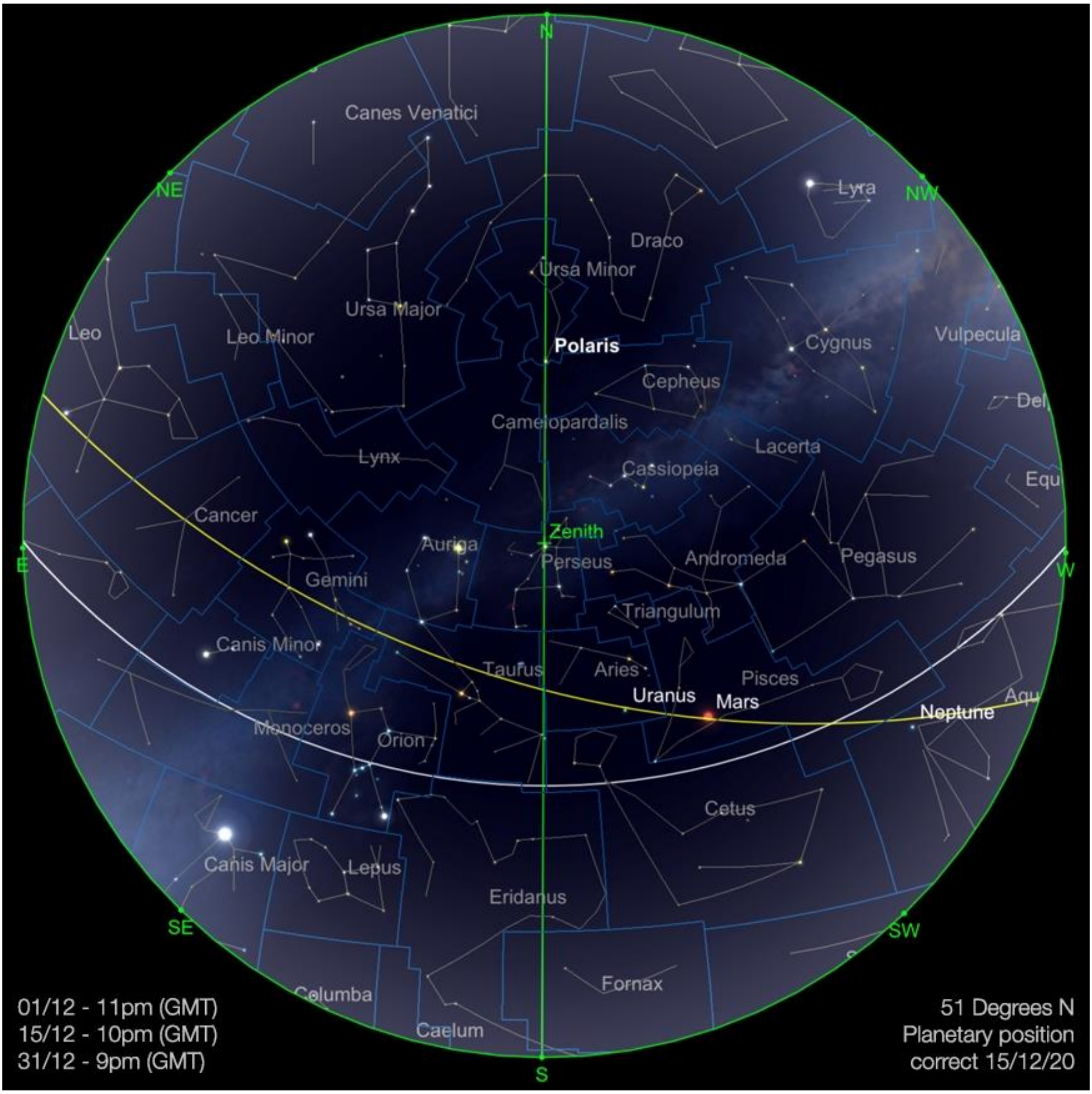

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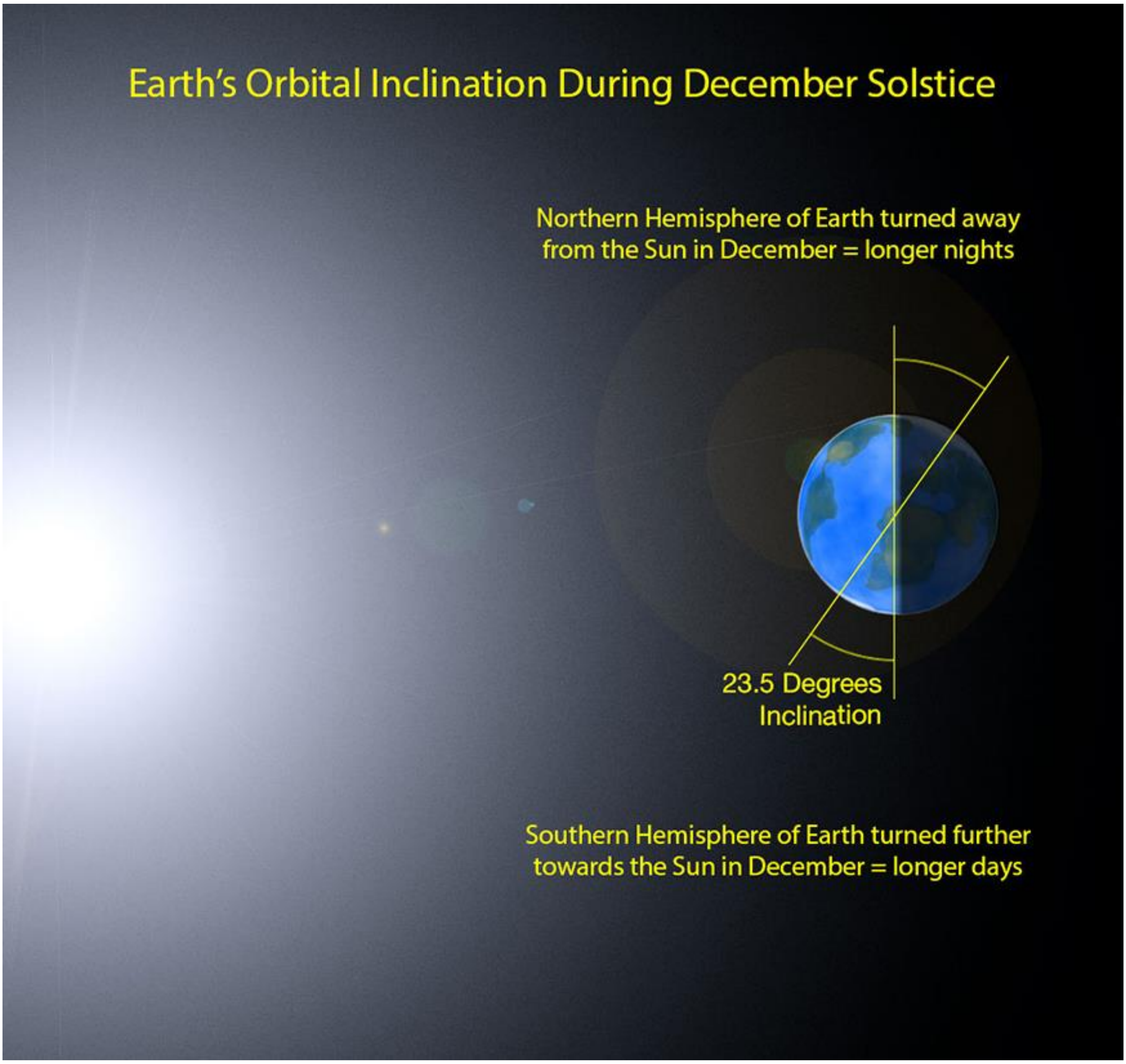
This month ushers in Midwinter for those in the northern hemisphere - and Midsummer for those readers in the Earth's southern climes. The Sun reaches the most southerly part of the ecliptic in the sky on 21st December 2020 at 13.30 GMT. At this point of the year for readers around the 51 degree N latitude, the Sun will be just 15 degrees above the horizon at the highest point of transit in the south. The more northerly you are, the smaller the Sun's altitude at transit point will be. For those at the Arctic Circle, the Sun won't rise at all. Those above the Arctic Circle will be already experiencing total darkness for days or even weeks surrounding the Winter Solstice. No matter where you are in the northern hemisphere, this day will be the shortest of the year and the night the longest. This is caused by the Earth's 23.5 degree polar inclination from its orbital plane - the major cause of the seasonal nature of our planet's weather.



The Earth at the Winter Solstice. Image Credit: Kerin Smith

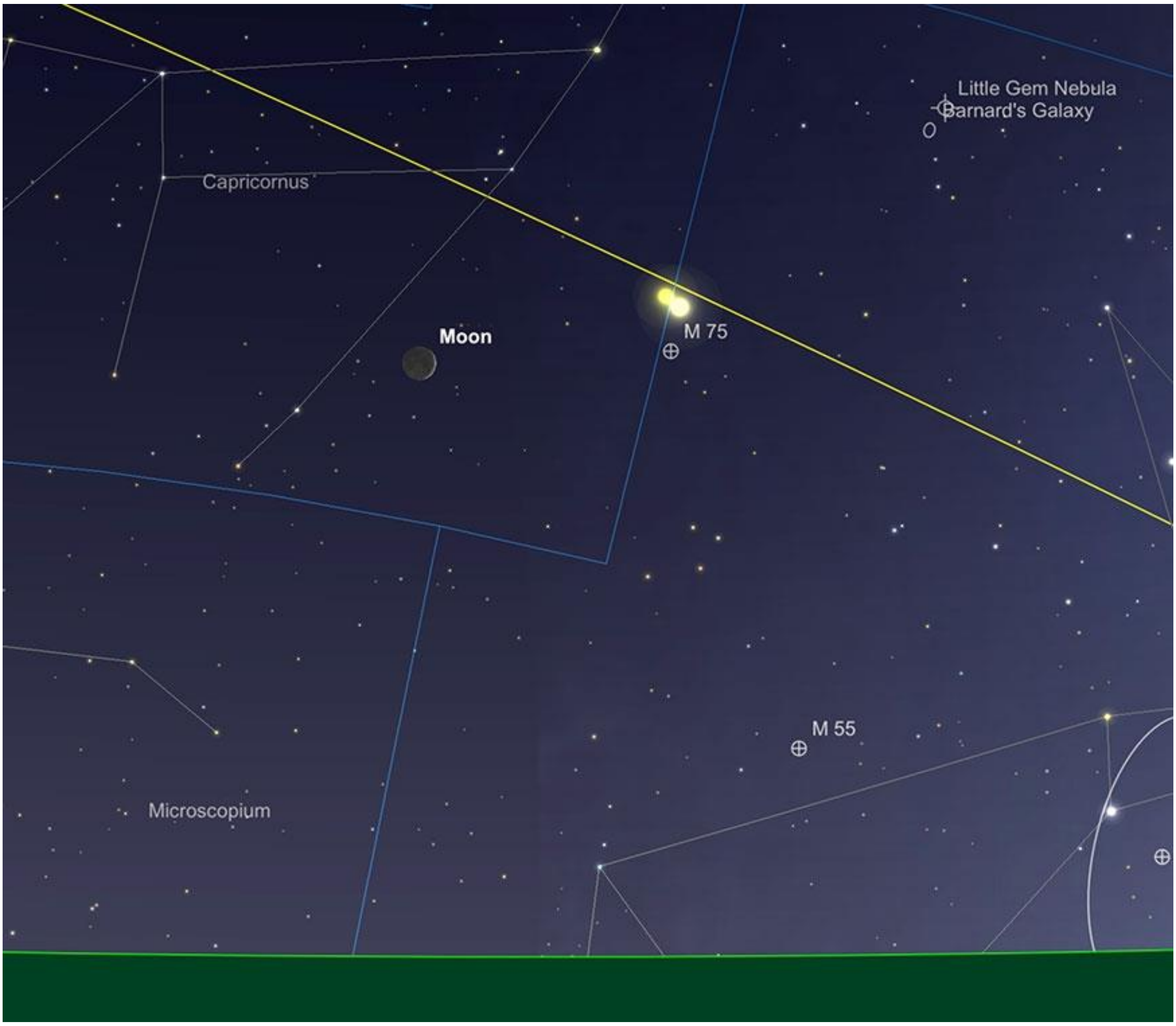
Conversely, those in the southern hemisphere will experience the longest day of the year, the shortest night and the very height of Summer on the 21st December. Wherever you find yourself at this time of the year, we wish all you the very best, whatever season you're experiencing. As usual, if you turn your eyes, binoculars and telescopes skyward, there's lots to see…

The Solar System

The Moon

The Moon begins December just past Full phase in Taurus. High in the sky from the northern hemisphere, this recent Full Moon is not the most northerly of the winter months, as late December's Full Moon in Gemini will be slightly higher in the Ecliptic.

Last Quarter occurs on the 8th, with the Moon in Leo. As the Full Moon appears in the very northerly part of the Ecliptic, common sense suggests that New Moon will occur in the most southerly part of the solar system's plane. This will happen on the 14th with the Moon in the non-Zodiacal constellation of Ophiuchus. The Moon will pass to the south of the Sun, before starting the climb up the "evening" side of the Ecliptic, passing the planets Jupiter and Saturn on the evenings of the 16th and 17th on the Sagittarius/Capricornus borders.



The Moon, Jupiter and Saturn, sunset, 17th December. Image created with SkySafari 5 for Mac OS X, ©2010-2016 Simulation Curriculum Corp., skysafariastronomy.com.

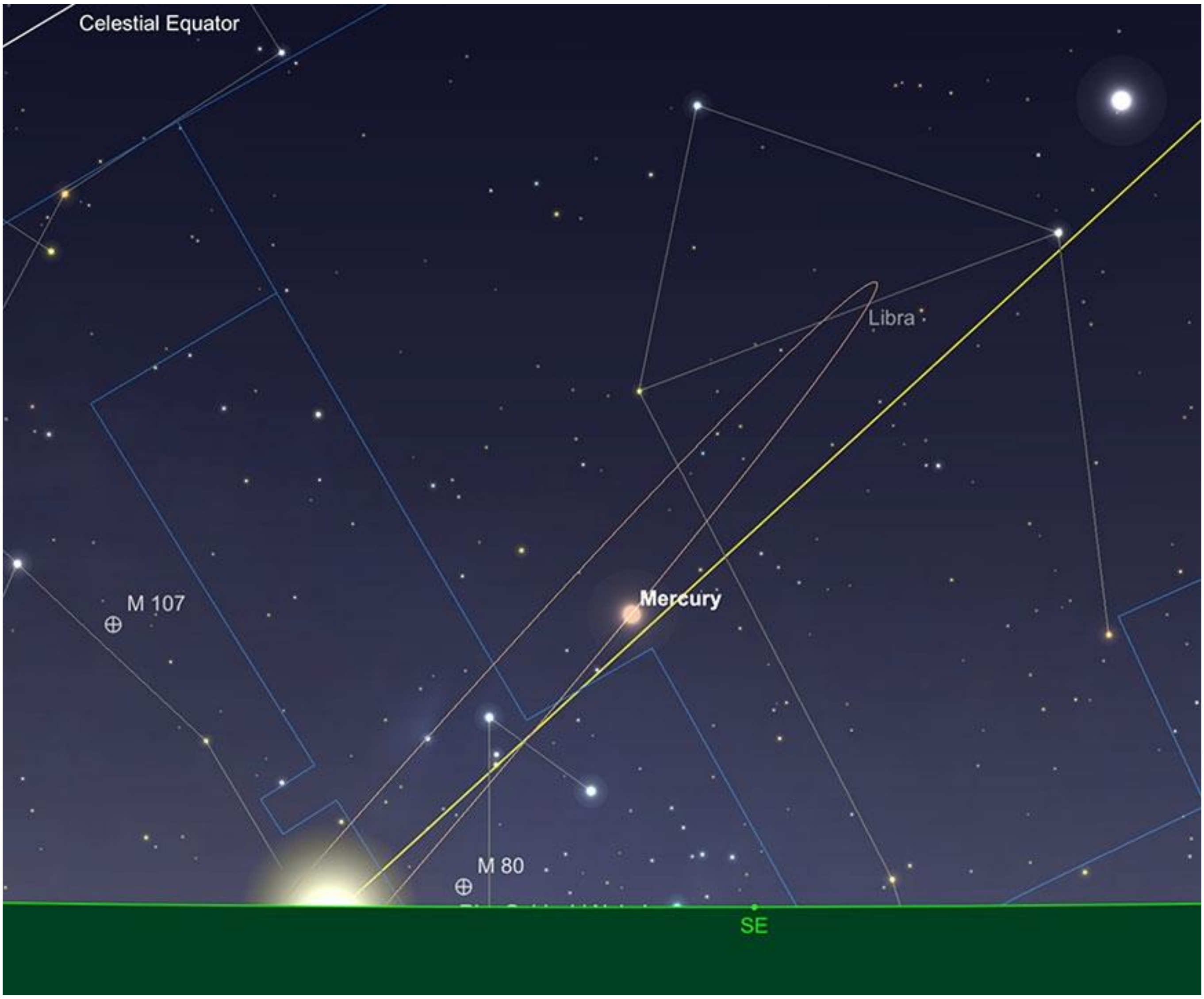
First Quarter is reached on the 21st. Two days later, the Gibbous 9-day-old Moon passes 5 1/2 degrees to the south of the planet Mars in Pisces.

As previous reported, Full Moon occurs on the 30th, making this (and the beginning of the month) not the best time for observations of deep sky objects, or astrophotography (without narrowband filtration).

The Moon ends the year in the western reaches of Gemini.

Mercury

The solar system's smallest true planet starts the month as a morning object in Libra. Sitting around 7 degrees high (from 51 degrees N), Mercury is -0.7 magnitude in brightness on the 1st, presenting a 5 arc second diameter 98% illuminated disk. The planet is separated from the Sun by just under 11 degrees, making it difficult, but not impossible to spot at the month's beginning.



Mercury, surise, 1st December. Image created with SkySafari 5 for Mac OS X, ©2010-2016 Simulation Curriculum Corp., skysafariastronomy.com.

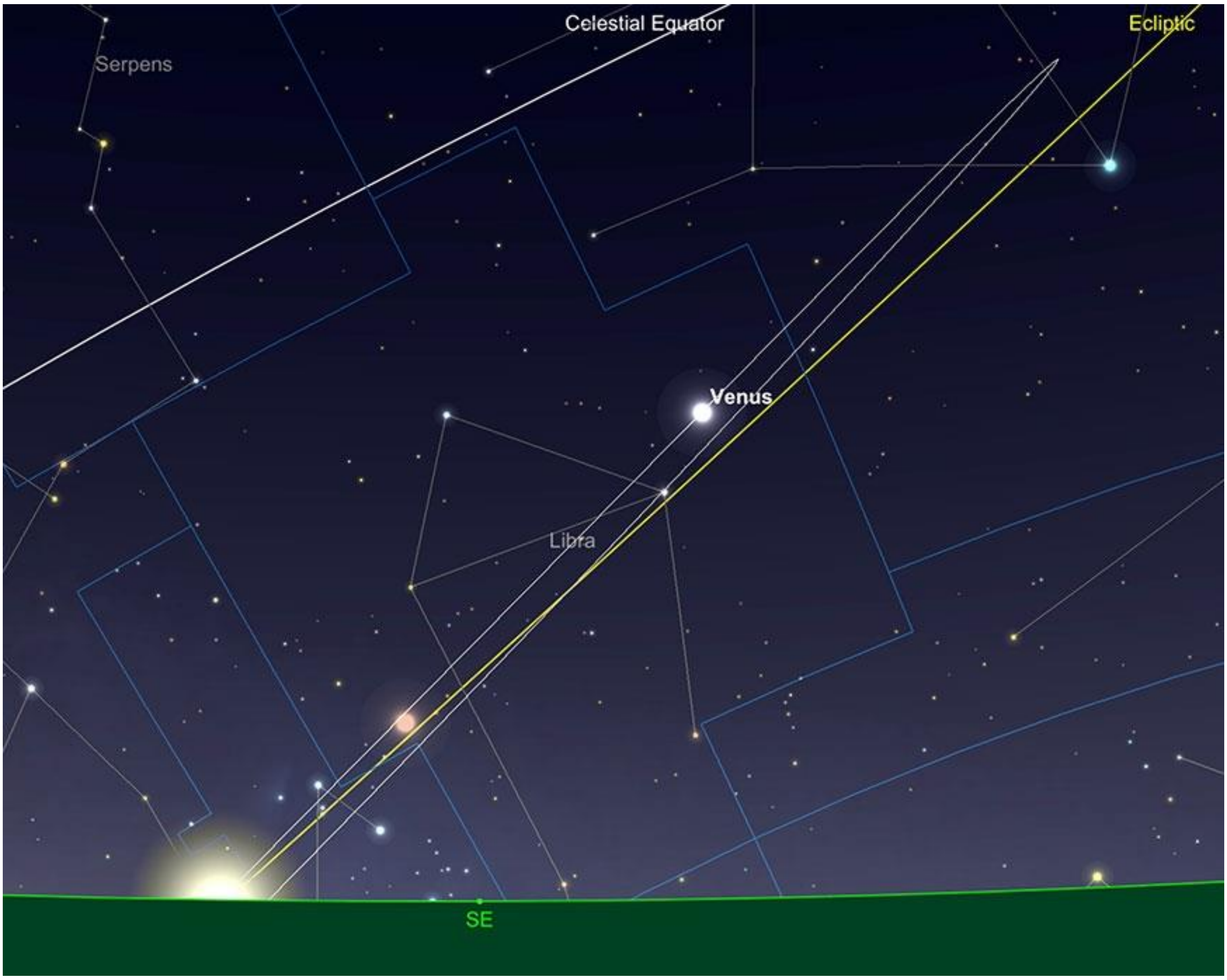
As usual for an object that orbits the Sun every 88 days, nothing stays static as far as Mercury in concerned. The planet is headed back towards the Sun from our perspective here on Earth, moving round behind our parent star. The planet reaches Superior Conjunction on the 19th and will not be observable until it re-emerges on the evening side of the Sun, at a reasonable separation.

At the month's end, Mercury can be found at 7 degrees separation from the Sun, shining at -1.0 mag. However it will be the second week of January 2021 before Mercury is visible in the evenings from temperate northern locations.

Venus

Venus is found in Libra at the month's beginning. At Gibbous Phase and -4.0 mag, the planet is its usual brilliant self, far brighter than anything in the same area of sky (bar the Sun itself). The planet is sinking sunward at a reasonably sedate pace and it will still be some time (March 2021) before it reaches Superior Conjunction. But due to the complex arrangement of the plane of the horizon, to that of the plane of the Ecliptic, Venus will appear to sink quite rapidly sunward from mid-northern latitudes.

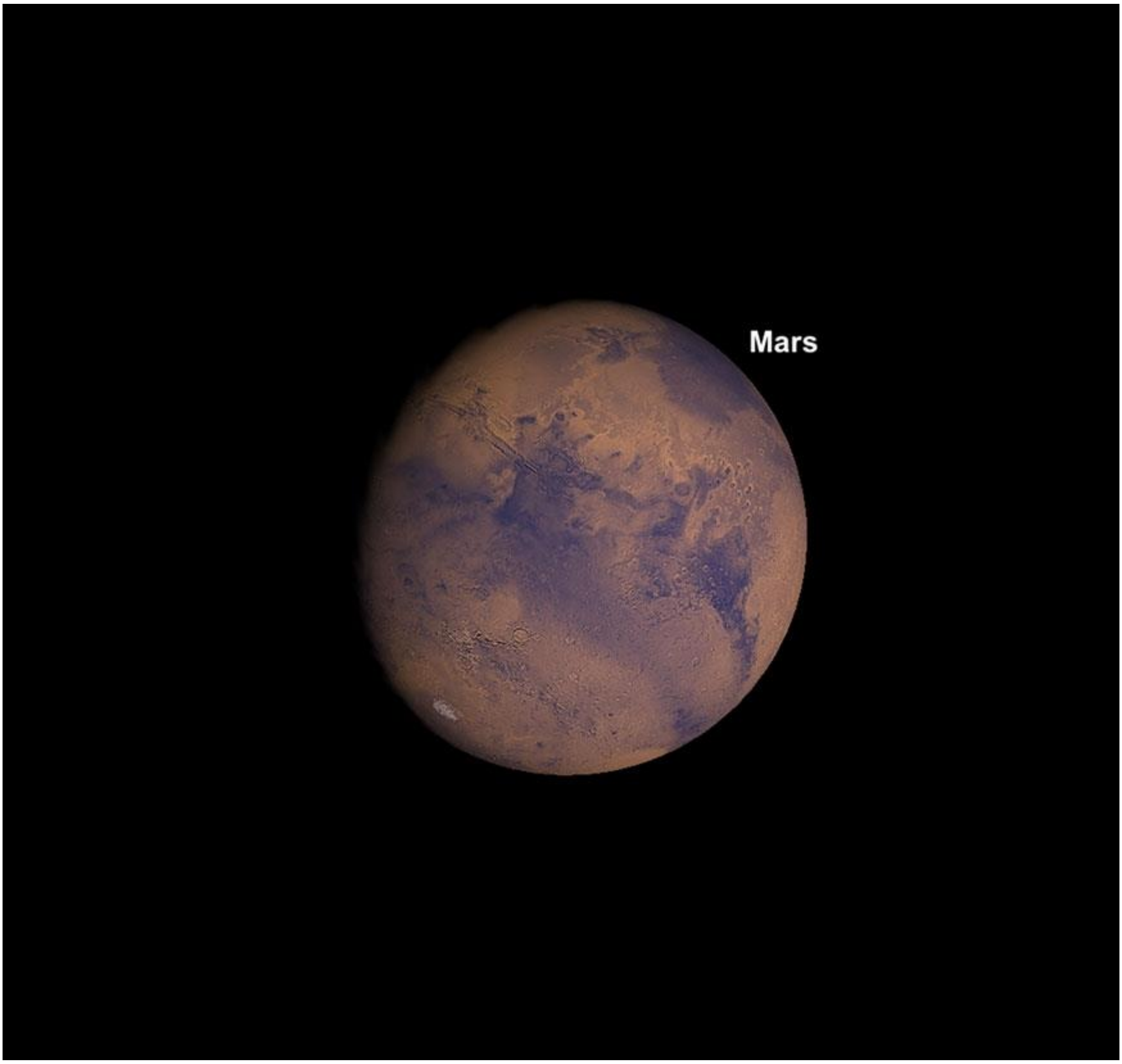
Venus stands 18 3/4 degrees high (from 51 degrees N), on the morning of the 1st, separated from the Sun by 27 1/2 degrees.



Venus, sunrise, 1st December. Image created with SkySafari 5 for Mac OS X, ©2010-2016 Simulation Curriculum Corp., skysafariastronomy.com.

As December progresses, Venus remains at the same brightness and doesn't change significantly in phase. By mid-month, Venus stands just over 14 degrees high (again, from 51 degrees N) at sunrise. This decreases to just under 10 degrees elevation at the month's end, by which point, the planet will have faded imperceivably to -3.9 magnitude.

Mars
Mars remains well-placed for evening observations in Pisces. Transiting at just after 8.30pm, Mars is 14 1/2 arc seconds across and is -1.1 magnitude on the 1st.



Mars at Transit, 1st December. Image created with SkySafari 5 for Mac OS X, ©2010-2016 Simulation Curriculum Corp., skysafariastronomy.com.

As Mars is a comparatively small planet in relation to the Earth, once we begin to pull away from it on our faster interior orbit, the planet's disk appears to shrink quite rapidly. Subsequently, the earlier Mars is observed during December, the better.

By mid-month, Mars has shrunk to a 12.4 arc second diameter target, shining at -0.7 magnitude. The planet is still at a very reasonable height from the horizon at transit point - just over 48 degrees (from 51 degrees N).

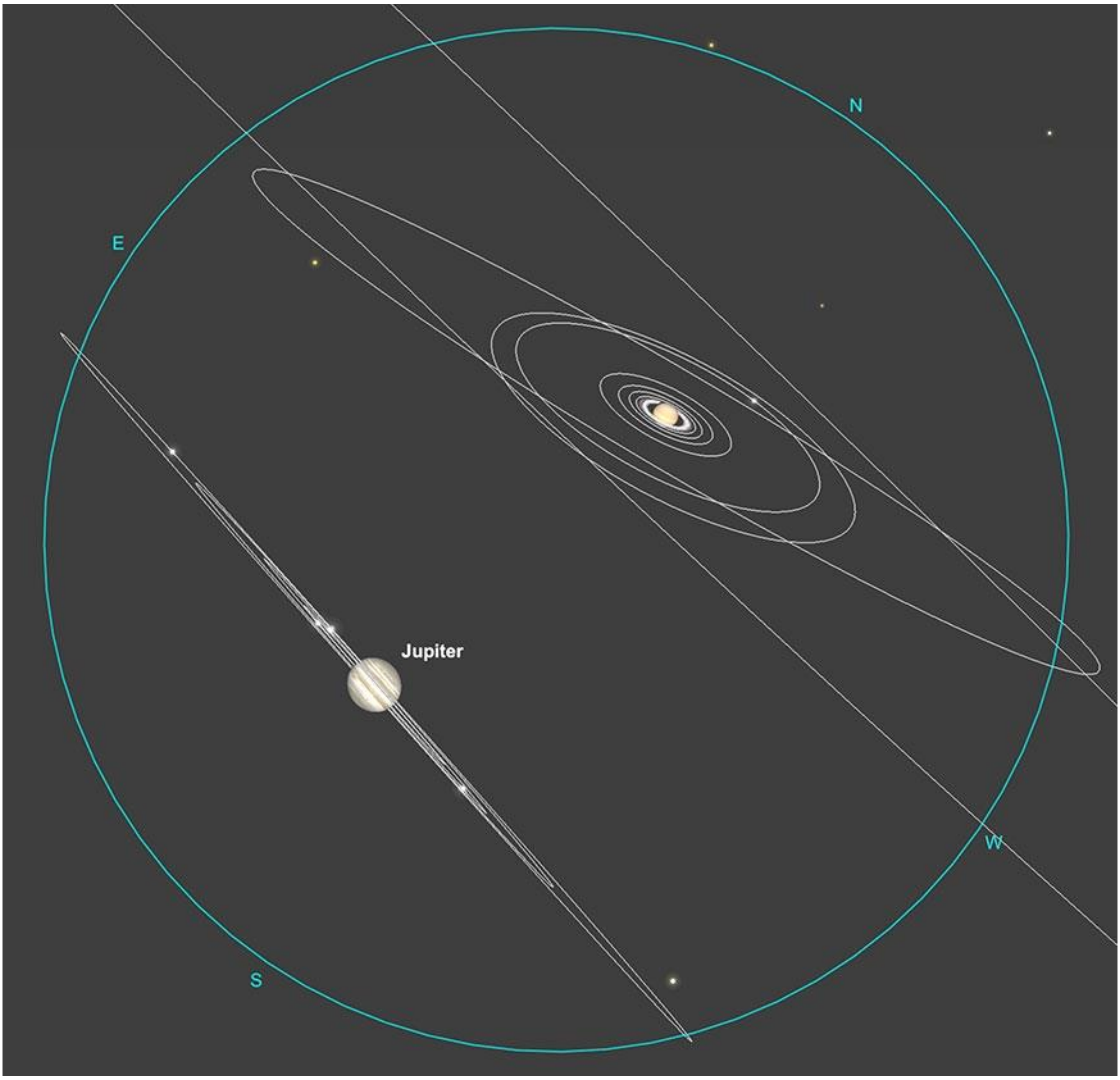
By the end of the year, Mars will present a 10.4 arc second disk. By this point, the planet will be -0.2 mag brightness. Mars will still be worth observing for a little while to come, but the later in the month it is observed, the less impact it will have.

Jupiter
The Solar System's largest planet begins December in Sagittarius. There's a limited window for early evening observations available at the month's beginning, but as we'll see, this closes as the month progresses. At -2.0 mag and 34.4 arc second diameter on the 1st, Jupiter sets a little over three hours after the Sun, which it is separated from by just over 46 degrees.

Jupiter is very close to neighbouring Saturn on the 1st, with the distance between each other being just over 2 degrees. This separation will decrease as the month progresses, with the two planets finally appearing to meet in the sky on the evening of the 21st. While conjunctions between planets are not rare events, this is a very close one, with the two bodies being separated by just 6 arc minutes. Indeed, this is the closest conjunction between Jupiter and Saturn since July 16th and 17th 1623. The last closest conjunction of Jupiter and Saturn in living memory was that of 18th February 1961, where the two planets were just under a quarter of a degree at closest point.

Jupiter and Saturn appear to merge, sunset, 21st December. Image created with SkySafari 5 for Mac OS X, ©2010-2016 Simulation Curriculum Corp., skysafariastronomy.com.

At closest approach to each other, both planets will be visible at significant magnification in a single telescopic field of view, which will be something to experience. This also presents a fantastic imaging opportunity. If you catch this event photographically, please send us your results - we'd love to see them.



Jupiter and Saturn in a simulated telescopic view at 190x magnification. Image created with SkySafari 5 for Mac OS X, ©2010-2016 Simulation Curriculum Corp., skysafariastronomy.com.

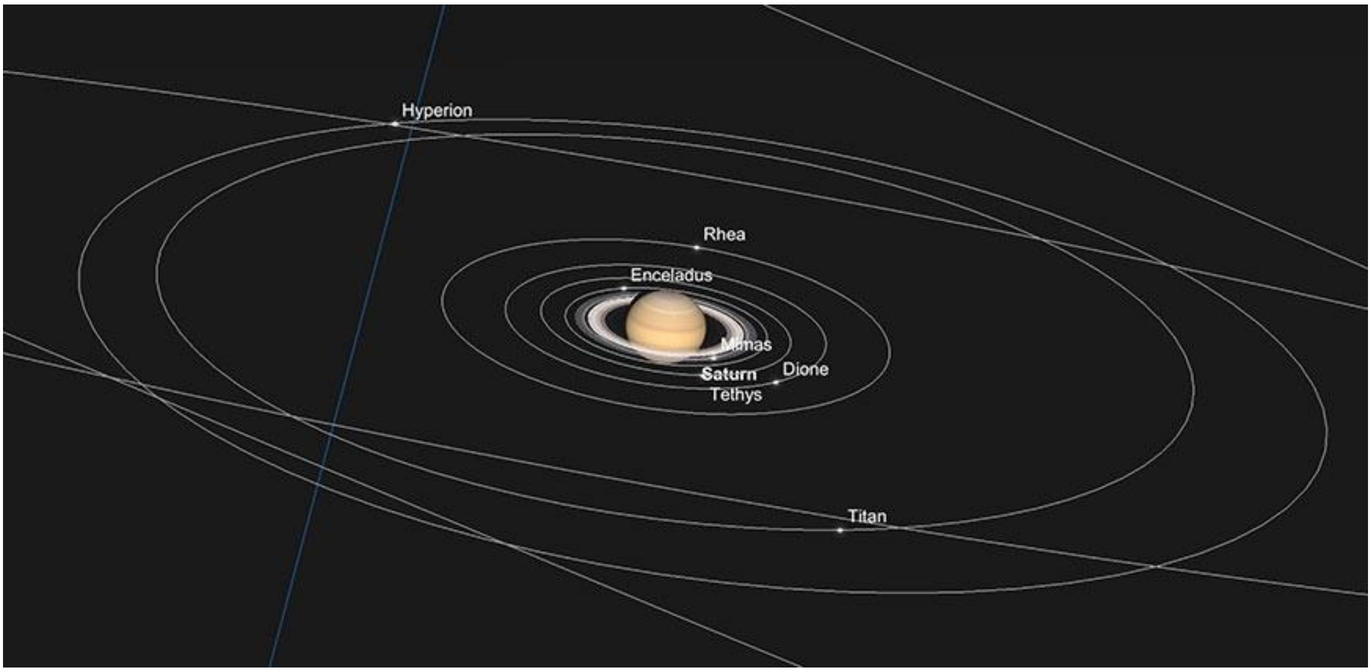
On the evening of the conjunction, Jupiter will stand just under 15 degrees high in altitude as the Sun sets. Both Jupiter and Saturn will set a little over two hours after the Sun, so the window for observing this conjunction at its closest is short. You will need a reasonably clear southwesterly horizon to give yourself the best chance of seeing the event. We wish you the best of luck with the weather, which as ever will be the principal variable we have to deal with.

Beyond this event, those with telescopes can look forward to a few early evening Jovian events. There's a Europa Transit visible from Europe on the evening on the 2nd, followed by and Io and Io Shadow Transit on the evening on the 4th. There's a mutual Great Red Spot and Ganymede Transit on the evening of the 7th. There's a Callisto Transit on the evening of the 23rd, followed by a triple GRS, Io and Europa Transit event on the evening of the 27th.

Jupiter, GRS, Io, Europa and Europa Shadow Transit, early evening, 27th December. Image created with SkySafari 5 for Mac OS X, ©2010-2016 Simulation Curriculum Corp., skysafariastronomy.com.

Jupiter ends the year in Capricornus (having crossed over the border from Sagittarius on the 18th), still at -2.0 magnitude and displaying a 33 arc second diameter disk. It will set just under two hours after the Sun (from 51 degrees N).

Saturn
As previous mentioned, the big news this month as far as Saturn is concerned is the very close conjunction with Jupiter on the 21st.



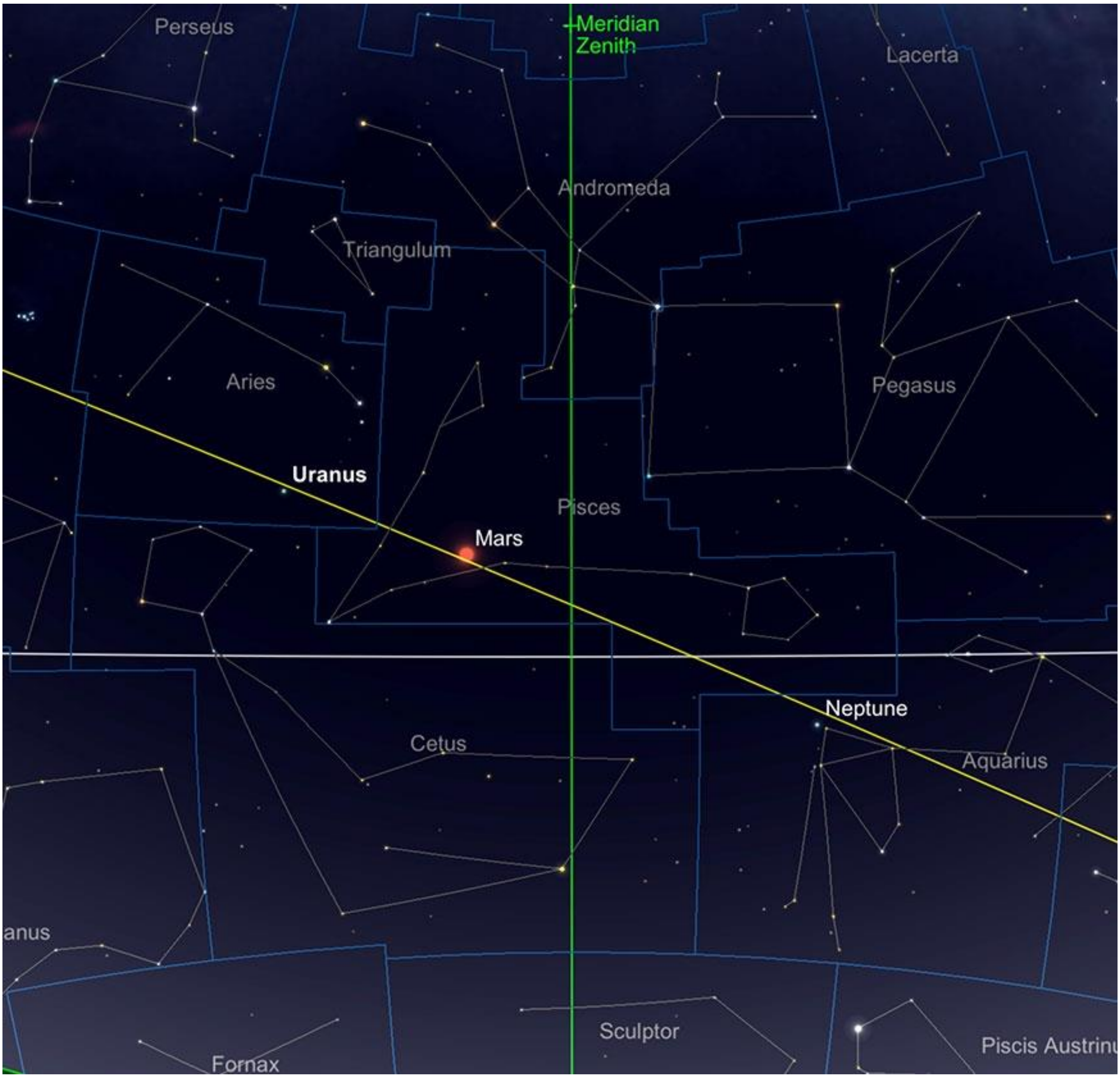
Saturn and Inner Moons, December 1st. Image created with SkySafari 5 for Mac OS X, ©2010-2016 Simulation Curriculum Corp., skysafariastronomy.com.

Saturn starts December further east in the Ecliptic than Jupiter, setting only slightly later at 7.45pm (GMT) on the 1st. At +0.6 mag and 15.7 arc seconds diameter, the planet is significantly fainter than its planetary neighbour, but arguably no less interesting to observe in a telescope.

By the month's end, the window for Saturnian observations, just like that of Jupiter, is closing. On the 31st, Saturn sets just over two hours after the Sun. The planet stands just under 12 degrees high at sundown, making it a trick target for meaningful high power observing, when the vagaries of the atmosphere's negative influence is factored in. From this point on, though Saturn will still technically be visible in the evening sky for a little while into 2021, with Superior Conjunction occurring on the 24th January, Saturn's evening apparition is effectively over.

Uranus and Neptune

The two outer gas giants continue to be well-placed for evening observations. The fainter Neptune is further west within the Ecliptic than Uranus and as such rises and sets earlier. At the beginning of December, Neptune is a +7.9 magnitude, 2.3 arc second diameter target in Aquarius. The planet transits a little after 6.45pm (GMT) on the 1st and sets at just before 12.30am the following morning.



Uranus and Neptune relative positions, December 2020. Image created with SkySafari 5 for Mac OS X, ©2010-2016 Simulation Curriculum Corp., skysafariastronomy.com.

Uranus will be easier to find at +5.7 mag and presenting a 3.7 arc second diameter disk. The planet transits at a little before 10pm (GMT), setting around 5 hours later. Higher up in the sky than its neighbour, Uranus will reach a maximum separation from the horizon of just under 53 degrees (from 51 degrees N).

Given a suitably dark sky, it is technically possible to find Uranus with the naked eye. However, we would always recommend the use of binoculars or a telescope under less than ideal conditions. Neptune by contrast always requires optical assistance to find and positively identify.

Comets

At present, comet 2020 M3 ATLAS is our best hope for cometary observations during December. Having reached perihelion on 25th October, the comet started November in Lepus and tracked north through Orion and into Taurus at the month's end. At December's beginning it is found in Taurus, making the passage into Auriga on the 4th and will continue to track northwards through the constellation throughout December, ending the month around 3/4 of a degree from Capella (the third brightest star in the sky's northern hemisphere). Passing through this readily identifiable constellation should (in theory) make this comet relatively easy to find. However it is relatively faint, being only +8.5 mag at time of writing and possibly much fainter come December. Subsequently, this means this comet is the preserve of those with telescopes and larger binoculars only.

Comet 2020 M3 Atlas path through December 2020 (comet position shown for 1st Dcember). Image created with SkySafari 5 for Mac OS X, ©2010-2016 Simulation Curriculum Corp., skysafariastronomy.com.

Meteors

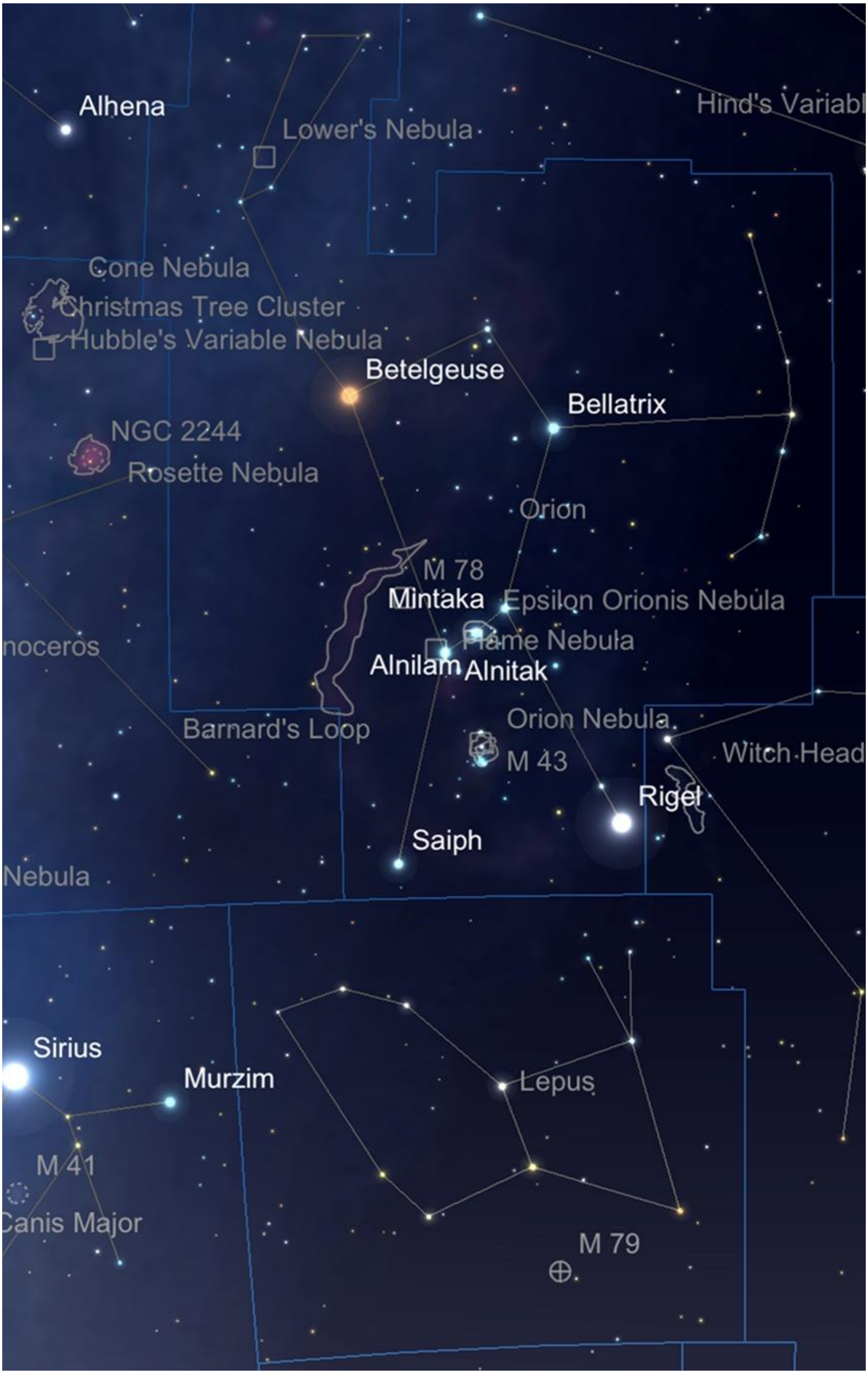
The annual spectacle of the Geminid Meteors, which peak in the night of the 13th-14th December, neatly coincides with a New Moon this year, giving us the best chance to see them. Peaking at anything up to 100 meteors per hours (not all of which will be visible from any given location), the Geminids are arguably the most reliable shower of the year, fed by the mysterious "rock comet" asteroid 3200 Phaethon. The shower is expected to be visible from 4th/5th to the 17th December this year.

The Geminids radiate from an area inside the constellation of Gemini and are usually very well seen from the northern hemisphere. 2020 is a best case scenario in terms of the influence of moonlight and presents great opportunities for astrophotographic record - all you need is a solidly mounted camera, capable of timed exposures, with a reasonably wide field lens. Once set up - even in a fairly light polluted environment - you will be unlucky not to capture a couple of brighter meteors, given an hour-or-so's multiple exposures. The brightest of the Geminids will cut through even the worst influence of light pollution.

A Geminid Meteor through cloud. Image credit: Kerin Smith.

Deep Sky Delights in Orion and Lepus

Last month, we covered two well-known winter constellations, Taurus and neighbouring Auriga, which are home to some of the best-known of this season's deep sky treasures. Almost inevitably, at this time of year, we must cover with the spectacular constellation of Orion. As a constellation, it is perhaps the the most instantaneously recognisable of all those in the sky. It is home to many deep sky wonders, so it won't surprise many readers that we practically we should start with one of the most recognisable of astronomical targets: the Orion Nebula complex - M42, M43 and the outlying NGCs 1973, 1975 and 1977. This remarkable set of objects are the most prominent part of the larger Orion Molecular Cloud, a huge collection of clouds of gas and material that were we to be able to see it all, would take up almost the entirely of the constellation.



Alhena
Lower's Nebula
Hind's Variabl
Cone Nebula
Christmas Tree Cluster
Hubble's Variable Nebula
Betelgeuse
Bellatrix
NGC 2244
Rosette Nebula
Orion
M 78
Mintaka
Epsilon Orionis Nebula
noceros
Flame Nebula
Alnilam
Alnitak
Barnard's Loop
Orion Nebula
M 43
Witch Head
Rigel
Saiph
Nebula
Sirius
Murzim
Lepus
M 41
Canis Major
M 79

Orion and Lepus. Image created with SkySafari 5 for Mac OS X, ©2010-2016 Simulation Curriculum Corp., skysafariastronomy.com.

M42, the brightest part of the complex and the best know is visible to the naked eye as a misty patch in the "Sword Handle" of Orion, a patch of sky hanging below the three stars in Orion's belt: Alnitak, Alnilam and Mintaka (Zeta, Epslion and Delta, respectively). At +4.00 mag, the Orion Nebula is the brightest of all the nebulous regions in the sky and can be easily seen well in binoculars and small telescopes. It has a huge area of 85 arc minutes x 60 arc minutes and has a heart-shaped void, amidst two "wings" flying out to either side. This void is often described as resembling a fish mouth, in which nestle the compact cluster of stars, the Trapezium. This cluster was first described by Galileo in 1610, who mysteriously neglected to mention the huge amount of nebulosity surrounding them! The Trapezium stars are very young and are formed out of the nebulosity that surrounds them. Four of these stars, A ,B, C and D are easily resolved with all manner of instruments. The fainter E and F stars are more of a challenge and can be used to test seeing conditions and the resolving power of optics. The A and B stars of the Trapezium are both eclipsing binary stars: A drops in magnitude every 65 days as an unseen companion, most likely a nascent star or large brown dwarf eclipses it; whereas B drops by a magnitude every 6.5 days as it is eclipsed by a star the size of our Sun. Confusingly B is a double double or quadruple star system. Many of the large amount of stars seen around the M42/Trapezium area are also members of this central star cluster. In all there are thought to be 400 stars in close proximity which have been born from the interior of the Nebula. As large globules of superheated gas have been observed within the confines of M42, active star formation is still very much ongoing. The "Fish Mouth" feature is thought to be caused by the young stars pushing away gas and dust with their solar wind.

M42, M43 and the Running Man. Image Credit: Mark Blundell

Adjacent to M42 is M43, a very bright globular-shaped ball of gas and dust of +9 mag., which is separated from M42 by a large dust lane. This nebula, though not as prominent as M42, is easy in small telescopes and has its own associated small cluster of stars imbedded within it. Larger telescopes of 8-inch+ will show much of the dark striation of the border lane with M42. This nebula was first identified by Jean-Jaques Dortous de Marian in 1731. It lies around 1400 light years from us.

To the north of both M42 and M43 lies the complex and beautiful reflection nebulae of NGC 1973, 1975 and 1977. Otherwise known are The Running Man Nebula, due to the impression of a running stick figure which is easily visible in long duration photographs of the area. This feature is much less easily seen visually as filtration rarely aids visual observation. With a large scope and good skies, it is possible to see the striation of the running figure with averted vision, but it is a challenge. The nebulosity of this area is clear enough with a medium-sized scope. However, the distance to this collection of objects is disputed. Many sources list it as part of the Orion complex at around 1500 light years away, though others put them at a closer 650 light years away.

Moving NE of the M42/43 and Running Man Complex, we come to the most easterly star in Orion's belt, Alnitak, Zeta Orionis. This star is flanked by two well known, beautiful, but challenging nebulae - NGC 2024, the Flame Nebula and the IC434/Barnard 33 the famous Horsehead Nebula.

Of the two, the Flame Nebula is technically the fainter at +10.0 mag and is about half a degree by half a degree (30 arc minutes) in area. With a small scope and less than optimal skies, it is a challenge, but with an 8-10-inch class scope and a UHC filter, this nebula can be quite easily observed from a reasonable location and photographs well too. It does, both visually and photographically, resemble the shape, if not the exact hue of a flame. Photographically NGC2024 can appear as a yellowy-brown nebula, though some more detailed images do reveal a pinkish tinge too. The Flame is an emission nebula and its glow is caused by the Ultraviolet radiation of nearby Alnitak exciting the Hydrogen gas of the Flame and stripping electrons from their atomic bonds. These electrons then combine with ionised Hydrogen which causes a glow. William Herschel is credited with the discovery of The Flame in 1786. Again, sources differ as to the Flame's distance from Earth, some put it some 1400 light years away, while others put it at a more modest 750-850 light years away - roughly the same as Alnitak.

The Flame and Horsehead Nebulae. Image Credit: Mark Blundell

The Flame's neighbour, the Horsehead Nebula, is one of the most stunning objects in the sky, yet one of the most challenging to observe well. Lying under half a degree to the west of Alnitak, it is really two objects - the backdrop is the +7.30 mag emission nebula IC434, which is nearly a degree long yet only around 10 arc minutes wide, against which lies the dark lane nebula Barnard 33. This is the famous Horsehead silhouette, know form countless images and a perennial target for astrophotographers. Visually however, observation of the Horsehead requires aperture, a really dark sky and/or proper filtration. Observers have reported seeing the Horsehead feature against IC434 with medium aperture telescopes, though these have tended to be from a very dark location. The Hydrogen Beta filter is the best aid to any attempt to observe the Horsehead with any telescope, as it is one of the relatively few objects that really responds well to the wavelength. Experienced observers have reported observations in smaller scopes, but this must be down to exceptional conditions. Those with 12-inch+ telescopes, the H-Beta filter and reasonable skies stand a good chance of locating it.

A little further to the north of Alnitak and the Flame Nebula lurks an often overlooked, but very interesting object - or series of objects - M78. Discovered by Pierre Mechain in 1780, this reflection nebula is a group of objects (NgCs 2065, 2067 and 2071), clustered around two minor 10th magnitude stars. The light from these stars reflected from the nebula is the reason we can see this part of the Orion Molecular Cloud. M78 isn't as bright as its illustrious neighbours, but can be relatively easily observed with a reasonable-sized telescope. M78's visual magnitude is about +8.3 and its area is about 8x6 arc minutes. Interesting internal structure is visible in large telescopes and in images - though it's a trick object to catch as most of the nebulosity is so dark.

M78. Image Credit: Mark Blundell

More challenging still - and by far the largest of the nebulous objects in the Orion area - is Barnard's Loop or Sharpless 2-276. Reputedly (though rather controversially) discovered and described by William Herschel in the 1786 - he mentions faint nebulosity in the area of Barnard's Loop - it is E. E. Barnard who in 1896 photographically definitively discovered this large, expansive and extremely illusive nebula, which is an amazing 14 degrees arc at its widest point. Though technically listed as being a +10 mag object, it is so diffuse that it seems almost impossible to see from all but the darkest areas on Earth. Yet some observers have even reported seeing it without the aid of a telescope. Rigging up "goggles" of two H-Beta filters appears to be an inventive way of attempting observations of this kind, as does binoculars with these filters attached to the objectives. Telescopically, one has a greater chance of seeing some of the brighter parts of Barnard's Loop, but dark skies are of paramount importance whatever the method used. The rule is: if you don't have them - don't bother!

Barnard's loop shows up very well in long-duration ultra-widefield astrophotography, but again, this will require very good sky conditions, patience and multiple, stacked exposures to get the nebula to stand out from the sky background.

Barnard's Loop. Image Credit: Hunter Wilson, Creative Commons

It is thought that Barnard's Loop is a supernova remnant that has been expanded by further supernovae and subsequent star forming over many millions of years, forming a "bubble" of gas, part of which is visible as the loop. This awe-inspiring piece of stellar architecture is thought to be around 300 light years in diameter and lie around 1600 light years from our Solar System.

Lepus, the constellation representing the Hare, sits to the south of Orion and is much less spectacular to the naked eye. From light polluted environments it is often difficult to see at all. The only major object of interest in this particular constellation is M79. This object is an unusual globular cluster, situated so far from the usual "Halo" of globulars which surround the centre of our Milky Way galaxy. It could well be an inherited object from the adjacent Canis Minor dwarf galaxy, a satellite of our Milky Way which is located not too far away from this point in the sky. M79 is a fine globular of +7.73 mag and 1.3 arc minutes diameter. Discovered by Pierre Mechain - Messier's fellow in observation and responsible for many discoveries in the Messier list - in 1780 and added to Messier's list in the same year, this globular can easily be resolved into stars in a medium-sized 6-8 inch telescope. Lying some 40,000 light years hence, M79 is a reasonably tricky object to observe from a northern hemispherical perspective as it rises a mere 14 degrees high at transit point from latitude 51 degrees N. It is better seen by readers in the southern hemisphere, who will have to battle considerably less with atmospherics to resolve individual members. Still, compared to the likes of the Messier globulars in southern Ophiuchius, Scorpius and Sagittarius, M79 is best seen during the evening in the northern hemisphere at a time of the year when the atmosphere tends to be steadier and more settled. Due to its location in the sky, M79 is better imaged by astrophotographers in more southerly climes - though observers worldwide are encouraged to seek it out.

M79. Image Credit: Siding Spring Observatory, Public Domain.

Text: Kerin Smith