Although winter nights are very cold, amateur astronomers have good reason the bundle themselves up into warm clothing to brave the chill. For one thing, the ecliptic is at its highest this time of year, so if you’re observing the planets, they’ll be well above the murky skies of the horizon, resulting in the best possible views. But the wintertime sky also contains some of the most spectacular deep sky objects, of which the Orion Nebula and the Pleiades are the best known.

It shouldn’t be overlooked that this is also the time of year when people give each other gifts. Quite a few budding astronomers will be testing out their first telescope under wintertime skies, and as we’ll see, there are some real treats in store for them!

The winter sky is dominated by the Milky Way, and most of the objects observed at this time of year are within the Milky Way, such as nebulae and open star clusters. In particular, we’re mostly looking at things in one particular part of the Milky Way Galaxy, known as the Local Spur or Orion Arm.

Our galaxy is a barred spiral galaxy with four major arms and several minor arms. The four major arms are known as the Perseus Arm, Scutum-Crux (or Centaurus) Arm, the Cygnus-Norma Arm, and the Sagittarius (or Sagittarius-Carina) Arm. As you’d expect, their names come from constellations within which their particular bits of the Milky Way passes through. Of the four major arms, the Perseus arm and the Scutum-Crux arm are by far the largest. If the Milky Way was viewed from above, these would be the two arms that would catch the eye first, the two other major arms slotting inside them.

As well as the four major arms, there are several fragmentary minor arms sometimes called spurs. One of these is the Orion Arm, and this is where our Solar System lies. Being relatively nearby, it contains many of the biggest and brightest deep sky objects, including the Orion Nebula, the Pleiades, the Dumbbell Nebula, the
Go-To Telescopes Under Suburban Skies

Beehive Cluster, the Hyades, the Ring Nebula, and the Owl Nebula. On the other hand, because we’re mostly looking into the Milky Way rather than away from it, objects outside our galaxy don’t figure much this season, with a few notable exceptions such as the Andromeda Galaxy.

Suburban astronomers will find winter a particularly good time of the year for deep sky observing. The objects visible during this season are mostly those that are either unaffected by moderate levels of light pollution, as in the case of open star clusters, or else benefit from the use of light pollution filters, as is the case with emission nebulae and planetary nebulae.

Of course there is a downside to wintertime observing: the weather! Or more specifically, the freezing cold weather characteristic of this time of year. To get the most out of wintertime observing you’ll need to be wearing suitably warm clothing. This will usually mean several layers on your body, a hat to keep your head warm, and a pair of gloves. In the colder parts of the world, this might be augmented with earmuffs and a scarf.

It’s also important to take your telescope outside before you want to start observing. This gives the telescope time to cool down to the ambient air temperature. Otherwise the warm air inside the tube will move about, messing up the images you see at the eyepiece. This is particularly noticeable at high magnifications, where you’ll find stars flickering rather than forming small, stable points.

The amount of time it takes for a telescope to cool down properly will depend upon how big the telescope is, and how much colder the air outdoors is compared with the temperature inside your home. Open tube telescopes such as Newtonian reflectors tend to cool down quickly because the warm air can escape quickly, whereas closed tube telescopes such as SCTs take much, much longer. Something like a 200-mm SCT will typically take 1–2 hours to completely cool down, whereas a reflector of similar aperture will be ready within half an hour.

Showpiece Objects

NGC 224 (M31, Andromeda Galaxy)

Of all the galaxies in the northern sky, none rival the Andromeda Galaxy in size or brightness. At a mere 2.5 million light years away, it is far closer to us than any other major galaxy, and its angular size is about six times that of the full Moon. But the Andromeda Galaxy is more apt to disappoint than any other object in the sky (with the possible exception of the planet Mars which, most of the time, is much smaller and reveals less detail than its almost mythic reputation would suggest).

The main reason the Andromeda Galaxy is a ‘difficult’ target is that it is so big. At about 3° in angular width, you need a very wide field of view if you want to see the whole thing in its entirety. In practice very few telescopes other than short focal length refractors or Newtonian reflectors provide anything like the necessary fields of view, and certainly not the popular SCT and Maksutov telescopes, around which most go-to telescope systems are built. So for the most part, amateur astronomers end up viewing just a bit of this galaxy at any one time.
With an apparent magnitude of about 4, the Andromeda Galaxy is technically quite a bright object, but its sheer size means that the light it emits is rather spread out. As a result, it doesn’t stand out from the background sky as much as more compact objects of similar brightness might do. In fact at first glance, you’ll probably only notice the central core. It isn’t difficult to see the Andromeda Galaxy then, but between its size and its lack of contrast, it is a challenge to get a good view of the whole thing.

So what can you actually see? A 200-mm SCT fitted with a 32-mm Plössl delivers a field of view of about 50 arcminutes (or put another way, 5/6 of a degree). This is enough to show the core of the Andromeda Galaxy, which should be visible as a fairly bright, rather large elliptical blur. It looks like a cloud, and it isn’t difficult to see why such objects were called nebulae, from the Latin word for ‘cloud.’ In fact, older astronomy books commonly referred to this galaxy as the Great Nebula in Andromeda or words to that effect, and continued to do so at least into the 1950s, long after it was demonstrated that it wasn’t a nebula at all but a very distant collection of stars much like our own Milky Way.

One difference between galaxies and nebulae is the effect light pollution filters have on them. Narrowband and line filters aren’t useful at all, and broadband filters help only up to a point. Broadband filters will block natural skyglow and a small amount of artificial light pollution, but won’t produce anything like the view you’d get of this galaxy when observed from a genuinely dark site.

Figure 2.1. The Andromeda Galaxy is notoriously disappointing despite its size and relative brightness, but you should at least detect its bright core, the smudgy spiral arms around the core, and given reasonably dark conditions, its two satellite galaxies. Ample aperture and a wide field of view are both helpful. (Image produced using Starry Night Pro. AllSky data courtesy of Main-Sequence Software Inc.)
Is the Andromeda Galaxy a total waste of time then? Far from it! For a start, have a look around for its two companion galaxies, M32 (NGC 221) and M110 (NGC 205).

Assuming you’re using a low-powered eyepiece centered on the core of the Andromeda Galaxy, then M32 should be easily visible as a near-spherical blob of light towards the edge of the field of view, 22 arcminutes away from the center of the Andromeda Galaxy. M32 is surprisingly massive for its size and type and probably has a supermassive black hole at its center. It is also rather odd in lacking globular clusters; most galaxies have at least a few; its neighbor, M101, has at least eight, and the Andromeda Galaxy around 460.

M110 is a bit farther out, about 36 arcminutes from the core of the Andromeda Galaxy. It is a reasonably bright elliptical blob, and while still classified as a dwarf elliptical galaxy, it’s about twice the size of M32. Both M110 and M32 can be mistaken for each other.

What else is there to see in the Andromeda Galaxy? Really big telescopes can spot star clouds within this galaxy, most notably NGC 206, and under good, dark skies dust lanes can be seen as well. But under suburban skies none of these features are going to be visible.

Instead, the Andromeda Galaxy is an object best appreciated in the imagination. The light that arrives at your eyepiece left the Andromeda Galaxy 2.5 million years ago, about the time the earliest human-like animals, *Homo habilis*, were walking about and using stone tools. The Isthmus of Panama had only recently formed, and the great faunal interchange of mammals between the North and South American continents was starting to take place. In geological terms, these events took place almost yesterday – the dinosaurs, for example, having lived between 230 and 65 million years ago. But that’s the point: as distant as 2.5 million years seems, and as far away as 2.5 million light years might be, these are actually very small numbers when measured against a geological or cosmic scale.

The Andromeda Galaxy may seem a long way off, but it’s actually in our galactic backyard.

**NGC 1502 (Kemble’s Cascade Cluster) – See Also SAO 12969**

Kemble’s Cascade is a very pretty chain-shaped asterism of about twenty reasonably bright stars in the otherwise unexciting constellation of Camelopardalis. At one end of the chain is the open star cluster NGC 1502, sometimes called the Kemble’s Cascade Cluster.

NGC 1502 is an open star cluster of around 45 moderately bright stars. At its center is a particularly attractive double star known as Struve 485, made up of two seventh-magnitude stars, SAO 13030 and SAO 13031. These two stars are separated by about 18 arcminutes. NGC 1502 is a relatively young cluster, about 11 million years old, and located about 3,000 light years from Earth.
NGC 1535 (Cleopatra’s Eye)

This planetary nebula is one of very few easy targets in the constellation of Eridanus, a southerly constellation often overlooked by astronomers at mid to high northern latitudes. From southern England, for example, this object doesn’t rise much more than $25^\circ$ above the southern horizon. But it’s well worth trying to pin down. For a start, like most planetary nebulae, it’s small but bright, and benefits greatly from the use of light pollution filters. Both narrowband and O-III filters work well on this object. Boosting magnification heightens the contrast further, and while you might not see much detail, you will at least be able to tell that it’s a planetary nebula rather than a star.

![Image of NGC 1535](image)

*Figure 2.2. Use a narrowband or O-III filter to distinguish Cleopatra’s Eye (at center) from the very similar looking stars in the same field of view. (Image produced using Starry Night Pro. AllSky data courtesy of Main-Sequence Software Inc.)*

Under good conditions this nebula is one of that select group of deep sky objects that has some color, in this case a vague blue-green hue. You will need a reasonably large telescope for this to be obvious, though, around 200 mm at minimum. Large aperture telescopes, upwards of 250 mm, are required to make out the magnitude-12 star at the heart of the nebula. NGC 1535 is about 1,500 light years from us.

NGC 1976 and 1982 (Orion Nebula)

If you need one good reason to brave the winter chill on a cold December night, then this is it. Few deep sky objects rival the Orion Nebula in beauty, brightness, and
interest, and none surpass it. It really is the standard against which all other deep sky objects are compared!

When you turn your telescope towards the Orion Nebula, you’re looking deep into something called the Orion Molecular Cloud Complex. This vast cloud of dust and gas is some 240 light years in width, and includes not just the Orion Nebula but also the Flame Nebula (NGC 2024) and the notoriously elusive Horsehead Nebula (IC 434). The Orion Molecular Cloud Complex is a relatively nearby object, lying in the same minor arm, the Orion Arm, as our own Solar System. This is why the thing is so big and, in some parts at least, so incredibly bright.

The Orion Nebula is a region of the Orion Molecular Cloud Complex that is especially nearby, a mere 1,300 light years away. It is visible even to the naked eye, as a fuzzy patch halfway down the Sword of Orion asterism. A small telescope reveals its two brightest regions, the larger of which is M42 (NGC 1976) and the other M43 (NGC 1982).

The Orion Molecular Cloud Complex is generally a site of active star formation, and the Orion Nebula is no exception. Long-exposure photographs reveal all sorts of complex features, including star clusters, reflection nebulae, and clouds of gas and dust. The Hubble Telescope has also shown evidence of protoplanetary discs, known as proplyds, meaning that at least some of the young stars in the Orion Nebula are well on the way to forming their own solar systems.

Amateurs may not see that level of detail, but they can still enjoy the view. The Trapezium Cluster, for example, is a good starting point. This celebrated cluster of four bright stars is a very young cluster, a mere million years in age. Although only four stars are immediately visible, and one or two more with more magnification and good seeing conditions, there are actually many more stars in the cluster obscured by the surrounding dust and gas. Infrared images have allowed astronomers to see these stars, and in fact the Trapezium Cluster has become one of the best studied of all open star clusters.

Although a broadband filter will improve your views of the Orion Nebula somewhat, a narrowband filter will be much more useful. The nebula typically looks bigger when viewed with a filter because the outlying parts become easier to see. Of course a narrowband filter will also dim the stars within the nebula, and one reason a broadband filter might be preferred is so that you can view both the nebula and the stars at the same time. O-III filters are useful, too, and there are subtle differences in how the Orion Nebula appears when viewed with O-III filters and narrowband filters. An H-beta filter isn’t the filter of choice for viewing the overall Orion Nebula, but it does seem to bring out the details on the M43 part of the nebula in a way the other filters don’t.

Unlike most deep sky objects, long-exposure photographs don’t provide better views of this object than you get through a telescope. Because the Orion Nebula has regions that span a tremendous range of brightnesses, long-exposure photographs tend to show the fainter extensions rather than you see at the eyepiece, but overexpose the brighter core of the object. By contrast, your eyes may not be as sensitive to dim objects as cameras, but they’re much better at dealing with varying levels of brightness. So while you won’t see quite as much detail around the edges of
the Orion Nebula, the view you’ll see at the eyepiece is at least as good as any photo. Indeed, some seasoned observers think it’s rather better.

The glowing gas that you see is what is known as an emission nebula, a cloud of gas that fluoresces thanks to the young, hot stars within it. Science fiction films often give the impression that nebulae of this type look something like the water vapor clouds in Earth’s atmosphere. However, these clouds of gas are incredibly tenuous, and by comparison with the air around us, are practically vacuums! But because they’re so big, and the stars inside them are so hot, emission nebula can be very impressive objects when viewed from our distant vantage point.

By far the bigger of the two halves of the Orion Nebula is M42. This bird-shaped cloud is something like 25 light years in diameter at its widest point, or about nine times the distance from the Sun to Alpha Centauri. M43 is the much smaller cloud of gas. Although they look like separate objects, they’re actually just the one big cloud of gas, with seeming division between them being a vast lane of dust that obscures the light emitted by that part of the nebula behind it.

**NGC 2168 (M35) and NGC 2158**

M35 is a fantastic open star cluster in the zodiacal constellation of Gemini, and surely among the finest open star clusters in the northern sky. It’s an easy object for any telescope, and the longer you look at it, the more stars you’ll find within the cluster.
Almost all are hot blue stars, and only a single red giant is a confirmed member of the cluster.

Some would argue that a medium-sized telescope, around 75-150 mm, is the optimal size for viewing M35, since bigger telescopes show too many of the fainter stars too easily, resulting in something a bit less engaging. On the other hand, it’s an object that tolerates moderate levels of light pollution rather well, and if a few of the fainter stars are hidden from view, what’s left over is still very attractive.

M35 is a large object, almost 30 arcminutes in diameter, so you need to use a low-power eyepiece to see it at its best. On a 200-mm SCT, a 32-mm Plössl works well, getting the whole cluster comfortably into the field of view.

Just to one side of M35 is a smaller and fainter cluster, NGC 2158. Small telescopes may reveal this object as a faint, fuzzy patch, but larger telescopes, from about 200 mm upwards, will be able to resolve out some of its constituent stars, including numerous yellow and orange stars that are older and cooler than the blue ones that dominate M35. Although an attractive cluster in its own right, NGC 2158 is easily overlooked given its proximity to M35.

Actually, although the two clusters seem close together from our point of view, they’re actually a long way apart. M35 is about 2,800 light years away, compared to a distance of about 16,000 light year for NGC 2158. The two clusters are also very different in terms of age. M35 is about 100 million years old, making it relatively young by open star cluster standards. NGC 2158 is much older, current estimates suggesting it is between 1 and 2 billion years in age. That’s why it contains so many
yellow and orange stars, which tend to be older than the hotter and brighter blue ones.

**NGC 2287 (M41)**

M41 is an open cluster in Canis Major not far from Sirius, the brightest star in the night sky. Because of its relatively southerly location, M41 is sometimes overlooked by far northern observers, but it’s well worth taking the time to examine. Under the right conditions it is extremely attractive, as well as rather an interesting open star cluster.

All telescopes will reveal good views of this object, though as is often the case with the brighter open star clusters, moderate apertures seem to provide the best balance between showing lots of stars without showing too many all at once. But it is a big cluster, some 38 arcminutes in diameter, and a low-power, wide-field eyepiece is what you need more than anything else. If you have a 200-mm SCT, you’ll find that an f/6.3 reducer-corrector really earns its keep on this object, allowing a 32-mm Plössl to center M41 against a good-sized chunk of sky. A wide-field 2-in. eyepiece such as a 35-mm Panoptic could be used instead, if you have a 2-in. star diagonal, to get a similarly expansive field of view.

M41 is around 200 million years old, and although it contains mostly blue stars, it also contains a fair number of red giants. This makes it an interesting contrast to M35 in Gemini, an open star cluster that is only half the age of M41 and contains just a single red giant. The two star clusters are otherwise fairly similar, both being about 25 light years in diameter, though M41 is a bit closer to Earth at a distance of 2,300 light years compared to 2,800 light years for M35.

**NGC 2392 (Eskimo or Clown Face Nebula)**

The Eskimo Nebula is one of the nicest planetary nebulae in the sky, and certainly among the best of the ones visible during the winter months. It is a small, bright object, and unusually among deep sky objects, it has some color to it. Some observers see it as green, others as blue. The bigger the telescope, the more obvious its color will seem, while very small telescopes (anything less than 100 mm) may show no color at all.

At low magnifications the Eskimo Nebula appears to be a somewhat fuzzy star, and it’s easy to imagine why such objects became known as planetary nebulae: they can indeed look a bit like planets. With increasing aperture and magnification its details become apparent. At high levels of magnification the two-shell structure that gives this nebula its popular name can be seen. The inner shell is the ‘face,’ and the outer shell is the fluffy fur of the Eskimo’s hood. In the case of a 200-mm SCT, try using a 10-mm Plössl for a magnification of ×200. If the two-shell structure isn’t apparent when looked at directly, use averted vision to see if the details snap into view.
With apertures upwards of 200 mm, you should be able to see a circular halo around a faint (ninth-magnitude) star as well. Long-exposure photographs reveal considerably more detail than this, but to see such details visually you need a very large telescope.

From our vantage point, we’re actually looking down into a funnel of hot gas emanating from a dying star. The star itself was apparently rather similar to our own Sun, so when we look at the Eskimo Nebula, we’re getting a glimpse of the likely fate of the Sun, a somewhat eerie thought.

Like other planetary nebulae, your views of the Eskimo Nebula benefit greatly from the use of a suitable filter. Light pollution filters help a bit, but your best views will come from using either a narrowband or O-III filter.

There is some debate over the distance between Earth and the Eskimo Nebula, values ranging from 1,600 to 7,500 light years, but most astronomers tend towards a value of about 3,000 light years.

The Eskimo Nebula gets its name from its appearance in photographs, which some have likened to that of a human face tucked up inside the hood of a parka jacket. Others see a clown’s face, hence the name Clown Face Nebula.

**NGC 2422 (M47), NGC 2437 (M46), and NGC 2438**

These are a pair of superb open star clusters in the constellation of Puppis that mid to far northern observers tend to overlook because they don’t rise far above the
southern horizon. But they’re well worth adding to your observing program, because they form such a nice pair of star clusters when viewed through a low-power, wide-field telescope. Of course they’re nice objects when viewed on their own, but taken together, they make a particularly interesting sight.

Of the two, M47 is the easiest to see and under dark skies can be seen with the naked eye. It is fairly tolerant of light pollution and a good 20 to 30 stars should be seen through any telescope. M46 is much less easily resolved and can be difficult to spot under light-polluted skies. Through small telescopes it looks more like a hazy patch of light than an open cluster. When presented in the same field of view the contrast between the two clusters is immediately apparent. Although their size and proximity suggests that famous pairing of open clusters in Perseus we call the Double Cluster, in actual fact the view is very different indeed.

Rich-field refractors or fast Newtonians are the telescopes of choice for viewing the two clusters together, since the required field of view is a good 2°. By default that won’t be possible using a standard 200-mm SCT with 1.25-in. eyepieces. But if you have an f/6.3 reducer-corrector and a wide-field 2-in. eyepiece such as a 35-mm Panoptic, the resulting view, assuming fairly dark skies and a clear horizon, can be spectacular.

To get the two star clusters into the same field of view you could have your go-to telescope slew to either star cluster, locate the other star cluster through the finder telescope, and then use the control pad to bring that second star cluster into the field of view. But an easier approach is to have the telescope center itself on the star SAO
153190 instead. This will place both M46 and M47 in the field of view, together with a smaller and much dimmer open star cluster called NGC 2423. This little cluster is at the third point of a right-angled triangle, with M47 at the right angle and M46 the farther away of the two points that form the rest of the triangle.

M46 is the far bigger of the two clusters, about 30 light years in diameter versus about 17 light years for M47. But it is also much farther away, and that’s why it is so much more difficult to see and resolve. M46 is believed to be about 5,500 light years away, compared to a mere 1,600 light years for M47. Their ages are pretty similar, though, with M46 being about 100 million years old, and M47 a little younger, at about 78 million years of age.

Seemingly within M46 is a small planetary nebula, NGC 2438. It’s actually just an object that happens to be between us and M46, and not a member of the M46 star cluster at all. NGC 2438 is not easy to see at all and may be completely invisible to those under light-polluted suburban skies or using small- to medium-aperture telescopes. You need at least 200 mm to spot this object, and the use of a narrowband or O-III filter makes picking it out from the background stars dramatically easier. The star in the center of this planetary nebula is called HD62166. Although it looks like it’s the star that formed the nebula, it isn’t, and is merely in the same line of site; the actual star that belongs to this nebula is far too faint to be seen with amateur astronomers’ telescopes.

**NGC 2437**

See NGC 2422.

**NGC 2451**

NGC 2451 is a star cluster in Puppis scattered across a 1.7° of space and centered on the orange supergiant star c Puppis (SAO 198398). It contains about 40 stars, of which c Puppis, at magnitude 3.6, is by far the brightest. Although an easy open cluster to find with binoculars and very attractive through wide-field telescopes, its relatively southern location in the sky makes it tricky to spot from mid-northern latitudes, and far northern observers may not be able to see it at all.

NGC 2451 is about 850 light years from Earth and is believed to be about 40 million years old, which explains why it is filled with mostly hot blue stars. There is some debate about the nature of this star cluster, some astronomers maintaining that it is merely as asterism and not a true cluster at all. In other words, although there seem to be a lot of rather bright stars neatly arranged in a clump, they don’t have a common origin and weren’t born from the same cloud of gas and dust (as would be the case for a true open cluster). Instead, NGC 2451 is something more like Kemble’s Cascade, just a chance alignment of stars that catch the eye.
NGC 2632 (M44, Praesepe, Beehive Cluster)

The only impressive deep sky object in the dim constellation of Cancer, M44 is an easy naked-eye object under dark skies that reveals itself as a small but distinct cloudy patch of light. It was one of seven ‘nebulae,’ the Latin word for clouds, described by the Greek astronomer Ptolemy in the book we now know best through its Arabic translation, the *Almagest*.

![Image](image.png)

Figure 2.7. The Beehive Cluster is best observed at very low powers, and the use of a reducer-corrector and a 2-in. wide field eyepiece is highly recommended. (Image produced using Starry Night Pro. AllSky data courtesy of Main-Sequence Software Inc.)

Ancient astronomers described this nebula as the manger from which two donkeys, the stars Asellus Borealis and Asellus Australis, were feeding. The word Praesepe is in fact the Latin for manger, and the names of the two nearby stars literally mean ‘northern ass’ and ‘southern ass,’ respectively.

The Greek poet Aratus, writing in the third century B.C., include the manger and the two donkeys in a famous poem, the *Phaenomena*, that describes various astronomical curiosities. One odd aspect of the poem is that he relates the appearance of the manger and the two donkeys to weather forecasting. For example, should the manger become dim but the two donkeys remain equally bright, then rain is likely. But if the manger and the northern donkey both become dim, and only the southern donkey stays bright, then you can expect winds from the south. This is a good reminder of how astronomy and astrology were connected in the past, the whole subject being one of practical rather than theoretical importance.
By 1844 the English astronomer (and naval officer) William Henry Smyth translated the name Praesepe as ‘bee-hive’ in his book on practical astronomy, *A Cycle of Celestial Objects*. Presumably the name referred to its swarm-like appearance; as Smyth pointed out, ancient astronomers were limited to naked-eye observations and couldn’t see this object as anything other than a nebula. Smyth further explains that it wasn’t until Galileo turned his telescope towards the Praesepe that it was seen to be made up of 36 small stars. Most astronomers now call this cluster the Beehive Cluster rather than the Praesepe.

If you want a good view of this object, which has an angular diameter of over 1.5°, you absolutely must use the widest-field, lowest-power eyepieces at your disposal. In the case of a standard f/10 200-mm SCT, a 1.25-in. eyepiece won’t do justice to this object, though the view you’ll get using a 32-mm Plössl will be pleasant enough. Instead, use an f/6.3 reducer-corrector to shorten the focal length, and a 2-in. visual back that allows for the biggest possible field of view. Suitably equipped, a 200-mm SCT at f/6.3 with a 35-mm Panoptic will return an incredibly lovely view of this open star cluster.

This star cluster is one of the closest ones to Earth. It was assumed to be about 525 light years away until quite recently, when its distance was revised upwards to about 575 light years thanks to additional data from the Hipparcos satellite. Only a few star clusters are any closer than this, the most notable ones being the Pleiades, around 440 light years away, and the Hyades, about 150 light years away (and do also see the entry for SAO 27876, a member of the very nearby Ursa Major Moving Group).

**NGC 3201**

This is one of the very few globular clusters visible in winter for northern observers, reaching its highest point above the southern horizon around midnight in mid-February. It is a fairly loose cluster by the standards of globular clusters, at Class X on the Shapley–Sawyer scale, and under good skies 100- to 150-mm telescopes will start to resolve this cluster nicely.

Unfortunately, while NGC 3201 is a lovely object by any standards, it is so far south that most northern hemisphere observers won’t be able to see it. Even at latitudes as low as central Florida, NGC 3201 barely gets to more than 15° above the horizon.

NGC 3201 is about 16,000 light years from Earth and measures roughly 14 light years in diameter. Whereas most globular clusters orbiting the Milky Way Galaxy do so in the same direction as the rotation of the galaxy, NGC 3201 orbits the Milky Way in the opposite direction. Some astronomers have taken this to mean that NGC 3201 is a globular cluster that wasn’t originally part of the Milky Way, but was instead captured by its gravity at some point in time. Although an intriguing possibility, this assertion is far from universally accepted.
Interesting Deep Sky Objects

NGC 205 (M110)

See NGC 224, the Andromeda Galaxy, in the showpiece objects section above.

NGC 221 (M32)

See NGC 224, the Andromeda Galaxy, in the showpiece objects section above.

NGC 752

This is a bright open cluster in Andromeda containing more than 60 stars, mostly white and blue in color, but some orange and yellow as well.

It’s a veritable jewel box of a cluster, but because it spans some 50 arcminutes of space, you’ll need the widest possible field of view to see the whole thing. On a 200-mm SCT, a 32-mm Plössl will just about squeeze the cluster into the field of view, but you’ll get a better impression by using either a 2-in. eyepiece like a 35-mm Panoptic, an f/6.3 reducer-corrector, or ideally both.
NGC 752 is about 1,300 light years from Earth. It appears to be at least 1.1 billion years old, making it a rather old open cluster. (Most only last a few hundred million years until their constituent stars drift apart completely.)

**NGC 1291**

This elliptical galaxy in the southern sky constellation of Eridanus is not visible to observers at mid to high northern latitudes. Even as far south as central Florida it doesn’t get more than about 16° or so above the southern horizon. That’s a shame, because this galaxy is bright and easy to see even with small telescopes. Large aperture instruments should clearly show a bright core surrounded by a more hazy area around the outside. Very large telescopes (from 300 mm upwards) show hints of a huge ring of dust encircling the galaxy, a feature prominently shown in long-exposure photographs. In this regard, it is similar to the Sombrero Galaxy (NGC 4594).

NGC 1291 is about 30 million light years away and a member of the Dorado Cloud of galaxies.

**NGC 1501 (Blue Oyster Nebula)**

NGC 1501 is a small planetary nebula in the remarkably nondescript far northern constellation of Camelopardalis. Completely lacking in bright stars, few amateur
astronomers spend much time in this constellation, but it does have a couple of worthwhile sights, one of which, Kemble’s Cascade, has already been mentioned. NGC 1501 is another, and being far above the horizon at this time of year, it tends to be in the darkest part of the sky, well away from the dust and light pollution that hangs above the horizon.

NGC 1501 is less than an arcminute in diameter, and at an apparent magnitude of 13, it can easily be mistaken for a slightly blurry bluish-green star. The use of a narrowband filter or an O-III filter can be used to help clear up any confusion; although such a filter will substantially dim a star, it will have only a minimal effect on the nebula.

Once you’ve found NGC 1501, is there anything to see? To start with, you should be able to detect its slightly elliptical shape. Large telescopes (200 mm upwards) and high magnifications may reveal that it has slightly annular, i.e., hoop-like, shape but this isn’t an easy observation to make. NGC 1501 is a little over 1 light year in diameter and about 5,000 light years from Earth.

**NGC 1662 (Klingon Battlecruiser Cluster)**

The Romans named the planets after their gods; the eighteenth-century French astronomer de Lacaille introduced 14 new constellations named after various bits of scientific equipment; and modern amateur astronomers have named a star cluster after a spaceship featured in a 1960s television show. So it is that the seemingly unchanging heavens reflect the changeable nature of human interests!

In fact NGC 1662 really does look remarkably like a head-on view of a Klingon battle cruiser. A straight row of bright stars about 10 arcminutes in length makes up the two wings, two shorter rows hang off each end of the first row, making the warp nacelles, and a compact clutch of stars in the middle is the bridge. It’s a very neat little cluster, and a treat for any *Star Trek* fan.

NGC 1662 contains at least 20 members, is about 4 light years in diameter, and is about 1,200 light years away.

**NGC 1973, 1975 and 1977 (Running Man Nebula)**

The Orion Nebula is one portion of the Orion Molecular Cloud Complex illuminated by a cluster of young, hot stars; taken as a group, NGC 1973, 1975, and 1977 refer to another. In this case the emission and reflection nebula is much less strongly illuminated, so it tends to be overlooked by astronomers distracted by the Orion Nebula. That’s a shame, because this reflection nebula with emission nebula components is an attractive and interesting object in its own right.

Of the three components, NGC 1973 and 1975 are the easiest to spot, being smaller and brighter. But unless your skies are reasonably dark, you might not be able to see any of them.
Try centering your telescope on the magnitude 4.6 star 42 Orionis (SAO 132230). This is one of the stars that illuminates the portion of the nebula referred to as NGC 1977, and quite a bit brighter than the nearby magnitude 7 star 45 Orionis a mere 4 arcminutes away. About 8 arcminutes away from this pair of stars is another pair of stars, quite a bit dimmer than the first pair, one of magnitude 7.3 and the other magnitude 9.7. These stars are at the centers of NGC 1973 and NGC 1975, respectively. The use of a narrowband filter or, to a lesser extent, a broadband filter will help when observing this object. Such filters will dim the stars, making them easier to see the nebulosity around them.

The nebula is 1,500 light years away and taken together a little under 10 light years in diameter.

**NGC 2169 (The 37 Cluster)**

This sparse open star cluster in Orion has received its common name because its members seem to be arranged in two clumps, one arranged like the number ‘3,’ and the other like the number ‘7.’ Fans of the works of Douglas Adams might be a bit disappointed that it isn’t the number 42 that is spelled out in the night sky, but NGC 2169 is still a pretty neat arrangement of stars nonetheless.

NGC 2169 is about 3,600 light years from Earth and a mere 7 light years in diameter. It contains about 30 stars and is believed to be quite young, around 50 million years old.
**NGC 2237-9, 2244 and 2246 (Rosette Nebula)**

The Rosette Nebula is a big but dim emission nebula that was initially only detected piece by piece, hence its multiple NGC numbers: 2237, 2238, 2239, and 2246. Only subsequently was its shape and full extent recognized. Spanning some 1.3° of space, it is almost three times as wide as a full Moon. The nebula has a roughly circular shape and, in photographs at least, a distinctly reddish glow.

Although its apparent magnitude is comparatively high, 6.0, because this object is so big all this light is very spread out, resulting in an exceedingly dim object. Narrowband and O-III filters help significantly but can’t do much about moderate to high levels of urban light pollution. You really do need dark skies to see the Rosette Nebula.

In the center of the nebula is a small but bright open start cluster, NGC 2244. Even small telescopes should reveal this cluster without problems. Together with the Rosette Nebula, the two objects make up a cloud of gas and dust around some young, hot stars a mere 3 million years in age.

Astronomers estimate that the Rosette Nebula is about 4,500 light years away and 130 light years in diameter.

![Image of Rosette Nebula](image-url)

**Figure 2.11.** The Rosette Nebula is a very difficult object to see under suburban conditions, but the open star cluster at its center, NGC 2244, is much easier to detect. (Image produced using Starry Night Pro. AllSky data courtesy of Main-Sequence Software Inc.)
NGC 2264 (Cone Nebula, Christmas Tree Cluster)

This interesting object in Monoceros is a two-for-one deal: most observers under suburban skies should be able to see the star cluster, while observers with big telescopes and dark skies get a faint nebula thrown in as well.

The Christmas Tree Cluster is, as its name suggests, an arrangement of stars that really does look a bit like a child’s drawing of a Christmas tree – though admittedly an upside-down Christmas tree for northern observers, with the bright star at the top of cluster forming the base of the tree. Although it can be seen with binoculars, it looks best through telescopes with apertures from 100 mm upwards.

Do note that this isn’t the only Christmas tree in the night sky: NGC 581 (M103) in Cassiopeia is sometimes called the Christmas Tree Cluster as well, thanks to an equally festive pattern of stars.

Surrounding the Christmas Tree Cluster is a cloud of gas and dust known as the Cone Nebula. This complex structure contains both a diffuse nebula of hot gas and a dark nebula of obscuring dust. The gas is excited by radiation from the bright star 15 Monocerotis, the star that forms the base of the Christmas Tree Cluster. 15 Monocerotis, also known as S Monocerotis, is a fascinating target in itself, and more will be said about this star in the entry for SAO 114258 in the fourth section of this chapter.

Unfortunately for the amateur astronomer, the Cone Nebula is an incredibly difficult object to see visually. Pitch black skies are essential, and a narrowband filter will be very useful for cutting out skyglow and making the nebula a bit easier to see. Even under good conditions, most astronomers only see the (relatively) bright tip of the nebula.

The Cone Nebula is in fact one of the brighter (!) parts of the nebulosity that makes up NGC 2264. At least two other bits have received names, the Snowflake Cluster and the Fox Fur Nebula, both of which are targets for astrophotographers rather than visual observers.

NGC 2264 is 2,400 light years away and believed to be between 3 and 5 million years old, making it one of the youngest open star clusters amateur astronomers can observe. Because it is both young and comparatively nearby, NGC 2264 is of particular importance to professional astronomers interested in star formation.

NGC 2323 (M50)

M50 is a fairly bright open star cluster in Monoceros about 16 arcminutes in diameter. It is quite compact, but because the background field of stars is very rich, it can be difficult to pick out. According to some, this cluster has a heart shape, but this has never been obvious to the author.

This cluster is about 20 light years in diameter and contains at least 109 stars, including a red giant (SAO 134103) and a few yellow giants. Astronomers believe
that it is a relatively young cluster, around 100 million years old. M50 is almost 3,000 light years away.

**NGC 2353**

NGC 2353 is an open star cluster in Monoceros. It lies in a part of the Milky Way with lots of open clusters, and picking out the boundaries between them and the background stars isn’t easy. With an angular width of about 20 arcminutes this is an object that looks best through a low-power, wide-field eyepiece. On a 200-mm SCT, a 32-mm Plössl does a good job, but if you can get a wider field by using either an f/6.3 reducer-corrector or a low power 2-in. eyepiece – ideally, both – then this cluster will look even better.

NGC 2353 is about 5 light years in diameter and is located about 3,400 light years from Earth. It is thought to be about 76 million years old, making it a relatively young cluster. Most of its members are hot blue stars, and the older red giants seen appear to be background stars that happen to be in the same field of view.

Stephen James O’Meara has referred to this cluster as Avery’s Island, a reference to a seventeenth-century pirate by the name of Captain Avery. His idea was that the part of the sky spanning the Monoceros-Canis Major border is so filled with treasures – in this case star clusters – it would seem to be a pirate’s paradise.

**NGC 2360**

The constellation of Canis Major is distinctive and well known for its bright star Sirius, but it is not well stocked with deep sky objects suitable for small to medium aperture telescopes. NGC 2360 is one of the few, an open star cluster about 12 arcminutes in diameter and visible even through binoculars.

This is a charming little cluster, very bright and dense. Unusually for an open star cluster, it contains some red giants as well as hot blue stars, and it is one of the older open star clusters known. Current estimates put its age at about 2 billion years, much older than most other star clusters (see the section on ‘NGC 2682’ for more on why this is the case).

NGC 2360 lies in a patch of sky replete with open star clusters well worth exploring with binoculars or a wide-field telescope. It is believed to be about 6,150 light years away.

**NGC 2440**

NGC 2440 is a small planetary nebula in the southern sky constellation of Puppis. Because of its location it is difficult to see from mid to far northerly locations. Observers in southern England for example will find that it does not rise more than about 20° above the horizon, which means that an horizon free of trees and
buildings, as well as light pollution, is required. Observers farther south will of course have an easier time of things, and for observers at the latitude of the American Midwest this is a pleasant little planetary nebula that looks good through medium to large aperture telescopes.

Because this planetary nebula is rather small, less than an arcminute in diameter, at first glance it might be mistaken for a moderately bright but out-of-focus star. The use of either a narrowband or an O-III filter will pay dividends here, making it easy to pick out the nebula from the background stars. Raising the magnification should reveal its elliptical shape, but ordinary amateur telescopes aren’t big enough to show the magnitude 19 white dwarf star at its center. Oddly perhaps given its faintness, this star is apparently one of the hottest stars known to science, with a surface temperature thirty times that of the Sun!

NGC 2440 is about 3,600 light years away.

**NGC 2440**

M93 is an attractive open star cluster in Puppis that has a reputation for being very difficult to see from mid to far northern localities because of its southerly position in the sky. A clear, dark southern horizon is essential.

A wide field is important, too, given its angular diameter of about 22 arcminutes. NGC 2477 is believed to be about 4,200 light years away and at least 10 light years in diameter. It is thought to be around 100 million years old, but unusually for such a young open star cluster it contains at least two orange supergiant stars. Both can be easily picked out with medium to large aperture telescopes.
NGC 2477

NGC 2477 is an open star cluster in Puppis with around 300 members and spanning an area about 22 arcminutes in diameter. While highly regarded by some astronomers as being a very lovely cluster, it isn’t a familiar object, in part because it isn’t one of the Messier objects, but surely also because it is so difficult to see. Like the other deep sky objects in Puppis, from the point of view of many northern hemisphere observers it never gets very far above the horizon. Indeed, from England it is invisible, forever hidden below the horizon.

NGC 2477 is about 4,200 light years away and thought to be around 700 million years old.

NGC 2527

This open star cluster in Puppis is a large, fairly bright object that is difficult to see from far northern locations because of its location south of the celestial equator. It’s a fairly loose cluster of at least 50 stars scattered across about 22 arcminutes of space and is rather difficult to pick out from the rich background field of stars that makes up this part of the Milky Way.

NGC 2527 is about 1,920 light years away and is believed to be about 10.8 light years in width. The precise age of this cluster is somewhat uncertain but believed to be around a billion years, making this one of the older clusters in our galaxy.

NGC 2539

Another one of the nice open star clusters in the constellation of Puppis. Given the location of this constellation, to the south of the celestial equator, objects in this constellation can be difficult to see from far northern locations. But under good conditions, NGC 2539 is a surprisingly attractive non-Messier object, easily visible through binoculars and an interesting sight through any telescope.

NGC 2539 is a fairly big object, though, with an angular width of about 42 arcminutes, so a low-power, wide-field eyepiece is essential. On a 200-mm SCT, a 32-mm Plössl will deliver a 50-arcminute field of view just big enough to frame NGC 2539 against a less densely packed field of stars.

Just off to one side of the cluster is the magnitude 7.4 star 19 Puppis. Although this might appear to be part of the cluster, it isn’t, and is a good deal closer. 19 Puppis is estimated to be about 185 light years from Earth, whereas NGC 2539 is thought to be about 4,445 light years away.

NGC 2548 (M48)

M48 is a large, bright open star cluster in Hydra that can be easily seen through binoculars. Under dark skies it is just visible to the naked eye.
With an angular diameter of about a degree, it is an object that looks best through a wide-field, low-power eyepiece. On a 200-mm SCT, a 32-mm Plössl will just about squeeze it into the field of view, but for a really good look at this object you’ll want to use an f/6.3 reducer-corrector and a low-power 2-in. eyepiece such as a 35-mm Panoptic.

M48 contains some 80 stars spread out across about 23 light years of space. It is believed to be about 300 million years old and contains several yellow giants as well as the usual hot blue stars typical of open star clusters. It is a relatively nearby object at a mere 1,500 light years from Earth.

**NGC 2682 (M67)**

Compared to the celebrated Beehive Cluster M44, the other Messier object in Cancer, the open cluster M67, is far less often viewed. Despite that, it is an attractive cluster that is much easier to fit into the field of view than M44, and it’s also a much richer cluster, so looks more impressive. From a scientific perspective, it also has some points of interest.

One of its quirks is its age: M67 appears to be several billion years old, its age being at least 3.2 billion years, probably closer to 4 billion years, and possibly even as high as 5 billion years. By contrast most open clusters are relatively young objects, their constituent stars drifting apart within a few hundred million years. The Pleiades, for example, are about 100 million years old, and astronomers believe that within the next 250 million years its stars will have become so separated that the Pleiades Cluster will effectively cease to exist.

How do astronomers know that M67 is so old? One clue is the large number of stars similar to our own Sun, some of which have progressed to the red giant stage. For this to be the case, the cluster will have to have been in existence for a relatively long time, implying an age measured in billions rather than millions of years.

M67 also contains thirty or so blue stragglers, stars that are hotter and bluer than stars of equivalent luminosity in the cluster. The existence of such stars is a bit of a mystery, since stars in clusters were all formed from the same cloud of gas and should evolve in more or less the same sort of way. Blue stragglers buck this trend. Precisely how these stars have managed to develop in this way isn’t at all clear, but one explanation is that they have somehow absorbed material from another star. So whereas most stars are stuck with whatever stellar fuel they began life with, blue stragglers have received one or more ‘top ups,’ resulting in their exceptional properties.

M67 is about 2,700 light years away and believed to be about 19 light years in diameter.

**NGC 3132 (Southern Ring Nebula)**

This southern sky equivalent to the better known Ring Nebula (M57) in Lyra is a planetary nebula in the constellation of Vela. It’s a fairly bright nebula and easy to
see under even somewhat light-polluted skies. As with other planetary nebulae, the use of a narrowband or O-III filter will help confirm the identity of this object if you can’t distinguish it from nearby stars.

The Southern Ring Nebula is 0.4 light years (about 3 million million km) in diameter. It is about 2,000 light years from Earth, making it one of the closest planetary nebulae to us.

Unlike the northern Ring Nebula, the Southern Ring Nebula has a relatively bright (magnitude 10) star at its center. A medium to large aperture telescope should show this central star clearly under favorably dark skies. In actual fact there are two stars at the center of this nebula, and it’s the fainter of the two (a magnitude 16 star) that is actually the hot white dwarf that causes the nebula to glow.

**NGC 3242 (Ghost of Jupiter Nebula)**

Widely considered to be one of the best planetary nebulae in the sky, NGC 3242 is a small, bright object in the otherwise uninspiring constellation of Hydra. It is easy to spot even under somewhat light-polluted conditions, and the use of a narrowband or O-III filter to darken the background sky and adjacent stars should remove any doubt about its identification.

Unusually for a deep sky object, this planetary nebula has a certain amount of color, most observers reporting that it appears to be blue or blue–green.

Its common name, the Ghost of Jupiter, is a reference to its apparent size at the eyepiece, 25 arcseconds, slightly less than that of Jupiter, which ranges from 30 to 50 arcseconds. Just as you’d do when viewing Solar System objects, try using quite high levels of magnification so that its details become more apparent. Using magnifications of up to ×800, noted deep sky observer David Knisely at the Prairie Astronomy Club in Lincoln, Nebraska, likens the nebula to the eye-shaped logo of the Columbia Broadcasting Company (CBS). What do you see?

Of course, although Jupiter and the Ghost of Jupiter have about the same size when viewed through a telescope, the two objects are very different in absolute size: whereas the planet Jupiter has a diameter of about 143,000 km, the Ghost of Jupiter Nebula is about 20 million times larger, measuring a whopping 2,842,362,000,000 in diameter. But because the Ghost of Jupiter Nebula is also a lot farther away, about 1,400 light years away, compared to a mere 33 light minutes in the case of Jupiter, the two objects seem to be of similar size. Although these numbers may seem – literally as well as figuratively – astronomical, they do give you some idea of the scale of the universe.

The only downside to this object is that for far northern observers it may not rise very far above the southern horizon. In southern England, for example, it gets to about 20° or so above the horizon. Although your narrowband or O-III filter may help deal with ambient light pollution, they can’t do anything about inconveniently placed trees or houses!
NGC 3228

NGC 3228 is a small but bright open star cluster in Vela with an angular diameter of about 5 arcminutes. Although easily seen through binoculars under dark skies, this attractive cluster of mostly hot, blue stars is very much a southern sky object, and difficult to see even from latitudes as low as central Florida.

NGC 3228 is about 1,600 light years from Earth and is estimated to be a relatively young cluster around 42 million years in age. Stephen James O’Meara calls this cluster the Queen’s Cache Cluster, but whether this name catches on remains to be seen.

NGC 4590 (M68)

Although it may be the biggest of all 88 constellations, Hydra is singularly lacking in bright deep sky objects. One of the few is M68, a reasonably bright globular cluster easily visible through binoculars under good conditions and a lovely sight when viewed with mid to large aperture telescopes. It is rated at Class X on the Shapley–Sawyer scale.

As its Shapley–Sawyer class rating suggests, M68 is a fairly loose globular cluster, but the core is impossible to resolve visually even in large aperture telescopes. Unfortunately for mid to far northern observers, it’s a relatively low-lying object.
that doesn’t get very far above the southern horizon, which is perhaps one reason why it is one of the less familiar Messier Catalog globular clusters.

M68 is about 106 light years in diameter and lies about 33,000 light years from Earth.

**Figure 2.14.** M68 is a small, fairly loose globular cluster that lies in a relatively southerly part of the huge constellation Hydra. (Image produced using Starry Night Pro. AllSky data courtesy of Main-Sequence Software Inc.)

### NGC 7662 (Blue Snowball Nebula)

This small planetary nebula is sufficiently bright that it can be spotted through any telescope, but you do need reasonably dark skies and an aperture upwards of 200 mm to see its famous blue color. Like most planetary nebulae, its small angular diameter, a little over half an arcminute, means that it can easily be confused with an out-of-focus star. You will need quite high levels of magnification to see any details. Given sufficient magnification, a fainter halo around the bright central disc should be apparent. Narrowband and O-III filters are well worth using.

The precise distance between NGC 7662 and Earth is a matter of some debate, the usual value being placed at around 3,200 light years but some astronomers believing the distance could be nearly twice that. Since estimates of its diameter depend on how far away it is, there’s some uncertainty in this regard as well, but the minimum value is likely around 0.3 light years, just under 3 million million km. If NGC 7662 is farther away that had been previously assumed, then it would have to be larger as well.
NGC 7686

NGC 7686 is an open cluster in the constellation of Andromeda. It is about 13 light years in diameter and estimated to be about 3,000 light years from Earth.

It is reasonably bright and compact, with an angular diameter of about 15 arcminutes, and should be framed very nicely in the field of view a low-power eye-piece such as a 32-mm Plössl. At least nine bright stars should be visible, together with many more much fainter stars. The bright stars are at least between about sixth and tenth magnitudes and should be visible even under moderately light polluted skies.

Obscure and Challenging Deep Sky Objects

NGC 404 (Mirach’s Ghost)

NGC 404 is a dwarf lenticular galaxy in the constellation Andromeda, 6 arcminutes from the star Beta Andromedae (sometimes called Mirach). Because of its proximity to this star it is very difficult to see or even photograph, the glare from the star swamping out the light from this relatively dim galaxy. As a result it has become known as Mirach’s Ghost.

At the eyepiece this galaxy can seem very small and condensed, almost star-like. It can be seen with telescopes from 100 mm upwards, but it is easily overlooked in the glare of Mirach or mistaken for an out-of-focus star. Moving the star Mirach out of the field of view is the key, either by switching to a higher power or narrower field-of-view eyepiece, or else by slewing the telescope very slight off to one side.

NGC 404 is about 10 million light years away and 65,000 light years in diameter.

NGC 891

NGC 891 is a spiral galaxy in Andromeda that is viewed edge-on, but because it has a low surface brightness, it is dim and difficult to see. A large aperture telescope is required, as well as fairly dark skies. Even then, a broadband filter can be useful for blocking skylow and any slight light pollution.

NGC 891 is about 30 million light years away and part of the Coma-Sculptor Cloud of galaxies. It is believed to be about 110,000 light years in diameter, making it comparable to our own Milky Way Galaxy in size as well as shape.
NGC 1232

This spiral galaxy in the constellation of Eridanus is viewed face-on, and, as is often the case with galaxies in this orientation, its surface brightness is much lower than its visual magnitude would suggest. Indeed, this galaxy is very difficult to see under anything other than dark sky conditions. An aperture of 200 mm is certainly required under most conditions, and the best views come with much larger telescopes.

NGC 1232 is about 70 million light years away and part of the Eridanus Cluster of galaxies. It has a close neighbor, the galaxy NGC 1232A. The gravitational pull of this satellite galaxy has distorted the spiral arms of NGC 1232 in a way similar to that seen with the Whirlpool Galaxy (M51).

NGC 1788

NGC 1788 is a reflection nebula in Orion. It is small and notoriously difficult to see except from dark sky locations. The problem is that reflection nebulae shine by reflecting starlight from nearby stars, in this case a cluster of young stars actually hidden from view behind the nebula. Because reflection nebulae aren’t only emitting the wavelengths of light that narrowband and O-III filters are designed to let through, neither of these filters dramatically improves the view. A standard light-pollution reduction filter might be even more helpful if street lighting is the prime source of light pollution in your area.
From dark sky environments NGC 1788 can be seen with relatively small aperture telescopes, from 100 mm upwards. However, suburban astronomers will want to use larger telescopes. A 200-mm SCT should show the brightest region of the nebula, but since this is only about 3 arcminutes in diameter, a fair amount of magnification is required.

**NGC 1851**

This globular cluster in Columba is well south of the celestial equator and difficult to see from the northern hemisphere. At the latitude of the midwestern United States it barely gets 9° above the southern horizon, and from England it is always below the horizon.

It is bright enough to be spotted with medium aperture telescopes under dark sky conditions, assuming a clear horizon, but more realistically a 200-mm aperture telescope will be required to see any detail. It’s reasonably bright and quite large (about 18 arcminutes) and an attractive object through large telescopes and under at least somewhat dark skies.

NGC 1851 is about 40,000 light years away and 140 light years in diameter. Like most other globular clusters, it is an ancient object, around 14 billion years old.

**NGC 1904 (M79)**

The constellation of Lepus contains very few deep sky objects easily viewed through telescopes of the types owned by amateur astronomers. There’s really only a single deep sky object of note, the globular cluster M79. It is a fairly dim object, though, and isn’t an easy target for small to medium aperture telescopes under suburban skies, though at magnitude 7.7 it can be detected with binoculars under pitch black skies. Lepus is a relatively southerly constellation, and M79 is difficult to see from far northern locations. Observers in southern England will find it only rises about 13° above the horizon.

M79 is an odd globular cluster; it is unlike most other globular clusters in being best viewed in winter rather than summer. Most globular clusters orbit the galactic core, so we tend to view them by looking into that part of the Milky Way. M79 is different and actually orbits a long way out, 60,000 light years from the core.

The origins of M79 are uncertain, but one explanation is that it belongs to the Canis Major Dwarf Galaxy, a nearby galaxy being pulled apart by the Milky Way Galaxy. As this interaction progresses, bits of the Canis Major Dwarf Galaxy are absorbed by the Milky Way Galaxy, including M79. Although this explanation isn’t universally accepted by astronomers, it does at least explain why M79 is where it is.

M79 is about 42,000 light years from Earth and is thought to be about 118 light years in diameter.
NGC 1981

NGC 1981 is an open cluster at the northern end of the Sword of Orion. It is sparse and spread out across 25 arcminutes and looks best at low magnifications. The brightest of its few stars are arranged in a distinctive Y-shaped asterism. This cluster is thought to be about 1,500 light years away.

NGC 2022

Although Orion is famous for its emission nebulae, it is not a constellation most astronomers think of when talking about planetary nebulae. That’s perhaps why the planetary nebula NGC 2022 is so often overlooked.

In general terms it is a very ordinary nebula. Through a 200-mm SCT it appears as a small (18 arcsecond diameter) elliptical blur. Unlike the showpiece planetary nebulae, is not obviously colored, and simply looks like a faint gray spot. It can be easily mistaken for an out-of-focus star, but unlike stars, it is not substantially dimmed by a narrowband or O-III filter.

Beyond its general shape, there isn’t any obvious detail, even at high magnifications. Long-exposure photographs reveal a two-part structure, a bright inner core (the bit we can see with amateur astronomy telescopes), and a fainter shell of gas around the outside (only visible in photos or through large research-grade observatory telescopes). The outer shell of gas extends across a diameter of about 88
arcseconds, something like 3 light years of space. The star in the center of the nebula is very dim, around magnitude 16.5, but very hot and seemingly close to the point where it is cooling down as it becomes a white dwarf star.

The precise distance between Earth and NGC 2022 is not known, but is believed to be about 6,000–8,000 light years.

**NGC 2024 (Flame Nebula)**

The Flame Nebula in Orion is a tricky object. It is located rather close to the bright star Alnitak, and although this star is the one emitting the light that makes the nebula glow, its glare also makes it difficult to see the nebula at all. Almost any filter that tones down the starlight a bit will help, even a light pollution filter, though a narrowband filter or O-III filter help even more.

Between of its overall faintness this object looks best under dark skies, but it can be seen from reasonably dark suburban conditions as well. A narrowband or O-III filter will help cut out some of the sky glow as well as the brilliance of Alnitak, so they’re doubly useful in this regard. Through a 200-mm SCT the Flame Nebula is visible as a faint patch of light with a dark band, a dust cloud, running down the middle.

Darker skies and larger telescopes reveal more detail, including more dust clouds, and also show more of the nebula. Under optimal conditions, it can be seen to be remarkably large, about 30 arcminutes in diameter, though suburban astronomers will usually only see the bright central region.

The Flame Nebula is part of the Orion Molecular Cloud Complex mentioned in the section on the Orion Nebula (NGC 1976 and 1982).

**NGC 2194**

This open cluster is rather peculiar. Unlike most open clusters, it contains mostly metal-poor stars. These are the types of stars commonly found in globular clusters. Most open clusters tend to have metal-rich stars, stars rather like our own Sun. Part of the reason for this is that, unlike most open clusters, this cluster is far from the center of the galaxy (and some 10,000–12,000 light years from Earth). It is also an old star cluster, around 550 million years old in fact, making it much older than most open star clusters.

At the eyepiece this nebula is rather faint and may be difficult to see with small telescopes. Medium to large aperture telescopes reveal an attractive mix of blue and yellow stars.

**NGC 2232**

This bright open cluster includes the bright star 10 Monocerotis, so it should be easy to pick out from the background field of stars. It is a loose cluster, spread out
across some 29 arcminutes of space; thus a low-magnification, wide-field eyepiece is required for the best view. It contains over 40 stars, is 1,200 light years away, and thought to be about 40 million years old.

**NGC 2251**

NGC 2251 is one of numerous open clusters in Monoceros. It is easily seen through telescopes of all apertures as a tight cluster of stars surrounding a bright (ninth-magnitude) star in the center. NGC 2251 is about 4,300 light years away and is 6 light years in diameter.

**NGC 2261 (Hubble’s Variable Nebula)**

This object’s common name is unusually informative: it is indeed a nebula, it was discovered by Edwin Hubble, and its brightness varies across an irregular period of several weeks.

Under dark sky conditions the brightest portion of this combination reflection and emission nebula can be spotted with quite small telescopes. A telescope with an aperture of 100 mm should show the bright portion at the apex of this comma-shaped nebula, while larger telescopes allow more of its shape to become apparent. It is inevitably the case that suburban astronomers will have difficulty seeing the fainter...
parts of the nebula, but reasonably dark suburban skies should allow a 200-mm SCT to show the brightest part of this nebula.

Because this object is largely a reflection nebula, light-pollution filters are of limited value. If you must use one, a broadband filter is probably the best bet.

What makes the Variable Nebula variable? At the apex of the nebula is an irregular variable star, R Monocerotis. As its brightness varies, so, too, does the brightness of the nebula around it.

NGC 2301

Observers looking at Monoceros are viewing a part of the Milky Way thick with stars. There are numerous open star clusters to be seen, many of which are good targets for small to medium aperture telescopes, as is the case with NGC 2301.

This star cluster is about 3,000 light years away and has an angular width of about 12 arcminutes. NGC 2301 is relatively young, at about 164 million years of age, and contains at least 146 stars. The cluster is remarkable for sitting very close to both the galactic and celestial equators.

NGC 2343 (Seagull Nebula)

NGC 2343 is an open cluster in Monoceros that is easily viewed through small telescopes. However, through the eyepiece it isn’t very large, about 6 arcminutes across, and can be easily overlooked against the background stars. If you look closely, though, you’ll notice a group of mostly blue stars with one fairly bright orange star off to one side; this is NGC 2343. It is believed to be about 4,300 light years away and around 130 million years of age.

NGC 2343 and another nearby cluster, NGC 2335, are both part of a large region consisting of star clusters, clouds of dust, emission nebulae, and reflection nebulae. The whole system is sometimes called the Seagull Nebula, though amateur astronomers typically apply that name to the relatively bright southerly region of the complex cataloged as IC 2177. It doesn’t rise above the horizon at mid to far northern latitudes and is essentially a southern hemisphere target only.

Even at latitudes where the object is favorably placed, it is very dim and difficult to see, and requires a large aperture telescope and relatively dark skies. Light pollution filters help only somewhat, with narrowband and H-beta filters offering the most improvement.

NGC 2359 (Thor’s Helmet)

This object consists of an emission nebula surrounding a peculiarly hot type of supermassive star called a Wolf-Rayet star. Wolf-Rayet stars are approaching the point at which they become supernovae. The nebula is notoriously difficult to
see visually, though light pollution filters, in particular O-III filters, can help sig-
nificantly. Dark skies are almost a prerequisite, and while the nebula has been
detected with medium aperture telescopes, large aperture telescopes are usually
required.

NGC 2359 is at least 15,000 light years away and has a width of about 30 light
years. At the eyepiece it is often a lot smaller than people expect when looking at
photographs, having an angular diameter of only 10 arcminutes.

**NGC 2362**

The forty or so hot blue stars that make up this attractive open star cluster in Canis
Major seem to be swarming around the bright star Tau Canis Majoris. In fact this
star may not belong to the cluster at all and might just be in our line of sight, though
this is still a matter of debate.

In any case, NGC 2362 is an easy object for telescopes of all sizes, but it looks
really nice in telescopes of apertures 150 mm upwards. With an angular diameter of
about 8 arcminutes it is rather small and benefits from a bit of magnification, though
it can be difficult to pick out from the rest of the star field. Through a 200-mm SCT
and a 20-mm Plössl it looks particularly nice.

NGC 2362 is a young cluster, perhaps 5 million years old, and long-exposure
photographs reveal traces of gas and dust around its stars. Indeed, some of this mate-
rial seems to be what astronomers call protoplanetary discs. These are the discs of
gas and dust around young stars that eventually condenses to form planets, aster-
oids, comets, and other Solar System objects. The cluster is about 4,000 light years
away.

**NGC 2371 and 2372**

This odd planetary nebula has two bright regions, and initially each region was
counted as a separate nebula, hence the two NGC designations. Appropriately
enough for a single deep sky object with a dual identity, NGC 2371 and 2372 are
to be found in the constellation of Gemini.

A telescope of 200 mm is enough to show the two bright spots on either side
of this planetary nebula, assuming reasonably dark skies. However, its small angular
diameter – a bit over 2 arcminutes in width and about 1 arcminute in height – means
that it can be difficult to distinguish from neighboring stars.

Use either a narrowband filter or an O-III filter to double check that you are
looking at the right object: such filters dim stars greatly, but planetary nebulae hardly
at all. If your telescope has sufficient aperture, use of such filters make also make it
easier to see the fainter parts of the nebula that surround and connect the two bright
spots. Doing this is challenging, though, under suburban skies.

The whole nebula is about 4,400 light years away.
NGC 2403

NGC 2403 is a spiral galaxy in Camelopardalis. It is fairly bright, and under good dark skies can be seen through binoculars. But suburban astronomers will need reasonably large apertures to be sure of bagging this galaxy. Telescopes above 150 mm should show its bright core easily enough, but you will need much larger telescopes, 250 mm upwards, to see the fainter regions around the core.

NGC 2403 is part of the comparatively nearby M81 group and is believed to be about 8 million light years away. It is believed to be about 21,900 light years in diameter.

![Image of NGC 2403](image.png)

**Figure 2.18.** NGC 2403 is quite a large galaxy, but its surface brightness is low. (Image produced using Starry Night Pro. AllSky data courtesy of Main-Sequence Software Inc.)

NGC 2419 (Intergalactic Tramp)

This interesting but notoriously dim globular cluster is very difficult to find without a go-to telescope, lying in a part of the sky singularly lacking in bright stars. Although owners of go-to telescopes will at least be able to get NGC 2419 into the field of view easily enough, actually seeing the thing is a whole other problem! Some amateurs have reported being able to see NGC 2419 through telescopes with apertures as small as 100 mm under very dark skies, but from a reasonably dark suburban location, it is a challenge even with a 200-mm telescope. Once you have spotted NGC 2419, what you see is more like an elliptical galaxy than a globular cluster, the object appearing as little more than a faint circular blur less than 9 arcminutes in diameter.
So why bother? NGC 2419 is worth looking at because it is so distant. It orbits the galactic core at a distance of 300,000 light years, a good 275,000 light years from Earth. To put that into perspective, Omega Centauri is a mere 15,000 light years from us, and the Great Hercules Cluster only 25,000 light years away. So although apparently similar to Omega Centauri in terms of size and actual luminosity, from our earthbound point of view it seems incredibly small and faint.

For a long time this globular cluster was known as the Intergalactic Tramp or the Intergalactic Wanderer, the prevailing belief being that NGC 2419 was too far away from the galactic core to be held in place by gravity, and that it was instead a globular cluster that drifted through intergalactic space all by itself. That idea is not now generally accepted, but NGC 2419 remains an odd creature, farther out from the galactic core than the Milky Way’s two satellite galaxies, the Magellanic Clouds. How did NGC 2419 get so far out? Was it formed alongside the Milky Way Galaxy or somewhere else? One explanation is that NGC 2419 is the core of a dwarf galaxy that drifted by the Milky Way Galaxy at some point in time.

**NGC 2506**

NGC 2506 is one of many open clusters in Monoceros. It is quite small and easily overlooked, but an attractive enough object when viewed through medium to large aperture telescopes. It is only 7 arcminutes in diameter, though, so a certain amount of magnification is helpful. On a 200-mm SCT, a 20-mm Plössl frames the cluster nicely.

This cluster is over 11,000 light years away and apparently very old for an open cluster, current estimates suggesting an age of at least 1.5 billion years.

**NGC 2547**

This superb open cluster in the southern sky constellation of Vela cannot be seen by observers at mid to high northern latitudes. Even in central Florida it does not rise more than about 13° above the horizon.

NGC 2547 is quite broad, around 36 arcminutes in diameter, and contains at least 50 stars. It is about 2,000 light years from Earth and about 15 light years in width.

**NGC 2571**

NGC 2571 is an open cluster in the southern sky constellation of Puppis and difficult or impossible to see from mid to high northern locations. But from locations where it can be seen, such as Florida, it’s a compact, fairly bright open cluster that looks like a hazy patch through binoculars but can easily be resolved to its individual stars with small telescopes 100 mm in aperture upwards.
NGC 2571 is about 4,500 light years away and believed to be about 50 million years old. It appears to contain a white dwarf star. Since open clusters usually contain quite young stars, the presence of a white dwarf is rather unusual.

**NGC 2655**

This lenticular galaxy in Camelopardalis is not difficult to see, and its bright core can be seen with binoculars under pitch black skies. It’s an easy galaxy for telescopes 100 mm upwards, though not much will be seen beyond the core, and really large telescopes and good dark skies are needed to make out the fainter region around the core.

NGC 2655 is about 80 million light years away and the brightest member of its own group of galaxies, the NGC 2655 Group, within the Virgo Supercluster.

![NGC 2655 Image](image.png)

**Figure 2.19.** NGC 2655 is a lenticular galaxy with a fairly bright core. (Image produced using Starry Night Pro. AllSky data courtesy of Main-Sequence Software Inc.)

**NGC 3003**

NGC 3003 is a small spiral galaxy in Leo Minor about 80 million light years away. It is very difficult to see this galaxy with small telescopes, and even apertures of 200 mm only reveal this galaxy under reasonably dark skies.

Our view of NGC 3003 is edge-on, so we don’t really see very much, but assuming your skies are reasonably dark, the central core should be apparent. Darker skies
and larger apertures will show more of the shape of the galaxy, but details such as mottling or dust lanes are not apparent.

**NGC 3293 (Little Jewel Box Cluster)**

NGC 3293 is another deep sky object only visible to northern observers at very low latitudes. It is a very pretty open cluster in the constellation of Carina with numerous hot blue stars and several red giants. Although not quite in the same league as the real Jewel Box Cluster (NGC 4755) in Crux, it’s certainly a showpiece object at latitudes where it can be seen.

NGC 3293 is 8,400 light years away and is believed to be a mere 10–20 million years old, making it a very young object by open star cluster standards.

**NGC 3344**

Leo Minor is one the smallest and dimmest constellations in the sky, with no stars brighter than fourth magnitude. It’s of little interest to amateur astronomers, even though it does lie in a part of the sky rich with galaxies. Most of those galaxies are far too faint to be seen with the average amateur astronomer’s telescope, though there are a few just about worth looking for, of which NGC 3344 is perhaps the best.

NGC 3344 is a reasonably bright galaxy only 20 million light years away, and a member of a group of galaxies referred to as the Leo Spur. This is a region of the Virgo Supercluster close to the Local Group within which our galaxy belongs, so while Leo Spur galaxies are farther away than Local Group galaxies such as the Andromeda Galaxy, they’re still comparatively nearby.

**NGC 3432**

NGC 3432 is a spiral galaxy in the small constellation Leo Minor. It is small and faint, and consequently difficult to see. You’ll need at least 200 mm of aperture and fairly dark skies to spot this edge-on galaxy, in which case all you’ll see is a dim, thin streak anyway.

NGC 3432 is part of the Leo Spur group of galaxies and is believed to be about 48 million light years away.

**NGC 3621**

This elliptical galaxy in Hydra is somewhat faint, but under good dark skies its core, at least, is easily visible with medium to large aperture telescopes, from around 100 mm upwards. It is too far south for most northern observers to get a good look at, though, and even from central Florida it doesn’t quite reach 30°
above the horizon. Consequently it is not a well known galaxy among amateur astronomers.

NGC 3621 is about 20 million light years away and part of the Leo Spur group of galaxies. It is a fairly large galaxy with a diameter of at least 93,000 light years.

**NGC 5128 (Centaurus A)**

Although a dramatic and easy object for observers at equatorial and southern latitudes, observers at anything other than the lowest northern latitudes will find Centaurus A an impossible target. In central Florida, for example, it rises a little higher in the sky than Omega Centauri (NGC 5139) but has a much lower surface brightness, and is consequently far more difficult to see. So although it’s always worth having a stab at, don’t be too disheartened if you can’t see this object.

Under good conditions, this object is bright and easy to see even with a small telescope. A large telescope, anything from 150 mm upwards, should show the prominent dust lane across the middle of the galaxy. Technically a lenticular galaxy, this dust lane is unusually well developed for this type of galaxy, and astronomers believe that Centaurus A was formed by a collision between a big elliptical galaxy and a smaller spiral galaxy. Another quirk is its incredibly strong emission of radio waves. These are believed to come from a huge black hole at the center of the galaxy, a black hole estimated to have a mass equal to one billion times that of our Sun.

Centaurus A is a member of the Centaurus A/M83 Group of galaxies that, as its name suggests, is subdivided into two smaller groupings, one centered around Centaurus A and the other around Messier 83. Centaurus A itself is about 14 million light years away.

**NGC 5139 (Omega Centauri)**

Like Centaurus A, Omega Centauri is a southern sky object, but it is surprisingly easy to see from the latitude of central Florida. To be fair, your view won’t be anywhere near as good as that enjoyed by a southern sky observer, but it’s still a pleasingly large and bright object.

Under favorable conditions Omega Centauri can be seen with the naked eye, and southern sky observers consider this object to be one of the two best globular clusters in the sky, the other being 47 Tucanae (NGC 104). Poor old M13 (NGC 6205) in Hercules is very much an also-ran in comparison! Even with a low-power eyepiece, the sheer size of Omega Centauri is impressive, having an angular diameter of a whopping 36 arcminutes, making it appear bigger than the full Moon!

Omega Centauri is about 16,000 light years away. It is unlike most other globular clusters in that it contains multiple generations of stars rather than Population II stars only. One explanation is that Omega Centauri is actually the core of a dwarf
A galaxy that drifted too close to the Milky Way; most of its stars were absorbed into the Milky Way Galaxy, but the core remains as a globular cluster.

**NGC 5236 (M83, Southern Pinwheel Galaxy)**

M83 is a barred spiral galaxy in Hydra, and at only 15 million light years away, one of the closest of its type to Earth. Unfortunately for northern hemisphere observers this southern sky object is not easy to see. Indeed, mid to far northern hemisphere observers may not be able to see it at all: in southern England it only gets to about 8° above the southern horizon. M83 is the southernmost galaxy in the Messier Catalog and consequently one of the most difficult objects on the list for northern hemisphere observers to see.

This galaxy is viewed face-on, and as is often the case with galaxies oriented this way, it can be difficult to pick out from the background sky. Anything worse than the slightest amount of light pollution will obscure the galaxy completely, so dark or at least rural skies are important.

Five supernovae have been observed in M83, the first in 1923 and the most recent in 1983. It is part of its own cluster of galaxies, the M83 Group, a group that includes at least 14 galaxies in total, including Centaurus A (NGC 5128).

**Colorful and Curious Stars**

**SAO 12969 (Kemble’s Cascade) – See also NGC 1502**

Kemble’s Cascade is a famous asterism in Camelopardalis and is a remarkably straight chain of more than twenty stars. The chain runs for over 2.5° in length and as such is a showpiece target for astronomers using binoculars and rich-field telescopes. It is named after Fr. Lucian Kemble, the amateur astronomer and Franciscan friar who discovered the asterism.

Kemble’s Cascade cannot be seen well through a standard 200-mm SCT. At best, a combination of a reducer-corrector and a 2-in. eyepiece such as a 35-mm Panoptic will let you see about three-fourths of the chain. Have the telescope locate SAO 12969, the brightest star in the chain and conveniently located close to its center. Although you still won’t see the whole of Kemble’s Cascade, you’ll see enough to be impressed. If your telescope is equipped with a 50 mm finder, be sure to take a look at Kemble’s Cascade through it. You may decide the view looks better through the finder than through the telescope!

Kemble’s Cascade isn’t a star cluster, though it might appear to be one. It’s merely a chance alignment of stars. There are countless others such alignments, some with names, most without.
SAO 23906 (Stock 23)

SAO 23922 is a magnitude 7.5 star in a fairly large and loose open cluster known as Stock 23 in Camelopardalis. This cluster is about 25 arcminutes in diameter, so a reasonably large field of view is important. Within the cluster is a distinctive keystone-shaped asterism. Most of the stars are white, but there are at least two obviously yellow ones, including SAO 23906. Stock 23 is about 30 million years old and 1,240 light years away.

SAO 25939 (12 Lyncis)

12 Lyncis is a classic triple star, but it is often overlooked because it is located in the infamously dim constellation of Lynx, about which it has been said you need the eyes of a lynx simply to find it. Owners of go-to telescopes are saved the chore of finding their way around this constellation and can instead direct their attentions to enjoying this attractive triple star. At medium magnifications a blue–white magnitude 5.0 star will be seen with a yellow magnitude 7.2 companion. With higher magnification a medium aperture telescope will reveal that the brighter star is actually two stars very close together, one about magnitude 5.4 and the other magnitude 6.0.
Figure 2.21. SAO 23906 is the yellow star at center of the large, loose cluster known as Stock 23. (Image produced using Starry Night Pro. AllSky data courtesy of Main-Sequence Software Inc.)

Figure 2.22. With additional magnification, the dimmer of the two components that make up 12 Lyncis will be revealed to be a double star in its own right. (Image produced using Starry Night Pro. AllSky data courtesy of Main-Sequence Software Inc.)
SAO 26051 (15 Lyncis)

15 Lyncis is an attractive double star in Lynx that consists of two golden yellow stars, one at magnitude 4.7 and the other magnitude 5.8. They are only 0.9 arcseconds apart, and high magnifications will be required, as well as a medium aperture or larger telescope.

SAO 26312 (19 Lyncis)

This is a good triple star for telescopes of all sizes. The two brightest components are blue-white stars at magnitudes 5.8 and 6.9, separated by just under 15 arcseconds. The third component is a magnitude 7.6 star of similar color, about 3.5 arcminutes away.

SAO 55347 (Iota Trianguli)

Iota Trianguli, often referred to by its Flamsteed designation, 6 Trianguli, is an attractive double star consisting of a yellow magnitude 5.3 primary and its vaguely bluish magnitude 6.9 companion. They are separated by 3.9 arcseconds and are easily split with even small aperture telescopes given steady skies and sufficient magnification.

SAO 60198 (Alpha Geminorum, Castor)

Castor is one of the classic double stars of the sky. The two components are similar in colour, white, and also similar in brightness, one at magnitude 1.9 and the other at magnitude 2.2. They are quite close, a mere 2.2 arcseconds apart, but this isn’t as problematic as it might seem. Double stars with two equally bright components are the easiest to split, the degree of difficulty increasing the more dissimilar the two stars are in brightness. Castor fits the pattern neatly and can be split with very small apertures, as little as 75 mm, given steady skies and sufficient magnification.

SAO 61391 (38 Lyncis)

38 Lyncis is a pretty double star that requires at least medium aperture telescopes to split. The magnitude 3.9 primary is blue–white and the magnitude 6.1 secondary is also blue–white, though some observers report it as being lilac in color! The two components are separated by 2.6 arcseconds.
SAO 75020 (Struve 183)

This triple star system in Triangulum is a challenging target for medium to large aperture telescopes. The primary pair AB consists of a yellow magnitude 7.7 star and a blue–white 8.4 star just 0.6 arcseconds apart. The C component is much easier to see, a magnitude 8.7 star 5.6 arcseconds away from the AB pair.

SAO 80416 (Iota Cancri)

This double star looks like a somewhat dim, washed out version of Albireo, but it is easily split with even a small telescope, and consequently a popular addition to wintertime observing schedules. The primary (SAO 80416) is a yellow giant star at magnitude 4.0, while the secondary (SAO 80415) is an A-type blue-white main sequence star at magnitude 6.6.

SAO 96265 (38 Geminorum)

38 Geminorum is a nice double star consisting of a white primary and a yellow secondary, shining at magnitudes 4.7 and 7.7, respectively. The two stars are separated by about 7 arcseconds and are easily split even with relatively small aperture telescopes.

SAO 112740 (Gamma Orionis, Bellatrix)

Bellatrix is one of the hotter blue stars in the sky, and a classic example of a B-type blue giant star. It has a surface temperature of around 21,000 K and a distinctive steel-blue coloration.

SAO 112921 (Lambda Orionis, Meissa)

Meissa is a fairly easy wintertime double star for medium and large aperture telescopes. It consists of a magnitude 3.5 primary and a magnitude 5.5 secondary, the two stars 4.3 arcseconds apart. Both stars are essentially white in color.

SAO 113271 (Alpha Orionis, Betelgeuse)

Betelgeuse is a red supergiant, and one of the biggest stars known. It is over 900 times the diameter of the Sun, and more than 18 times its mass. A popular way of describing its size is to consider what would happen if the Sun was the same size
as Betelgeuse: the outer edge of the Sun would be somewhere between the orbits of Mars and Jupiter!

Having said this, because Betelgeuse is so big, its mass is spread out incredibly thinly, and most of the star would be about as matter-rich as a laboratory-grade vacuum. It’s difficult to imagine what a starship pilot approaching Betelgeuse would see, but it is certain that Betelgeuse would not have sharp, clear edges to its disc of the type we see around the Sun when it is observed (through an appropriate filter, of course). Presumably it would be like a huge orangey mass, tenuous at its edges, but becoming richer towards its center.

Betelgeuse is a an irregularly variable star, though its precise brightness is difficult to estimate by eye because of the distance between it and appropriately bright stars of similar color. Roughly speaking it varies between magnitudes 0 and 1, though the exact numbers are debatable, but likely around 0.3 and 1.2. In any event, its period is a long one, around 6–7 years, but given to considerable variation.

Because Betelgeuse is so large, it is exceptional among stars in that its angular diameter can actually be measured with some degree of accuracy. By doing this, astronomers have discovered that its size actually varies, and does so along with variations in its brightness. Betelgeuse has also been photographed, and these pictures show variations in brightness across its surface – what on the Sun would be called sunspots.

The fate of Betelgeuse is interesting. It is a very massive star, and because of this, it appears to be consuming its nuclear fuel at an incredible rate. Given its size and type, it is a comparatively old star, some 8.5 million years in age, and scientists believe its final collapse into a supernova is likely to happen in the relatively near future.

**SAO 114146 (Plaskett’s Star)**

Plaskett’s Star is a visually unremarkable, magnitude 6.1 blue–white star. However, from a scientific perspective it is a superlative star, one of the most massive binary stars known, with a mass of between 40 and 110 times that of our Sun. Estimates do vary a bit in this regard, with the more modern numbers tending towards the upper end of the range. This being the case, Plaskett’s Star is actually two very massive blue supergiants, one about 50 times the mass of the Sun, and the other about 40 times the mass of the Sun, each orbiting a common center of gravity with a period of a little over 14 days.

Perhaps the most astounding thing about Plaskett’s Star is how close together the two components are – a mere 0.5 astronomical units separates them! To put that into perspective, Mercury is on average 0.39 astronomical units from the Sun, while Venus is around 0.72 astronomical units from the Sun. As bizarre as it sounds, these two giant stars are orbiting one another with a distance between them that is less than that of the distance between Venus and the Sun! Needless to say, these stars are too close together to be resolved at the eyepiece.

Because they are so close to one another, the speed at which they orbit one another is very fast. They are also close enough to be exchanging material; that is, the
gravitational pull from each star is enough to pull away material from its companion. This extraordinary system won’t be like this forever, but its precise fate remains a mystery. Big stars usually have dramatic endings, and that is surely the case here. Will one star throw out the other one eventually? Or will they both become neutron stars after they go supernova? Or maybe even a twinned pair of black holes? Nobody really knows. So although this star isn’t much to look at through a telescope, it’s an amazing star to ponder.

**SAO 114258 (15 Monocerotis, S Monocerotis)**

15 Monocerotis is an extraordinary multiple-star system with no fewer than sixteen components! Six components are visible through medium aperture telescopes. 15 Monocerotis A is a magnitude 4.7 star and has an intensely blue color. 15 Monocerotis B is a magnitude 7.5 star separated from 15 Monocerotis A by 2.8 arcseconds.

15 Monocerotis C, D, and E are much fainter stars, at magnitudes 9.8, 9.6, and 9.9, respectively. They are separated from 15 Monocerotis A by 16.6, 41.3, and 41.3 arcseconds respectively.

The sixth component, 15 Monocerotis F is brighter, a magnitude 7.7 star 2.6 arcminutes away from 15 Monocerotis A.

15 Monocerotis A is also an irregularly variable star, though not a dramatic one, its brightness varying between 4.5 and 5.0.

**SAO 117112 (Epsilon Hydrae)**

This is a notoriously tricky multiple star system. There are actually five components in total, but it is Epsilon Hydrae A and Epsilon Hydrae B that are of interest. Epsilon Hydrae A is a yellow magnitude 3.4 star and Epsilon Hydrae C a blue magnitude 6.7 star. They are separated by slightly over 2 arcseconds, and when combined with the sharp difference in brightness, this closeness makes them difficult to split when viewed through small aperture telescopes.

**SAO 131063 (Omicron-2 Eridani, 40 Eridani)**

At magnitude 4.4, the orange star 40 Eridani A is the brightest star in a very interesting triple star system. It is a main sequence star a little smaller and cooler than our Sun, but like the Sun, it’s a metal-rich star, implying that any planets that orbit it would likely be rich in the different chemicals required for life to evolve. The other two members of the system are 40 Eridani B, a magnitude 9.5 white dwarf and 40 Eridani C, a magnitude 11 red dwarf.

40 Eridani A is bright enough to be seen with the naked eye, but 40 Eridani B and C can only be seen with a telescope. Small telescopes will show the two companions as a single star; apertures upwards of 200 mm are needed to resolve them. 40 Eridani
B was the first white dwarf to be discovered and remains the easiest one in the sky for backyard astronomers to see.

This triple-star system is not just pleasant to look at; it’s interesting to think about, too. In the Star Trek universe, 40 Eridani A is the star about which the planet Vulcan orbits, home of the redoubtable Mr. Spock. Although astronomers haven’t yet found any Earth-like (terrestrial) planets orbiting 40 Eridani A, they have established that this star has a habitable zone within which such a planet might orbit. They’ve also established that 40 Eridani A is about 4 billion years old, a trifle younger than our own Sun, but still plenty of time for complex life, perhaps even intelligent life, to have evolved.

But is there life on 40 Eridani A? No one knows at the moment, but suffice it to say that 40 Eridani A is one of the ten targets for the proposed Terrestrial Planet Finder mission.

Since 40 Eridani A is part of a triple-star system, what might Vulcans see if they looked up at their skies? Would they see three suns instead of just one? No; 40 Eridani A would look like our Sun, but the other two stars would simply be very bright stars, brighter than Venus, but still point sources of light rather than discs. 40 Eridani B would, of course, be white, while 40 Eridani C would be red. Moreover, although these two stars would sometimes be visible during the day, they wouldn’t provide appreciable amounts of heat or light, so they wouldn’t be altering the weather or climate.

The constellation of Eridanus is relatively southerly, but even at far northern locations 40 Eridani shouldn’t be too difficult to see. For observers in southern England it gets to about 30° above the horizon, high enough for it to be seen from anywhere that isn’t too built up.

**SAO 131907 (Beta Orionis, Rigel)**

Rigel is a very bright (magnitude 0.2) supergiant star with 17 times the mass of the Sun and around 50,000 times its luminosity. Its sheer brilliance makes spotting its magnitude 6.8 companion rather tricky. Although the companion star is a respectable 9.5 arcseconds from the primary, Rigel is a tough split for medium aperture telescopes.

**SAO 132314 (The Trapezium)**

The Trapezium is a favorite wintertime target. Although often listed as a multiple-star system, Theta-1 Orionis C, the Trapezium is actually a small star cluster. The cluster contains at least eight stars, with four of them being bright enough to spot with small telescopes, and two more visible through medium to large aperture telescopes.

The four bright stars are components A, B, C, and D. These are white stars at magnitudes 6.7, 8.1, 5.4, and 6.7, respectively. Note that components A and B are
both variable stars; A dims to magnitude 7.7 on a 65-day period, and B to magnitude 8.5 on a 6.5-day period. The four stars form a neat little quadrilateral shape, though more like a kite than a trapezium, with A at what would be top of the kite and D at the bottom.

Components E and F are both magnitude 10.0 stars and should be easily visible through medium aperture telescopes given favorable conditions. Component E is 4.5 arcseconds from A and F about the same distance from C.

SAO 132406 (Sigma Orionis)

Sigma Orionis is a famous five-star system with at least four stars that can be resolved with medium aperture telescopes. The brightest star (magnitude 3.7) is actually two very close stars, A and B, that can only be split with the very large aperture telescopes. The next brightest star is component E at magnitude 6.5 and 40 arcseconds from A/B. Component D is quite a bit fainter at magnitude 7.5, and 11.2 arcseconds away from A/B, nestling in between A/B and E. The faintest of the four resolvable stars is component C, a magnitude 10.3 star 11.3 arcseconds from A/B on the opposite side from D to E.

In the same field of view is the triple-star Struve 761, which you can slew to by locating SAO 132401 should you want to. The three stars in this system range in brightness from magnitude 7.9 to 8.7 and form a stretched triangle shape.
**SAO 133317 (Beta Monocerotis)**

Monoceras is a rather obscure constellation with only four stars above fourth magnitude and none above third magnitude, but the brightest of these stars, Beta Monocerotis, is a famous triple star. Indeed, some consider it to be the best triple star in the sky for amateurs using small and medium aperture telescopes.

![Diagram](image_url)

All three stars are essentially white in color, but one is noticeably brighter than the other two. The bright component is called Beta Monocerotis A, shines at magnitude 4.6, and is separated from the other two stars by about 7 arcseconds. Beta Monocerotis B and Beta Monocerotis C are separated by only 2.8 arcseconds and shine at magnitude 5.2 and 5.6, respectively. There is actually a fourth component almost half an arcminute away from Beta Monocerotis A, but it is too faint (magnitude 12.2) to be seen with the average amateur astronomer’s telescope.

**SAO 150058 (R Leporis, Hind’s Crimson Star)**

Hind’s Crimson Star is, as its name suggests, remarkably red. Like many other blood-red stars it is a carbon star, a type of late stage giant star with a lot of carbon (as well as other heavy elements) in its atmosphere. In common with other carbon stars it is also a long-period variable star, changing in brightness from magnitude 5.5 down to 11.7 across a (somewhat irregular) period of roughly 430 days. Surprisingly, perhaps,
most observers find that its reddish coloration is most apparent when it is at its
dimmest.

**SAO 150239 (Kappa Leporis)**

Kappa Leporis consists of two blue–white stars, a magnitude 4.5 primary and a mag-
nitude 7.4 secondary, the two stars separated by 2.6 arcseconds. This double star is
considered a stiff challenge for small aperture telescopes, but should be easily split
by medium to large aperture instruments.

**SAO 151881 (Sirius, Alpha Canis Majoris)**

Sirius is famous for being the brightest star in the sky (other than the Sun, of course).
It is obviously blue–white today, but the influential Greek astronomer Ptolemy
described it as being red, alongside other unambiguously red stars such as Antares
and Betelgeuse. It’s a bit of a mystery why he did so. One explanation is that he
was viewing Sirius low down in the sky, and so its light was refracted by dust in
the air and thereby appeared reddish. But that explanation isn’t terribly satisfying.
Ptolemy seems to have judged the colors of other stars very reliably. Since Ptolemy
observed Sirius only 1,850 years ago, it doesn’t seem likely that Sirius has substan-
tially changed, either.

Sirius is a double star, but the small companion star, a white dwarf known as
Sirius B, is so faint compared with its primary that it cannot be seen through most
telescopes. Sirius B was deduced initially through the observations of the German
astronomer Friedrich Bessel, who noticed that the proper motion of Sirius across
the sky wasn’t quite as it should have been. Essentially, it wasn’t moving smoothly
along a straight line, but wobbling ever so slightly. Bessel deduced that this was likely
caused by the gravitational pull of an unseen companion. Bessel himself never saw
the companion, and it would be almost 20 years before professional astronomers
were able to observe it.

**SAO 156110 (U Hydræ)**

This is a strikingly red carbon star. It is a variable star as well, its brightness chang-
ing from 4.7 to 5.2 usually across 450 days but with some irregularity. This star has
recently been photographed in the far infrared by the Japanese AKARI space tele-
scope, and this revealed the presence of clouds of dust around the star. Seemingly this
dying star is throwing out this material into interstellar space. The heavy elements in
this stuff (i.e., the elements other than hydrogen and helium) will ultimately become
the clouds of dust from which new stars are born, and things like carbon and nitro-
gen in particular will be crucial to the formation of complex chemicals and, perhaps,
even life itself.
SAO 172676 (Epsilon Canis Majoris, Adhara)

At magnitude 1.5 this is the second brightest star in Canis Major. Although Sirius is much brighter from our vantage point on Earth, this is actually misleading. Of the two stars, Adhara is intrinsically by far the brighter. Astronomers describe intrinsic brightness by calculating how bright a given star would appear when viewed from a distance of 10 parsecs (about 32.6 light years). This is known as the absolute magnitude. For Sirius, this would be magnitude 1.4, and for Adhara, magnitude –4.1. Sirius seems so bright because it is very nearby, a mere 8.6 light years away, whereas Adhara is 430 light years away.

Stars move, of course, in what astronomers call their proper motion, but in most cases it takes thousands of years for changes in their relative positions to become obvious. But Adhara is interesting in this regard because it was once very much closer to Earth than it is today. If you were an astronomer viewing this star 5 million years ago, it would have shone at magnitude 3.99 because it was only 34 light years away. Beta Canis Majoris would also have been extremely bright and for the same reasons, only 37 million light years away and shining at magnitude –3.65. In both cases, these are comparable to the brightness of the planet Venus.

Adhara is of significance to professional astronomers as one of the strongest sources of ultraviolet in the sky. Amateur astronomers will be more interested in spotting its faint companion, a magnitude 7.5 star about 161 arcseconds from the primary. On paper the two stars sound like an easy split, but in practice it is much more difficult because the secondary is often overwhelmed by glare from the primary. Adhara is consequently a tough split for small to medium aperture telescopes, though some have split the two stars with as little as 75 mm telescopes.

SAO 198752 (Zeta Puppis)

Zeta Puppis is the hottest and bluest naked-eye star. It has a surface temperature of 40,000°C. At magnitude 2.2 it is a fairly bright star and easy to spot, but its southerly declination makes it difficult to see even at mid-northern locations. At far northern locations such as southern England it never rises above the horizon.
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