

Bernadette Brady – Brief notes on The Milky Way

In *Meteorology*, Aristotle (384 BC—322 BC) described the milky way as always unchanged and among the same constellations and is one of the great circles which is made up of a fiery band of hot cosmic material which gathers in this region.¹ While Aratus (ca. 315 BC—240BC) waxed about its ability on a moonless night to bring a person to being 'awestruck beneath a sky-dividing belt embossed with brightness'. Aratus sees the Milky Way as another of the great circles and wrote that 'This belt outshines the other four. Though two match its diameter, [the equator and the ecliptic] the other two [Tropic of Capricorn and Cancer] are smaller.'²

The Milky Way, the galaxy to which our solar system belongs is a visible cloud of white or darkness that divides the night sky roughly into two hemispheres. The centre of the galaxy is located in the constellation Sagittarius, the brightest part of the Milky Way, and its anticenter is in Auriga, the charioteer. As a great circle, it is inclined about 60° to the ecliptic and touches around thirty constellations. Its path through the constellations travel past Orion and then onward to the Argo, the great ship in the south. From the Argo it moves north through the tail of Scorpio and cuts the ecliptic in the constellation Sagittarius. From there it continues north to move through Ophiuchus, Cygnus and Aquila touching Cassiopeia and Cepheus. From Cepheus it moves back towards the south and cuts through Auriga, down past the horns of Taurus and cuts the ecliptic at the feet of the constellation Gemini just above the club of Orion. Because of this high inclination, depending on the time of night and year, the arc of the Milky Way may appear relatively low or relatively high in the sky. For observers from approximately 65 degrees north to 65 degrees south the Milky Way will be seen to pass through the zenith at night (Fig. 1)

¹ Aristotle, *Meteorology*, trans J.L.Stocks,(Princeton, NJ: Princeton University Press, 1984), pp. Bk 1, 345a 345-335.

² Aratus, *Phaenomena*, trans Aaron Poochigian,(Baltimore, USA: John Hopkins University Press, 2010), pp. 490 - 499.

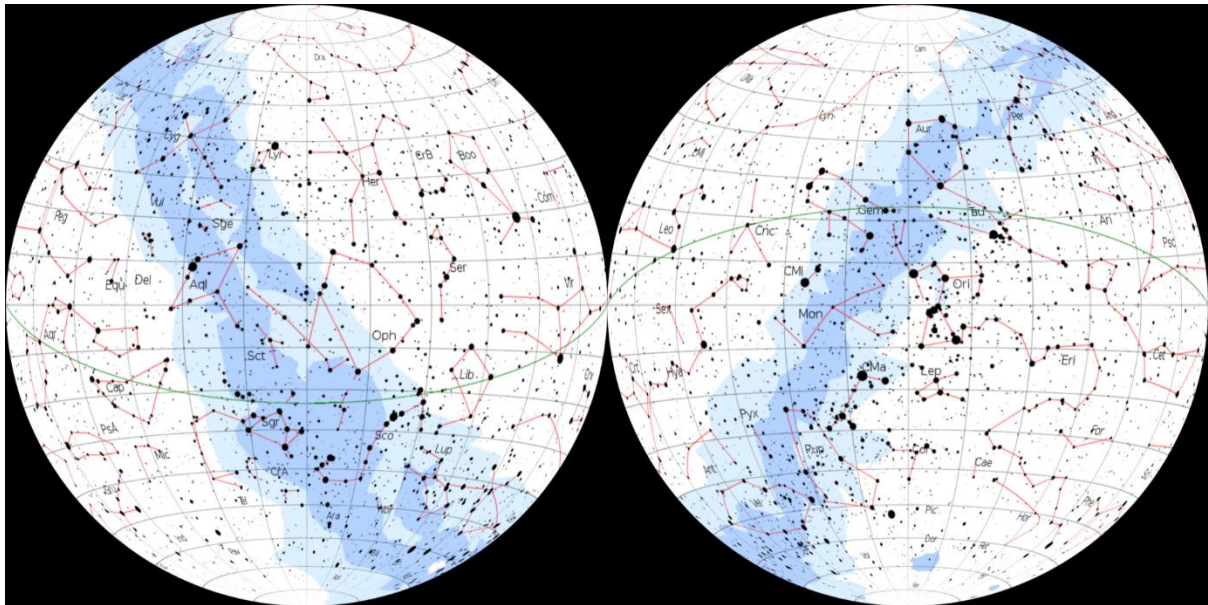


Figure 1 – The Milky Way stretches from declination 65° South to 65° North. It crosses the ecliptic at the feet of Gemini and the horns of Taurus and at the stars of Sagittarius and the tail of Scorpio. Image Wikimedia Commons.

In the night sky the whole band of the Milky Way will, like all of the stars, orbit around the pole. Thus, visually the effect is of an 'off-centred' circle moving from one side of the pole to the other, a little like spinning a hoop on one's arm, sometimes it will be above the arm, to the side and also underneath. Consequently, its range of rising or setting azimuths it will embrace a wide arc along the horizon covering the rising points of a declination range of 130° . For example, Figure 2 is a consideration of the movement of the Milky Way for a latitude of 30° North following the movement of Alderamin in Cepheus. As Alderamin begins to rise (0 hours Fig. 2) then the Milky Way is seen to be lying flat along the horizon from the north east, around azimuth 354° , to the south west around azimuth 165° . Six hours later the Milky Way will be rising higher in the sky still rising in the north east but now the setting place has moved westerly. Twelve hours after Alderamin had risen the Milky Way is now rising around due East and still moving westerly with it point of setting. Finally, eighteen hours after Alderamin has risen the Milky way is now rising in the south east and setting close to due west.

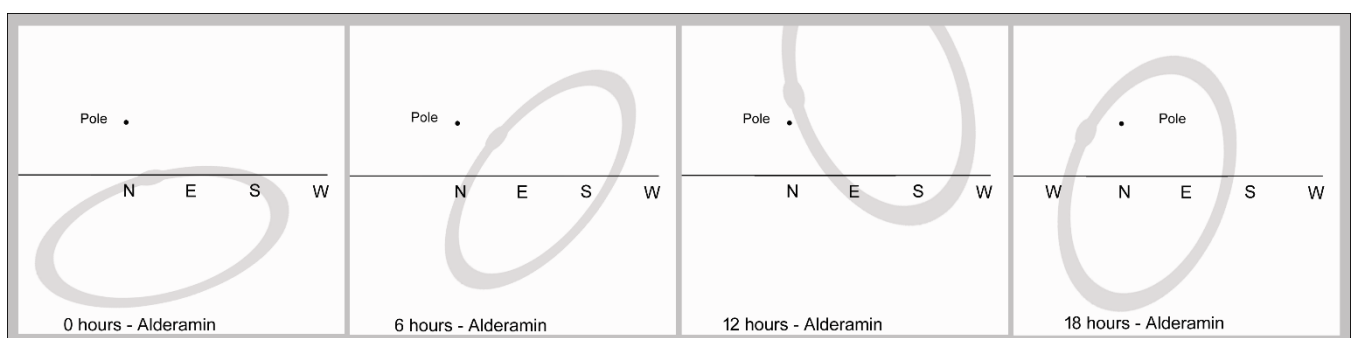


Figure 2 – The cycle of the Milky Way (grey ellipse) for a latitude of 30° North using the star Alderamin, indicated as the smaller circle on band of the Milky Way, through twenty-four hours.

What part of this cycle would be visible at any given night is seasonal and thus subject to procession. However regardless of the epoch, in the northern hemisphere if it is night when Alderamin is low on the horizon then the Milky Way will be seen low and flooding the line of the horizon for it runs through Cassiopeia and Cepheus. In the southern hemisphere, the horizon is flooded with the Milky Way when Centaurus is low on the horizon.

Apart from the visual appearance of the horizon being flooded with the Milky Way lying upon it, the other interesting visual that it provides with the horizon is when it stands and points directly upright into the sky. For a given latitude the stars rising or the stars setting that offer this visual will be consistent. For example, at a latitude of 30° North when the stars around Canis Major are rising, such as Sirius, Procyon, Betelgeuse, then the Milky Way will be at roughly 90° to the horizon. While when Cygnus is setting with its bright star Deneb the Milky Way will be seen 'standing' on the western horizon. Thus the Milky Way can both lie upon the horizon painting it with white light or it can 'stand' bolt upright rising out of the horizon 90° into the night sky.

However, the Milky Way is not a homogeneous band and therefore in working with its appearance for any time and place it is better to think of the Milky Way as a series of long narrow 'constellations' with different visual appearances that will engage with a landscape in a consistent manner. In the first century CE, Claudius Ptolemy recorded his observations of the Milky Way, providing an insight as to its level of visibility at that time. In the *Almagest*, he introduced the Milky Way by stating that 'with our observations of each of its [the Milky Way] sections we shall try to describe the form which the individual parts appear to take.'³ He then plotted the Milky Way against the stars, defining what stars were in the milk and what were left out in writing about what is now known to be the galactic centre Ptolemy writes, 'the northern part of the milk encloses the three joints before the sting of Scorpius... while the southern rim touches the star in the right front hock of Sagittarius'.⁴ While plotting its course he also wrote of the gaps, the Dark Rift, while noting the level of intensity of the milk. In returning to the centre of the galaxy, Ptolemy describes the milk as 'very dense indeed and appears smoky.' While in other places as in the area around Argo he describes the milk as 'somewhat rarefied'.⁵

Using Ptolemy's first century observations the Milky Way can be broken into the following sections

³ Claudius Ptolemy, *Ptolemy's Almagest*, trans G.J. Toomer, (New Jersey, USA: Princeton University Press, 1998), p. VIII 2. H170.

⁴ Ptolemy, *Ptolemy's Almagest*, p. BK VIII 2. H172.

⁵ Ptolemy, *Ptolemy's Almagest*, p. BK VIII 2. H170 - H179.

Constellations Starting from the most southerly	Stars in or close to the area of the Milky Way.	Ptolemy's Visual description	Section
Through legs of Centaurus	Agena and Toliman. Acrux in the Southern Cross,	Rather less dense and less bright than the rest.	Centaurus to Ara - light
In the area of Ara		Rather less dense	
The tail of Scorpio and the stars in the bow of Sagittarius	Aculeus and Acumen, near Antares	Very dense indeed, appears smoky.	Scorpio to Sagittarius – very dense, smoky
Serpens		Less dense	
Aquila	Altair	Dense	
Sagitta		Less dense	
Cygnus	Deneb Adige	Slightly denser moving to much denser.	Cygnus, over the pole to Perseus, very dense
Cepheus	Alderamin	This section from Cygnus to Cepheus gets denser	
Cassiopeia	Schedar	The milk in the middle of Cassiopeia are dense	
Perseus	Algol	Very dense	
Auriga	Capella	Becoming less dense	Auriga to Gemini – dense
Gemini	Castor and Pollux	Certain amount of density through the legs of Gemini	
Between Canis Major and Orion	Sirius, Betelgeuse	Somewhat thinner	Canis Major to Argo – thinning out.
Argo – through the keel.	Canopus	Somewhat rarefied.	

These can be considered as:

- The Dark or Great Rift, this is the large bulging part of the Milky Way that looks like a dark lane or pathway that divides the Milky Way into two. It runs for about one third of the entire length of the Milky Way. In considering it from north to south, it begins with a clear visual split of two roughly parallel lines of the milky lines starting at the constellation Cygnus (Fig.1 Left). The western line runs through Aquila and the eastern line moves through Serpens near Ophiuchus. It then merges together in the bow of Sagittarius and the tail of Scorpio. From this point, as it passes over the legs of Centaurus it becomes a less well defined cloudy mass with black gaps and finally becoming a somewhat clear band around the area of the Southern Cross. The milky edges next to the Dark Rift are dense.
- The dense milky section without the Dark Rift starts north of Cygnus and moves onwards to Cepheus. At its most northern point as it runs through Cassiopeia, it then turns south and moves through Perseus and Auriga.
- The opaque or fainter band. This begins just after Auriga and runs from the feet of Gemini, through the area between Canis Major with its bright star Sirius, and Orion, touching on his club. From there it moves down to the keel of the Argo and then into

the legs of the Centaurus onto the stars of the Southern Cross where the density of the milk phenomena begins to increase as the Dark Rift begins.

Thus, for visual purposes, there are three sections. The spectacular Dark or Great Rift with its many colours and black inky shapes, the white milky section and the opaque or much fainter wash of white and these three sections will all have a unique relationship with a given location.

The yearly seasonal rhythm of these Milky Way horizon relationships will be influenced by precession. For example, at 40° North for 2000 BCE the Milky Way stood upright on the horizon just before dawn for the summer solstice. This may not have any significant but for any work which is considering stars in the landscape a consideration of the seasonal relationship the Milky Way makes to the horizon for any location can be considered. However, to the naked eye the Milky Way is not a clearly defined band cutting the line of the horizon at a particular azimuth and as a result the occurrence of the Milky Way is more likely to be found in mythology and theology rather than in material artefacts.

The Milky Way and Theology

It is in the work of Marcus Cicero (106 BC—43 BC) that mythology is recorded concerning the Milky Way where in the *Dream of Scipio* his departing soul travels towards the Milky Way as the place of residence of men's souls.⁶ In Scipio's dream he is told that those who defend their country have a 'special place prepared for them in the heavens, where they may enjoy an eternal life of happiness'.⁷ Scipio is told in the dream that man 'has been given a soul out of those eternal fires which you call stars and planets' (line XV) but after leading a good life that,

"Such a life is the road to the skies, to that gathering of those who have completed their earthly lives and been relieved of the body, and who live in yonder place which you now see" (it was the circle of light which blazed most brightly among the other fires), "and which you on earth, borrowing a Greek term, call the Milk Circle."⁸

The notion of the eternal fires is reflective of Aristotle's writings on the composition of the Milky Way cited earlier of being a fiery band of cosmic material. But later in the dream, Scipio asks about a noise that he is hearing and Africanus tells him it is the movement of the heavenly spheres, the planets and the stars, but because it is always present humanity has grown deaf to it. This notion is then explained by Africanus who states, 'We find a similar phenomenon where the Nile rushes down from those lofty mountains at the place called Catadupa'.⁹ This remark may not be as casual as it appears as it could be a passing acknowledgment to the Egyptian source of this cosmic theology of the souls and stars.

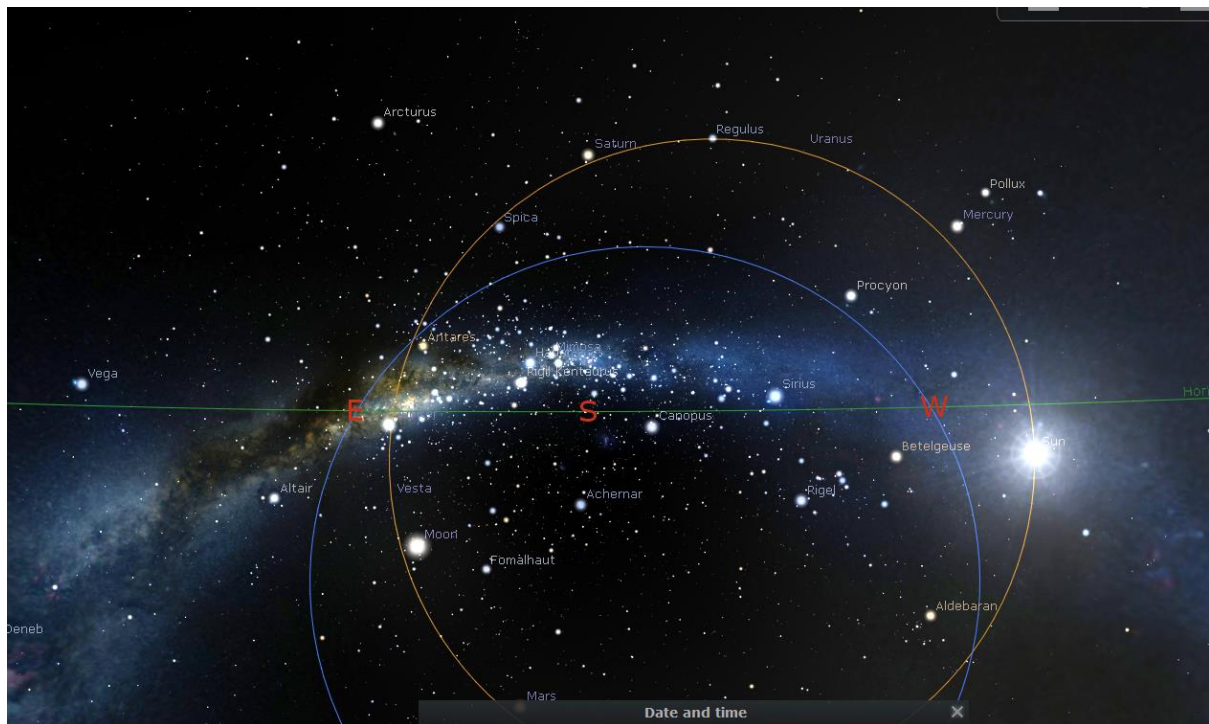
⁶ Marcus Tullius Cicero, *De Re Publica. De Legibus* trans Clinton Walker Keyes, (Harvard University Press, 1988), pp. BK VI, XVI.

⁷ Cicero, *De Re Publica. De Legibus* p. BK VI, IX, XIII.

⁸ Cicero, *De Re Publica. De Legibus* p. BK VI, IX, XV-XVI.

⁹ Cicero, *De Re Publica. De Legibus* p. BK VI, IX, XX.

Cairo, the Milky Way in the period of the Old Kingdom will rise from an azimuth in the north east 50° to that of 150° in the south-east.



The sky for Cairo 3000 BC, the AS of Sirius and the AR of Vega, as the Milky Way lies along the horizon. The Nurse Lake flooding?

Aratus, *Phaenomena*. trans. Aaron Pochigian (Baltimore, USA: John Hopkins University Press, 2010).

Aristotle, *Meteorology*. trans. J.L.Stocks. ed. by Jonathan Barnes, *The Complete Works of Aristotle* (Princeton, NJ: Princeton University Press, 1984), pp. 555 - 625.

Cicero, Marcus Tullius, *De Re Publica. De Legibus* trans. Clinton Walker Keyes (Harvard University Press, 1988).

Ptolemy, Claudius, *Ptolemy's Almagest*. trans. G.J. Toomer (New Jersey, USA: Princeton University Press, 1998).