diameter. It is also known as M67 and is situated in Cancer at 0850+1149, not quite 2^{o} west of α Cnc (Acubens, "the claw"). Messier cataloged it on April 6, 1780. It is 12 light years in diameter and 2,500 light years away. Its H-R diagram is closer to a globular cluster than an open cluster, since the brighter stars have already turned off the Main Sequence. (This leaving point is at absolute magnitude +3.5. As clusters age, the

leaving point for their stars moves down and to the right on the Main Sequence path of the H-R diagram. That this leaving point is at such a dim magnitude suggests that the cluster has been around for an awful long time. In fact, the H-R diagram suggests an age of 10 billion years for M67! (Recently, NGC 188 has been shown to have a similar spectral composition.) Perhaps one reason it has survived so long as an open cluster is that it lies high above the plane of the galaxy (1,500 light years or so). The brightest star– a B9V– is 9th magnitude (about 50 times brighter than the Sun). This cluster is 5 times as far as the Beehive (M44), also located in Cancer, but is only 1/4 the actual diameter. In the 8-in SCT at 65x, it is rich, dense and shimmery. An 8th magnitude star lies on the NE edge and a red one lies east. Look for a dark area near the center. (Steve Coe calls it a "dark finger.") In my 14x70 Binos, it is very faint and difficult (in comparison to M44). Its scale model would be bigger than Mars at a diameter of 6,790 miles with stars 426 miles apart.

Class II 3 m—Fairly well-detached, wide range in magnitudes, moderately rich in stars

NGC 6694 beckons to us from the summer sky in Scutum and is also known as M26. It shines with a magnitude of 8.0 and offers 30 stars in a 14 minute field. At a distance of 5,200 light years, it lies 23,000 light years from the galactic center and 250 light years below the galactic plane. Le Gentil discovered it in 1750; Messier added it to his list on June 20, 1764. It is 12 light years in diameter and 85 million years old. The earliest spectral type is B5, and 120 stars are known to be members. The brightest star is 10.3 magnitude. In my 8-in SCT at 104x, I saw a triangle of 10th magnitude stars dominating this patchy cluster with a neat "kite" at the center. The overall pattern suggests a tuning fork. (Steve Coe calls it a wishbone shape.) In the 14x70 Binos, I saw three stars resolved and lots of graininess. It is nestled inside a narrow 8th magnitude triangle. Its diameter would be 6,420 miles with stars 1,040 miles apart as a model.

In the winter, I suggest **NGC 2632**, a 3.1 magnitude powerhouse with 200 stars in a large 95 minute field. It is only 530 light years away and is more famously known as M44, the “Beehive” cluster in Cancer. In the 8-in SCT at 32x with a telecompressor, it still overflowed the field! Lots of white and blue stars, with many interesting "groupings". Note the 6.5 magnitude trapezoid at the center, and the triangle 5 minutes W. In the south end lie the doubles South 570, South 571, β 584, ε Cnc, and Σ1254. One of the Webb Society observers reports seeing a greenish star near the center, but I cannot verify this. Hartung notes three bright triangles, one with "a fine orange star with less bright wide reddish companion Nf." With the 14x70 Binos, it is nice, large, bright and loose. Known to Aratus (260 BC), Hipparchus (130 BC), Ptolemy, Al-Sufi, Ulugh-Begh, Tycho Brahe, Bayer, Hevelius, Flamsteed, Cassini, and De Cheseaux, Messier added it to his list on March 4, 1769. According to Pliny, it was used to predict the weather: if the cluster was invisible on an otherwise clear night, it meant a violent storm was coming. Galileo discovered its true nature as a star cluster in 1610 when he turned his primitive refractor on it. It is 40 light years in diameter. The brightest star, ε Cnc, is an A6 star about 70 times brighter than the Sun and shines at 6.3 magnitude. (At this distance, the Sun would be 10.9 magnitude.) Altogether, about 100 of the cluster’s stars are brighter than the Sun. This cluster is 660 million years old and the earliest star types are A0. Most of the stars are Main Sequence types, and there are 4 orange giants (type K0 III) and

at least 5 white dwarfs. There are 9 magnetic variables in this group, which lies 28,000 light years from the galaxy's center and 275 light years above its plane. It is about the same age as the Hyades. A model of the cluster would be 4,720 miles across with stars 430 miles apart.

Class II 3 p—Fairly well-detached, wide range in magnitudes, poor in stars

The best I can do for the summer is a rather poor cluster, **NGC 6613**, or M18, in Sagittarius (at 1820-1708, north of the lid of the "teapot"). I say "poor" because the fields here are so rich that NGC 6613 suffers from background overload. (If it were in a sparser part of the sky, it would no doubt be more stunning to view.) It is 4,220 light years away and offers 20 stars in a 9 minute field. Messier added it to his list on June 3, 1764. He described it as a "cluster of small stars, a little below the nebula above [M17], surrounded by a soft nebulosity." It is 17 million years old. At least 40 stars have been identified as members. It lies 24,000 light years from the galactic center and 70 light years below its plane. The 8-in SCT at 65x shows a sparse ringlet of 16 or so stars fainter than 9^{th} magnitude. The 11-in SCT at 98x rewarded me with a view of a cluster where the center is dominated by a small triangle with a base of brighter stars. In the 14x70 Binos, it is small and unimpressive. Its model reveals its very loose and sparse nature: 3,790 miles in diameter with stars 1,420 miles apart.

In the winter, **NGC 2239** is stunning! (Strangely, it is also cataloged as NGC 2244.) It is large (24 minutes), bright (4.8 magnitude) and populated with 40 stars. Situated at 0632+0457, it lies in northern Monoceros, about 9^{o} ESE of Betelgeuse. In the 11-in SCT at 115x, I noted a very bright and rich group with many fine sub-groups and pairs. Roughly triangular in shape. I counted 38 stars. There is supposed to be some nebulosity associated with this cluster, but I failed to detect it.

Class III 1 r—Not so well-detached, small range in magnitudes, rich in stars

From this point on, it will be more and more difficult to produce examples of stunning views simply because the clusters are becoming more and more blended into the background.

In the summer, let's go with **NGC 6811**, a group in Cygnus at 1938+4634 (almost 2^{o} NW of δ Cyg). It is 3,960 light years away and shines at magnitude 9.0 from 70 stars in a 12 minute field. It is 630 million years old. The earliest spectral type is A0. 249 stars belong to this group, and it lies 27,000 light years from the galactic center and 725 light years above the galactic plane. The brightest star is 9.9 magnitude. In the 8-in SCT at 65x, it is rich, with a nice triplet to the W. The 11-in SCT at 115x reveals a very dense, tight knot of faint stars with an almost nebulous background. The NW section hosts a small triangle. It fills the field of view at 193x, and the center is remarkably sparse. (Walter Scott Houston names this "Hole in a Cluster".) It would make a fairly dense model, being 3,260 miles across with stars 390 miles apart.

The winter cluster is **NGC 1245**, a wonderful but difficult cluster in Perseus (0315+4715, 3^{o} southwest of Mirfak or α Per). 200 stars lie in a 10 minute pocket and shine with a magnitude of 9.0. It is very far away (9,380 light years). It has survived almost 1 billion years because it orbits the galaxy 1,100 light years below the galactic plane.

> Like in NGC 2194 most bright stars of the cluster show a slightly blue color. These are the "normal" hydrogen core burning stars with their hot surface temperature. But there are also a lot of bright orange stars. They are evolved, i.e. they already left the usual stage of hydrogen core burning and started hydrogen shell burning. Some might already burn helium in their cores. The orange color is due to their cooler surface temperature. The relative large number of these evolved stars is a hint for the old age of the cluster. Indeed NGC 1245 is with 10^9 years about ten times older than the cluster M 50, and so belongs like NGC 2194 to the unusual population of old or intermediate age Open Clusters in our Galaxy. The two very bright blue stars are most probable foreground objects of the galactic field, i.e. they are no cluster members.
> {Source: http://www.allthesky.com/clusters/n1245.html]

In the 8-in SCT at 104x, it is nebulous and faint, round and very dense. Use high powers— it takes them well, but refuses to yield any secrets to you. A bright star is on the S side, and an 8^{th} magnitude star lies to the NE. The brightest member is 12.0 magnitude. The 11-in SCT at 98x let me count 16 stars. It is not as dense and tight as it looks. Its model is 7,500 miles in diameter with stars 630 miles apart.

Class III 1 m—Not so well-detached, small range in magnitudes, moderately rich in stars

The summer clusters of this class don't offer a lot of eye joy. The best I think we can do is **Ruprecht 145**. This cluster is 35 minutes in diameter and 2,510 light years away. In the 11-in SCT at 56x, it was elongated 3 by 1 in a N-S direction, with some sub-clusters or sub-groups. Richest group is in the middle; the brightest in the south. The south group is anchored by a reddish-orange star. This cluster is 437 million years old.

The winter cluster is **Stock 2**, a large but nice group in Cassiopeia centered at 0215+5916 (extend a line from Navi through Ruchbah another 6^{o} and you are there). It is 4.4 magnitude with 50 stars in a 60 minute field. It is only 990 light years away which makes it 18 light years in diameter. It is 170 million years old. The 8-in SCT at 104x reveals a bright group that overflows the 24 min field. There are many pairs in this group, but not many dominant patterns. This large cluster really looks best in a rich field instrument. An SCT has too small a field of view (even with a telecompressor) to reveal it in its true beauty.

Class III 1 p—Not so well-detached, small range in magnitudes, poor in stars

There are lots of clusters in the sky that meet this classification, but only two that are really great views. Luckily, both summer and winter get one of those two!

The summer cluster is **NGC 7063**, a tight and dense knot of stars in Cygnus (2124+3630, far removed from the familiar cross shape of the main part of Cygnus). Also known as Caroline's Cluster (after Caroline Herschel), 35 stars are tamped into a 7 minute field with an integrated magnitude of 8.9. It is 2,250 light years away and lies 27,500 light years from the galactic center and 350 light years below the galactic plane. It is 95 million years old. Its earliest stellar type is B8, and 66 stars are known to be members. The brightest star is 8.9 magnitude. The 8-in SCT at 65x shows an open and fairly bright group. A bright star dominates the N side. 69 Cyg (5.9 magnitude) lies 19 min NE. In the 11-in SCT at 115x, it looked open and bright; 18 stars counted. A jagged line of five 10m stars runs up the middle. As open clusters go, it is small and dense (its model would be 1,380 miles across with stars 207 miles apart).

For the winter, check out **NGC 225**, a very nice group of 30 stars in a 12 minute field shining at 7.0 magnitude from 0043+6147 (in beautiful downtown Cassiopeia, 2^{o} NW from Navi). It is 7 light years in diameter and 140 million years old. Its earliest stars are B8 and A2 types. 76 members are known. It lies 28,800 light years from the galactic center and just below its plane. It is also 22 light years in diameter and 2,140 light years away. The 8-in SCT at 65x shows a nice group with a "W" pattern, and the many blue and white stars. It has a loose scattering. Note the chain of stars on the E side. Its model is 6,970 miles across with stars 1,140 miles apart.

Class III 2 r—Not so well-detached, moderate range in magnitudes, rich in stars

The summer cluster is **NGC 6940**, in tiny Vulpecula. It is located at 2035+2818 and is 2,510 light years away. It has a magnitude of 8.0 and is made up of 100 stars in a nice 31 minute field. It is a surprising 1.1 billion years old (despite the fact that this cluster is 27,000 light years from the galactic center and only 330 light years below its plane), with the earliest spectral types remaining being B8 and A2. 170 stars are known to be members. The brightest star is 9.3 magnitude. The 8-in SCT at 83x reveals an exquisite group! It forms an oval that looks good under medium powers. An 8^{th} magnitude star lies in the NE quadrant. The 11-in SCT at 115x shows a very rich, very bright and scattered group that stands out well from a rich field. There seems to be a dark nebula behind it.

In the winter, I favor **NGC 2354**. This fine cluster lies in Canis Major 90 minutes ENE of Wezen (δ CMa) at coordinates 0714-2544. It is similar to NGC 6940 in population, but much smaller (20 minutes in diameter). Its magnitude is listed as 6.5. It is 35 light years in diameter and 134 million years old. The brightest star is 9.1 magnitude (690 times brighter than the Sun). This cluster lies 31,100 light years from the galactic center and 700 light years below the galactic plane. My 8-in SCT at 83x reveals a spread out cluster; it is easy and oblate, with 40 stars easily visible. There is a good double at the center too, and a very red star as well. 15 min E is a "Z" shaped asterism. At the Sentinel Star Gaze in December, 2004, I observed this cluster through Steve Coe's 11-in SCT at 90x. It was 20 min diameter, irregular in shape

(which I whimsically called a "spleen", a name that stuck that night with the group; several then reported seeing the "Spleen Cluster"). In reality, it is a large and very loose group, not destined for a long life. Its model reveals it to be 11,610 miles across with stars 1,250 miles apart!

Class III 2 m—Not so well-detached, moderate range in magnitudes, moderately rich in stars

NGC 6633 is my choice for the summer example. It is in Ophiuchus and is centered at 1828+0634. Lying some 1,230 light years away, it shines at magnitude 4.6. It is 660 million years old, with the earliest spectral type being B6. At least 159 stars belong to this cluster, which is 27,000 light years from the galactic center and 250 light years above its plane. Its model would be 2,530 miles across with stars 629 miles apart. The 8-in SCT at 65x shows a bright and colorful (many orange and yellow stars) group; it has a dominant fish-hook pattern. It is large and loose, and has a very small arrowhead on the NW edge. The 11-in SCT at 65x unveils a loose, scattered and bright cluster with mostly white stars. There is a flat triangle at the N end, an isosceles one in the center. A narrow triangle is at the S end.

In the winter, go to **NGC 2251**. Located at 0635+0822 in Monoceros, it has 30 members in a 10 minute field of magnitude 7.3. It lies 4,330 light years away, 32,000 light years from the galactic center and right on the galactic plane. At least 92 stars belong to this group. The brightest star is 9.1 magnitude (440 times brighter than the Sun). It is 267 million years old. In the 8-in SCT at 83x, I see a nice wedge with a NW to SE axis, and some nebulosity. The overall shape reminds me of a dolphin. The 11-in SCT at 115x shows a sparse and oblong cluster (about three to one in dimensions); I counted 15 stars. Very rich field!

Class III 2 p—Not so well-detached, moderate range in magnitudes, poor in stars

The summer sample is a bright and large cluster, **IC 4665**, which resides in Ophiuchus (1746+0543). It has 30 stars in its 55 minute field shining with a combined magnitude of 6.0. It is 1,150 light years away (which makes it 22.4 light years in diameter). It is only 43 million years old. The 8-in SCT at 37x was disappointing. It looks best in the spotter! But in the SCT, I was struck by a pattern that resembled a sideways figure "8". The 11-in SCT at 98x showed a large and scattered group; it is longer (NE-SW) than wide and a meandering stream of bright stars dominates the mid-line.

Collinder 115 is my choice for the winter. Located in Monoceros (at 0647+0146), it has 50 stars in an 8 minute field at 9th magnitude. It is a round group, but somewhat void in the middle.

Class III 3 r—Not so well-detached, wide range in magnitudes, rich in stars

I cannot locate an open cluster in the summer skies with a class of III 3 r.

The only decent winter sample is **NGC 2168**, located in Gemini and better known as M35! This cluster was discovered by J. Bevis in 1745; de Cheseaux mentioned it in 1745, and Messier added it to his list on August 30, 1764. Lord Rosse counted 300 stars in this cluster and modern counts go up to 434 stars. The brightest star (orange) is 8.2 magnitude (300 times brighter than the Sun). It is 30 light years in diameter and 95 million years old while the earliest spectral types are B3 and B4. In the 8-in SCT at 83x, it is extremely good! There are many red stars. Glenn Bock writes that the cluster is "somewhat doughnut shaped with a dark 'hole' in the center," a vivid description that is fitting. The 11-in SCT at 115x lets me rate it a "1" (a most stunning view)! There is a bright yellow star at the NE end; an orange star just N of the center; and a reddish-orange star just south of the center. The center is strangely empty. In my 14x70 Binos it is a rich sight! The model would be fairly large: 7,080 miles across with stars 606 miles apart.

Class III 3 m—Not so well-detached, wide range in magnitudes, moderately rich in stars

Neither example of this class will sweep you off your feet, but they do have at least moderately nice views to offer.

The summer cluster is **Dolidze 5**, an often-overlooked little flock of stars about 6 minutes in diameter. The 11-in SCT at 107x revealed a cluster that looks a little like a Christmas tree! One 7^{th} magnitude star and 13 others of 11^{th} magnitude and fainter.

In the winter, go to **NGC 2264**, a large (30 min by 60 min) cluster of 40 stars and at 3.9 magnitude. It is only 2,170 light years away. It is about 9 million years old. The 8-in SCT shows a very good object, and aptly named (the “Christmas Tree” cluster)! The bright star (5^{th} magnitude) in the base of the tree is S Mon, the one that lights the Cone Nebula. S Mon is 8,500 times brighter than the Sun. (Odd, don’t you think, that the two sample clusters for this class both look like Christmas trees?) NGC 2264 is a huge open cluster, and very spread out as its model suggests: 14,610 miles across with stars 2,140 miles apart.

Class III 3 p—Not so well-detached, wide range in magnitudes, poor in stars

The summer cluster is probably one you have never heard of: **Stephenson 1,** or the Delta Lyrae Cluster. It was cataloged by C. B. Stephenson in 1959, although T. W. Webb described it a century earlier. This loose association of hot, young stars is in Lyra at 1854+3655, just north of δ Lyr. Only 15 stars are members and it is spread out over 20 minutes of sky, but it is very bright (3.8 magnitude) and close (1,270 light years). The cluster is only 54 million years old. The 8-in SCT at 104x shows that δ Lyr and two 4^{th}

magnitude stars frame it nicely in a large triangle. The main feature is a four-star line (running N-S) of 9th magnitude stars just SW of δ Lyr.

For the winter, go to **Collinder 140** at 0724-3212 (in Canis Major, 3° south of δ CMa, Aludra). Also known as "the tuft in the tail of the dog", it is a naked eye object from good skies. This nice little knot of 30 stars lies in a 42 minute field and is bright (3.5 magnitude). It is nearby (1,320 light years) and thus it is 14 light years in diameter. The brightest star is 5.4 magnitude (540 times brighter than the Sun). This cluster is also 35 million years old. In the 8-in SCT at 83x, it appears as a very large and bright group. It is somewhat sparse, and the center looks even more rarefied. Actually, it looks best in the spotter.

Class IV 1 r—Poorly detached, narrow range in magnitudes, rich in stars

With the IV class of clusters, we enter the bottom of the Trumpler Barrel.

In fact, the barrel is so poor at this level that I cannot find an example of a IV 1 r for either Summer or Winter!

Class IV 1 m—Poorly detached, narrow range in magnitudes, moderately rich in stars

I was going to use Ruprecht 143 for the summer cluster but decided to go with **NGC 6645** instead. The NGC object has 75 stars in a 10 minute field but is only 9th magnitude. William Herschel discovered it in 1786. The 8-in SCT at 83x gave me a nice view. Delicate, rich and round, there seems to be a void in the middle, and a comma-like stinger of stars off the E side. Steve Coe mentions the central void, describing this cluster as having "a bizarre 'donut' shape with no stars in the center of the grouping." The position is 1833-1654 (in Sagittarius).

NGC 2482 is our winter example. This modest group (sometimes called the Starfish Cluster) is in Puppis (at 0755-2418) and offers 40 stars in a 12 minute field at 7.3 magnitude. This cluster is 400 million years old and lies 29,000 light years from the galactic center and 80 light years above the galactic plane. The brightest star is 10th magnitude (50 times brighter than the Sun). The 8-in SCT at 104x opens a rich and faint group to view; it has the shape of a swallowtail butterfly— better than M7 in Scorpius. Dean Williams thinks it looks more like a Christian cross running E-W. In the 11-in SCT at 98x, it is faint but rich, with small range in magnitude. I counted 24 stars in poor transparency (6 out of 10). Its model reveals a small and dense cluster: 2,920 miles in diameter with stars 425 miles apart.

Class IV 1 p—Poorly detached, narrow range in magnitudes, poor in stars

T here are many cases of IV 1 p clusters in the sky, so making selections for this tour was not easy.

I chose **NGC 6716** for the summer cluster. In Sagittarius at 1855-1954, it has 20 stars in a 7 minute field of magnitude 7.5. It lies 2,570 light years away, 25,800 light years from the galactic center and 330 light years below the galactic plane. It is 91 million years old, with B5 being the earliest spectral class. The 8-in SCT at 83x shows a bright but scattered out group. The 11-in SCT at 140x reveals a very nice little group! Rich and bright, I counted 28 stars in the general shape of Scorpius. Moderate spread in magnitudes.

The winter example is **NGC 743**. This nice little knot lies in Cassiopeia at 0159+6011. It contains only 12 stars but they are packed into a 5 minute field. The faint 10^{th} magnitude glow makes it glittery! The 8-in SCT showed a sharply triangular group framed by five 8^{th} magnitude stars.

Class IV 2 r—Poorly detached, moderate range in magnitudes, rich in stars

Like III 3 r, there was no summer cluster of this class.

The winter cluster is **NGC 1817**, an unimpressive little group in Taurus centered at 0512+1642. It is rich (60 stars) and small (15 minutes), and relatively bright (7.7 magnitude). The 8-in SCT at 83x shows a sparse cluster with two condensations separated by a gap. Note the 5-star chain on the W end. The westernmost group is NGC 1807, and gives an impression called "the poor man's Double Cluster" by Steve Coe. At the center is a "V" pattern, and there are three tight clumps of faint stars within 1817; these clumps form an equilateral triangle. A close double of even stars lies a few minutes SE. In the 11-in SCT at 115x, I got a very rich and faint group with the double star h3269. Four 11^{th} magnitude stars in a diamond, plus about 60 stars of 13^{th} – 15^{th} magnitude in a scattered dusty field. As you wait, more and more stars pop into view. Nice effect! The cluster is 409 million years old and includes an Ap star. The earliest spectral type is A0. The brightest star is 9^{th} magnitude (900 times brighter than the Sun). The cluster lies 33,500 light years from the galactic center and 1,350 light years below its plane.

Class IV 2 m—Poorly detached, moderate range in magnitudes, moderately rich in stars

Collinder 394 is located in Sagittarius (1854-2023), with stars in a 22 minute field and 6.3 magnitude. It is 2,250 light years away and 64 million years old. The 11-in SCT at 140x shows a large and bright cluster, with a moderate spread in magnitudes. I counted 24 stars.

The winter case is **NGC 2395**. Situated in Gemini (0727+1335), it boasts 53 stars in a 12 minute field with magnitude of 8.0. It is 1,670 light years away, 31,000 light years from the galactic center and 900 light years above the galactic plane. This group may be an asterism. It seems to be 1.2 billion years old. The 8-in SCT at 83x reveals a curving arc of 9 resolved stars; note the arc to the north too.

Class IV 2 p—Poorly detached, moderate range in magnitudes, poor in stars

The summer cluster is **Collinder 419**, a flock of 14 stars in a phone booth 4 minutes across and of 5.4 magnitude. It lies 2,400 light years away in Cygnus (2018+4043). It is about 7 million years old—virtually newborn! My 8-in SCT at 37x showed a very nice group. A 12th magnitude chain of 5 stars dominates the center. Σ2666 is a member.

For the winter, let's slew to Cassiopeia and **Czernik 4**, an obscure little group of stars only 3 minutes in diameter. It is located at 0136+6126 2^{o} northeast of Ruchbah. (The group may be the same as Trumpler 1.) In the 11-in SCT, it is a quaint and small group dominated by a short but straight chain of four stars (in a perfectly straight line), plus four more very faint stars.

Class IV 3 r—Poorly detached, little range in magnitudes, rich in stars

There are no IV 3 r clusters in either the summer or winter skies.

Class IV 3 m—Poorly detached, little range in magnitudes, moderately rich in stars

For the summer, I like **NGC 6507** in Sagittarius (1800-1724). 35 stars greet you from a field 6 minutes across. The 8-in SCT revealed a faint group of eleven stars in a rough pentagon.

The winter cluster is an ancient group, **Haffner 8**. This small but dense knot is located in Canis Major at 0723-1220. With 35 stars in a 4 minute field (magnitude 9.1), it is a dense but delicate little cluster. It lies 3,850 light years away (which makes it 6 light years in diameter). It is part of the Puppis OB1 Association and is about 1.4 billion years old. In the 8-in SCT, it is faint and hard to resolve; it requires averted vision. Small and dense, the model would be 1,930 miles across with stars 295 miles apart.

Class IV 3 p—Poorly detached, little range in magnitudes, poor in stars

We end our Trumpler Tour with two easy but unimpressive clusters.

The summer sample is **Dolidze 11**, located in Cygnus (2027+4127, 2^{o} northeast of Sadr). This group is 7 minutes in diameter. The 11-in SCT at 107x shows a Y-shaped group (E-W orientation) with the left side of the Y brighter (4 stars, with one yellow one of 7.5 magnitude). I counted 18 stars.

The winter cluster is **Collinder 97**. This little group of 15 stars spans 21 minutes of sky in Monoceros (at 0631+0555) and shines strongly at 5.4 magnitude. It is 2,050 light years away and about 100 million years old. The 8-in SCT shows a very uneven group of stars dominated by three 7th magnitude stars in a large right triangle. The star at the right angle is a lovely white-blue double (about 12" @ 320). Rich field. It lies just off the north edge of the Rosette Nebula.

This tour is summarized in the table that follows. Enjoy your tour of the Trumpler Classes of Clusters!

	Summer						Winter					
CLASS	ID	Pos	Con	No *	Size	Mag	ID	Pos	Con	No *	Size	Mag
I 1 r	NGC 6819	1941+4011	Cyg	40	5	7.3	NGC 2420	0739+2134	Gem	100	10	8.3
I 1 m	NGC 6756	1909+0441	Aql	40	4	10.7	NGC 2254	0636+0740	Mon	50	4	9.1
I 1 p	NGC 6425	1747-3132	Sco	35	7	7.2	Berk 94	2223+5551	Cep	10	4	8.7
I 2 r	NGC 6705	1851-0616	Sct	870	13	5.8	NGC 2099	0552+3233	Aur	170	23	5.6
I 2 m	Col 316	1656-4050	Sco		105	3.4	NGC 2489	0756-3004	Pup	45	8	7.9
	NGC 6704	1851-0512	Sct	60	5	9.5						
I 2 p	Trump 27	1734-3326	Sco	35	8	9.1	NGC 7788	2357+6124	Cas	20	9	9.4
I 3 r	NGC 6475	1754-3449	Sco	80	80	5	NGC 2287	0647-2044	CMa	100	38	4.5
I 3 m	NGC 6910	2023+4047	Cyg	66	7	7.4	NGC 2422	0737-1430	Pup	30	30	4.4
I 3 p	NGC 7160	2154+6236	Cep	25	7	6.1	Trump 1	0136+6116	Cas	25	4.5	8.1
II 1 r	NGC 6939	2031+6038	Cep	100	7	10.2	IC 361	0419+5818	Cam	40	7	11.2
II 1 m	(none)						NGC 1513	0410+4931	Per	40	9	9.0
II 1 p	Berk 90	2036+4648	Cyg		5	14.0	NGC 1220	0312+5320	Per	25	1.6	11.8
	IC 1434	2211+5250	Lac	40	8	9.0						
II 2 r	NGC 6866	2004+4400	Cyg	80	6	8.0	NGC 7789	2357+5644	Cas	1,000	15	10.0
II 2 m	NGC 6834	1952+2925	Cyg	50	5	9.7	NGC 2266	0643+2658	Gem	50	6	9.5
II 2 p	NGC 6281	1705-3754	Sco	25	8	5.4	NGC 2343	07007-1037	CMa	20	9	6.7
II 3 r	NGC 6405	1740-3213	Sco	132	14	4.2	NGC 2682	0850+1149	Cnc	500	29	6.9
II 3 m	NGC 6694	1845-0924	Sct	30	14	8.0	NGC 2632	0840+1959	Cnc	200	95	3.1
II 3 p	NGC 6613	1820-1708	Sgr	20	9	6.9	NGC 2239	0632+0457	Mon	40	24	4.8
III 1 r	NGC 6811	1938+4634	Cyg	70	12	9.0	NGC 1245	0315+4715	Per	200	10	9.0
III 1 m	Rup 145	1851-1805	Sgr		35		Stock 2	0215+5916	Cas	50	60	4.4
III 1 p	NGC 7063	2124+3630	Cyg	35	7	8.9	NGC 225	0043+6147	Cas	30	12	7.0
III 2 r	NGC 6940	2035+2818	Vul	100	31	8.0	NGC 2354	0714-2544	CMa	100	20	6.5
III 2 m	NGC 6633	1828+0634	Oph	65	27	4.6	NGC 2251	0635+0822	Mon	30	10	7.3
III 2 p	IC 4665	1746+0543	Oph	30	55	6.0	Col 115	0647+0146	Mon	50	8	9.0
III 3 r	(none)						NGC 2168	0609+2420	Gem	200	28	5.1
III 3 m	Dolidze 5	2021+3917	Cyg		6		NGC 2264	0641+0953	Mon	40	60	3.9
III 3 p	Steph 1	1854+3655	Lyr	15	20	3.8	Col 140	0724-3212	CMa	30	42	3.5

	Summer						Winter					
CLASS	**ID**	**Pos**	**Con**	**No ***	**Size**	**Mag**	**ID**	**Pos**	**Con**	**No ***	**Size**	**Mag**
IV 1 r	(none)						(none)					
IV 2 m	Rup 143	0833-1148	Sct		5		NGC 2482	0755-2418	Pup	40	12	7.3
IV 2 p	NGC 6716	1855-1954	Sgr	20	7	7.5	NGC 743	0159+6011	Cas	12	5	10.0
IV 2 r	(none)						NGC 1817	0512+1642	Tau	60	15	7.7
IV 2 m	Col 394	1854-2023	Sgr		22	6.3	NG 2395	0727+1335	Gem	53	12	8.0
IV 2 p	Col 419	2018+4043	Cyg	14	4	5.4	Czernik 4	0136+6126	Cas		3	
IV 3 r	(none)						(none)					
IV 3 m	NGC 6507	1800-1724	Sgr	35	6	9.6	Haffner 8	0723-1220	CMa	35	4	9.1
IV 3 p	Dolidze 11	2027+4127	Cyg		7		Col 97	0631+0555	Mon	15	21	5.4

[i] Published in the Lick Observatory Bulletin, Vol XIV, No. 420 (1930) 154-188