STAR-PATHS, STONES AND HORIZON ASTRONOMY

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Archaeoastronomers tend to approach ancient monuments focusing on the landscape and the horizon calendar events of sun and moon and, due to problems with precession, generally ignore the movement of the stars. However, locating the position of solar calendar points on the horizon can have other uses apart from calendar and/or cosmological purposes. This paper firstly suggests that the stars do not need to be ignored. By considering the evidence of the *Phaenomena*, a sky poem by Aratus of Soli, a third century BC Greek poet, and his use of second millennia BC star lore fragments, this paper argues that the stars were a part of the knowledge of horizon astronomy. Aratus' poem implied that the horizon astronomy of the late Neolithic and Bronze Age periods included knowledge of star-paths or 'linear constellations' that were defined by particular horizon calendar events and other azimuths. Knowledge of such star-paths would have enabled navigation and orientation and by using permanent markers, constructed or natural, to define these paths, they were immune to precession as the stones could redefine a star-path for a future generation. Finally the paper presents other possible intentions behind the diverse orientation of passage tombs and some megalithic sites.

The epic star map poem *Phaenomena*, written by the Greek poet Aratus of Soli (315–240 BC), is now considered to be one of the earliest Greek works which described the heavens and the constellations, with the Mesopotamian MUL.APIN most likely being the oldest document dating from the period 1000 BC (Hunger and Pingree, 1999,58). Aratus' work was written as a poem and took the apparently unusual step of mirroring the style of Hesiod (c.750 BC), rather than following the style of Homer (argued to be c.850 BC) as other poets of his day had done (Kidd, 1981,356; Porter,1946). According to Howard Porter, Aratus may have taken this step to underline and enhance a divine inspirational theme: 'These are the lines of the poet speaking as prophet and seer. They set the mood for the whole song, a mood of antique, megalithic, simple piety…'(1946,158). Porter further suggests that Aratus' use of Hesiod's style with its 'deep religious feeling and mantic prose' may have been due to Aratus signalling his use of older pastoral and folk wisdom, weaving together 'subject matter, myth and proverb'(1946,158). This is in contrast to the Homeric style generally reserved for heroic epics. Douglas Kidd makes the same argument, that Aratus appears to be stressing that his poem was coming from an earlier age, referring to the 'earlier men, the astronomers, poets and mathematicians, from whom he drew the material for his poem. …the generations before Zeus'(1981,356).

Adding to this complex weave of sky, stars and mythic story drawn from antiquity, Aratus threaded his poem with acrostics. First noted in Aratus' work by J.M. Jacques (1960), an acrostic poem is one where the first letter of each line spells out a coded message or word. Aratus used this literary trick to encode his name within the text (Haslam, 1992,200) as well as other messages with which he animated the constellations he described (Danielewicz, 2005;de Callatay, 1996,2). Commenting on Aratus' acrostics Danielewiczs states:

> When the mythical past is evoked, the figures naturally regain (at least partially) the status of living beings. What is interesting in these passages is the possibility of the poet's looking at the terrestrial back-ground of the action in a similar way, i.e., with the intention of animating it. (2005,325).

Given that Aratus wrote in a Hesiodic style and used acrostics to add movement to the constellations, scholars concur that Aratus' poem draws on sky lore and folk wisdom from an earlier period in order to honour the idea of an animated and ensouled sky. Yet Aratus' poem is a mixture. S. Zhitomirsky (1999,483) points out that Aratus blended the older sky lore with the observational work of Eudoxus of Cnidus (c.408–355 BC). In the poem, however, Aratus makes no distinction between Eudoxus' astronomical observations and the older fragmented sky lore. It is no wonder, then, that a century later the Greek astronomer Hipparchus (190-120 BC) became so alarmed at the astronomical inaccuracies of some of Aratus' work that, in the face of its growing popularity, he wrote a treatise warning others of its errors (Sale, 1966,160). In so doing he confirmed that Aratus' sources came from both Eudoxus and fragments of other material (Zhitomirsky, 1999,490).

The poem itself consists of three parts: a description of the constellations, the paranatellonta of these constellations, and a set of weather/sky omens. Between the first and the second, Aratus described the band of stars that constituted the 'great circles': the Milky Way, the Tropic of Cancer, the of Capricorn and the Equator. He then traced each of these star-paths through the constellations. In describing the line of the Tropic of Cancer he wrote:

> Along it, both the Brothers' twin heads lie
> As do the two knees of the Charioteer.
> The left shoulder and leg of Perseus here
> Swing through the heavens. Set above the bend
> In Andromeda's right arm, beneath her hand
> (Nearer the north), above her elbow (bent
> Due south), its span transects the whole extent
> of her outreaching arm.
>
> The Bird's neck moves
> Along this ring behind the Horse's hooves
> And the Serpent-Holder's shoulders. …
> (2010,Lines 502-11)

The actual errors that Hipparchus criticised can been seen in Figure 1 which displays the Tropic of Cancer for the time of Eudoxus c.400 BC as well as for the periods of 1000, 2000 and 3000 BC. Aratus' poem states that the tropic passed through the heads of the Twins — the easily

recognisable stars of Castor and Pollux (the far left of figure 1). However, this was not the case when Eudoxus was making his observations, as can be seen in the top diagram in figure 1 when the tropic passed through the body of the twins marked by the star Wasat, δ Geminorum. Only in the period around 3000 BC, (bottom diagram of figure 1), did the Tropic of Cancer pass through the heads of the Twins. It was also in this period of around 3200 - 2500 BC that the tropic passed through the shoulders of the Serpent Holder (the far right of figure 1) marked by Claudius Ptolemy as the stars Celbalrai, β Ophiuchi and κ Ophiuchi.

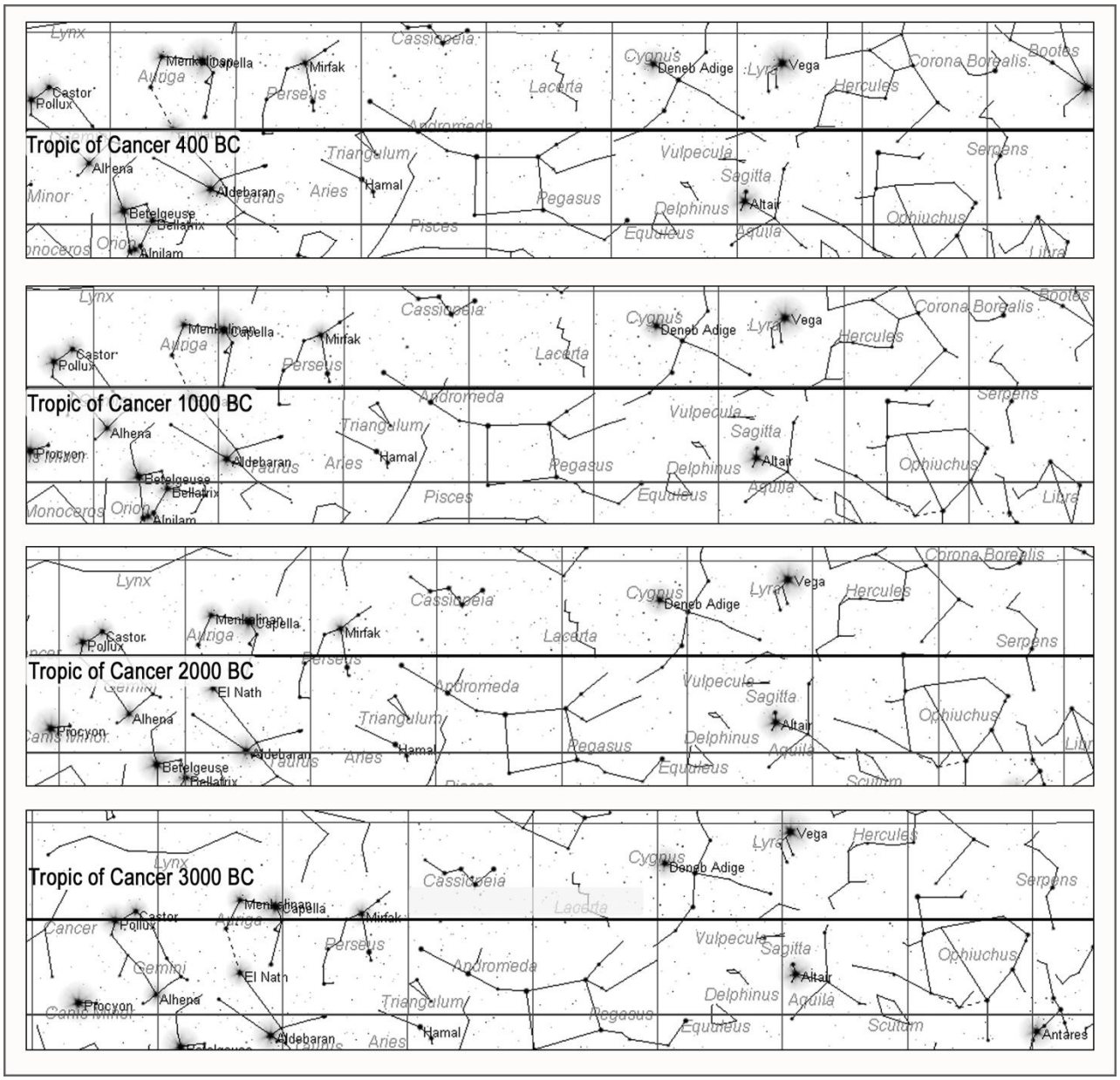

Figure 1 – Four views of the Tropic of Cancer, marked as the heavier line. The top view is for the time of Eudoxus at 400 BC. The other three views are, in descending order, for 1000, 2000, and 3000 BC.

The left shoulder and leg of Perseus (third column from the left in figure 1) in the area of the star ε Persei were crossed by the tropic in the period around 2000 – 1500 BC while also crossing 'Andromeda's right arm, beneath her hand', around the area of σ Andromedae, (Andromeda is found in the fourth column on the left in figure 1). The 'knees of the Charioteer' (second column from the left in figure 1, labelled Auriga) were only seen to be on the tropic for the period around 2500 – 1500 BC. Indeed in Eudoxus' time this tropic passed through the easily seen bright star El nath, β Tauri, at the tip of the horn of Taurus (second column from the left in figure 1). Based on such evidence, Crommellin (1923,644) made the assessment that Aratus' poem drew on observations from around 2460 BC. More recently, however, Zhitomirsky (1999,491-5) dated 31 positions described by Aratus in defining the Tropic of Cancer, Capricorn and the Equator and found that over half (16 of the 31)

were associated with time periods ranging from 3000 BC to 1000 BC. He based his calculations on a 5^0 margin of error applied to Ptolemy's constellations in order to allow for the possibility of variants in Aratus' constellations. Aratus' description of the location for the Tropic of Cancer suggests that astronomical accuracy was not his motivation in producing his poem. Sale (1966,161) argues that Aratus used his poem as a celebration of Stoic pantheism while Kidd (1981,356) suggests that the work was written primarily as a Hymn to Zeus.

With the poem's privileging of ancient sky lore over astronomical correctness, Aratus' work provides a unique legacy for archaeoastronomers. The poem infers that people in the late Neolithic and Bronze Age knew that the stars that rose at the same point on the horizon as the summer solstice sunrise included the heads of the Twins, as well as the bright shoulders of the Serpent Holder (if they were named as such at that time). It also implies that Neolithic and Bronze Age sky watchers saw groups of stars on pathways or lines which were defined by the horizon calendar events. Aratus' poem thus offers a small window into the sky lore of the late Neolithic through to the Bronze Age period.

There are at least two other bodies of evidence of this view of the sky. The first comes from the Babylonian *Enuma Anu Enlil* which identified three gods or sky entities (Hunger and Pingree, 1989,139). This text is thought to be dated between the eleventh and seventh centuries BC and described three gods, each being represented by a band of stars: Ea was god represented by the band of stars located in the southern sky, Anu's area of the sky was the band of the equator, and the god Enlil was represented by the band of stars in the north (Hunger and Pingree, 1999,50-1). Although it is not possible to make a direct correlation of these star-paths with those of the Tropic of Cancer, Capricorn and the Equator, the evidence that the Babylonian sky view consisted of bands of stars supports Aratus' work. This suggests that the Bronze Age view of the sky was not solely focused on horizon calendar events but also on bands of stars traced out across the night sky. Hunger and Pingree also point out that the Greek practice of horizon astronomy, of watching for the 'turnings of the Sun' from the Greek island of Syra, 'appears to be imitative of an earlier Mesopotamian practice' (1999,76-7).

Shifting to a very different time and culture, the second piece of evidence that also used the horizon to define bands of stars comes from the Polynesian and Micronesian tradition. In 1974 D. Lewis (1974,137-139) pointed out that Polynesian and Micronesian navigation was aided by the use of stones. These stones were aligned to the direction of far off islands so that seafarers could learn the stars that would rise or set over the stones. These star-paths could then be used to navigate a boat to the island. In the same year Charlotte Kursh and Theodora Kreps (1974,334) named this style of navigation the 'starpaths system' using what they identified as 'linear constellations', lines of stars that have the same declination and marked azimuths on the horizon in their rising and setting which defined bearings to key points of travel. Kursh and Kreps (1974,335) described how the Polynesians dealt with the influence of precession. Over just a few generations the stars defining a star-path could shift, thus each new generation would need to learn these star-paths from observing the stones rather than learning from their elders. The use of fixed markers such as stones removed the problems of precession. The star-path provided four directions – backward, forwards, and right angles to the star line (Kursh and Kreps, 1974,336). These star-paths were occupied by mythical figures and contained narrative, all of which would have acted as an aid to learning. Communities would have five, seven or nine star-paths traced out through the night sky and this in turn produced a collection of twenty to thirty-six separate 'compass' bearings, all used for travel and exploration (Kursh and Kreps, 1974,336-7).

Focusing once again on Aratus, his poem also made reference to navigation at sea. In his description of Ursa Major he wrote, 'the latter star-sign beacons Greek Seafarers, while Phoenician sailors seek Her sister cluster when they cross the sea'(2010,Lines 37-9). In discussing Aratus' reference to sea and stars, Barry Clunliffe (2001,81) comments that such stellar knowledge and its link to sea navigation would have originated in the prehistoric period. Sea and land, however, do offer different views of the horizon. Weather permitting, the sea provides a clear view of the horizon, yet it is one which is moving. On land, the horizon may be harder to see but once viewed it is fixed. Realistically a Neolithic or Bronze Age traveller would have taken notice of many navigational signs: the features of the landscape, the direction of shadows during the day, wind, birds, as well as the stars located on the horizon.

Horizon astronomy can in fact easily identify what we now define as the Tropic of Capricorn, Tropic of Cancer and the Equator. By using a marker to observe the location on the horizon of the summer solstice sunrise, or any other calendar event, it is a simple matter to watch that same marker through the course of a few nights at different times of the year. One would then see that the same stars rose over this point and then set exactly opposite on the western side of the horizon, thus forming a path of stars through the night sky. In modern terms the stars on this star-path would all be at the same declination. Knowledge of such star-paths would be advantageous as it could be used for orientation in a foreign landscape by observing the points on the horizon which were touched by the star-path. Issues of a star's extinction angle, a star's invisibility close to the horizon, would be nullified by simply visually extending the line of the star-path to the horizon. Such knowledge would provide seasonal markers in any landscape while also allowing for orientation and navigation. The individual could, for example, move towards a point marked on the horizon by a rising star-path, knowing that to return they would simply follow that same star-path's setting point on the western horizon. Accuracy would not be a strong consideration as the star-path would only need to deliver

the traveller into their own familiar landscape. Familiarity with a set of star-paths would in effect offer freedom of movement in the landscape. Locally known sky and horizon markers could be used to learn the star-paths, providing the individual with a mental star compass.

These star-paths would be impervious to precession, as already discussed for the Polynesian navigation system; for as long as there existed some durable and fixed markers, natural or human-made, every generation could learn the star-paths from them, rather than from oral tradition. In this way the stones themselves would be the holders of this knowledge rather than the tribal elders. The actual calendar horizon events would also become central in such a scheme as they would provide fixed anchors in any local landscape, and thus enable common points of reference for all communities. In this way the sun, with its sunrise and sunset horizon events, would be fixed and permanent, and thus possibly more sacred, while the star-paths, which may have been full of mythical figures and their narratives, would be animated by precession. The two, the fixed nature of the sun and horizon and the animated mythical characters of the stars were bought together by the fixed bearing of the stones, which linked them in a cosmic and cultural knot; a union that offered the tribe knowledge of navigation.

If we accept the argument that star-paths are part of the cosmology of megalithic builders, then we can take a different approach to some of the questions currently posed within archaeoastronomy. A. Ellegård amongst others establishes that the orientation of many megalithic sites are to calendar horizon events (1981,113). These orientations include the solstice sunrise and sunset, equinox orientation, as well as markers to define the moon's major and possibly minor standstills. Commenting on Ellegård's paper Clive Ruggles voiced the obvious question of why? Why bother to go to the considerable trouble of constructing a megalithic structure to mark the calendar horizon events? Ruggles points out that it is far easier to tell the time of the year by light, plants, bird movement, and so forth, and he states, 'The motivation for a precise solar calendar is not clear…(Ellegård et al., 1981,122).

In the face of such an obvious question, archaeoastronomers have tended view a megalithic site as a complex which embraced both the landscape and the sky (Jones, 2007,183-218). This is what Julian Thomas (1999,46,53) defines as 'cosmological engineering', where the materials of the landscape as well as the movement of the heavens are arranged with no one component being privileged over the other. In this view any alignments to the calendar horizon events are seen as a part of the cosmology of the site, threaded with religious/ritual and/or cultural significance for the community. With the horizon calendar events for any single location producing fixed horizon points, the construction of a durable and non-moveable marker such as a pair of stones or a circle of stones would serve to create a cosmological union of sky, landscape, calendar, and orientation, providing future generations with a knowledge-based 'compass'.

Additionally this knowledge of orientation would help to embed a community in 'place', their place, and thus aid the community's understanding of their orientation to others. These 'others' could include important ritual places, burial grounds, clan meeting places or other communities. All of these other places could be designated by their azimuth bearing indicated by different stones or markers, which in turn would define a star-path. This paper argues that one motivation for the calendar orientations of megalithic sites may well be the need to erect stones that would hold the knowledge of the community's star-paths: at the same time other markers could be erected to point to important locations and thereby define other star-paths.

These star-paths could also be associated with the orientation of the dead to the living. Thomas (1999,162) points out that in the late Neolithic and into the early Bronze Age the dead were still a part of the living community. Based on the evidence of human bones as part of the communities' objects, he suggests that one lived *with* rather than were descended *from* the dead. With this union in mind, the builders' intent behind the orientation of a court cairn or passage tomb may have been to orientate it to its community's 'place' of living. Such tombs may well point back to their communities by orientating the tomb to the 'return' star-path. Indeed if communities looked to the setting side of a star-path, the west, for the rightful place of the dead, then the dead will thus tend to 'look' easterly back to their communities.

One can extend the concept of star-paths to the notion of 'home' star-paths. Zenith observations can be made by lying at the base of a tall straight-edged stone. This establishes the star-path that passes directly overhead. In modern terms this star-path's declination corresponds with one's latitude. A community may then wish to mark this knowledge with a special lone tall stone. This 'home' star-path would be important if there were attempts to 'map' a collection of culturally linked communities in some manner. Some of the many decorated stones within the Boyne Valley in Ireland may, for example, reflect such intent. This suggestion is highly speculative but does show the different questions that can be brought to future investigations of megalithic sites if star-paths are considered part of the Neolithic cosmological view.

In conclusion, using the evidence of Aratus' *Phaenomena*, this paper has argued that the late Neolithic and Bronze Age communities could have easily gained knowledge of the existence of star-paths. By using natural or constructed markers which were aligned to horizon calendar events, it would be obvious that the stars that rose at these key horizon points were consistent and that these stars transcribed a path or line through the heavens. Knowledge of such star-paths would be highly valued as, in the case of the Polynesians, they allow for navigation in an alien landscape, as well as orientation to other places or communities. Furthermore, a community could

use markers to define other star-paths that were not connected to horizon calendar events but may have been orientated to other communities or important cultural centres, or even maintained the links between the living and the dead. Given their awareness of sky-horizon events, I argue that the megalithic builders would have been aware of star-paths, particularly when the value of this easily gained knowledge was to provide a mental star-based compass which allowed for navigation, exploration, orientation, and a sense of place.

These star-paths would shift slowly every few generations but new generations would learn these star-paths by revisiting the constructed markers, in many cases the standing stones erected by communities from an earlier time. In this way the standing stones themselves become the holders of the community's knowledge and the teachers of future generations. Star-paths allow the knowledge gained by horizon calendar points to be lifted from horizon to sky while at the same time placing the stones themselves in an honoured position.

References

Aratus 2010. *Phaenomena,* Baltimore, USA, John Hopkins University Press.

Brennan, M. 1994. *The stones of time : calendars, sundials, and stone chambers of ancient Ireland,* Rochester, Vt., Inner Traditions.

Cooney, G. 2000. *Landscapes in Neolithic Ireland,* London, Routledge.

Crommellin, A. C. D. 1923. The Ancient Constellations Figures. *Splendor of the Heavens 2.* London: Hitchinson and Co.

Cunliffe, B. 2001. *Facing the Ocean, the Atlantic and its Peoples 8000 BC - AD 1500,* Oxford, Oxford University Press.

Danielewicz, J. 2005. Further Hellenistic Acrostics: Aratus and Others. *Mnemosyne,* 58**,** 321-334.

de Callatay, G. 1996. The Knot of Heavens. *Journal of the Warburg and Courtauld Institutes,* Vol. 59**,** 1-13.

Ellegård, A. 1981. Stone Age Science in Britain? *Current Anthropology,* 22**,** 99-125.

Ellegård, A., Aveni, A. F., Baity, E. C., Blakeslee, D. J., Carlson, J. B., Cohodas, M., Edmonson, M. S., Flanagan, L. N. W., Gingerich, O., Hicks, R., Kehoe, T. F., Kehoe, A. B., McCluskey, S. C., MacKie, E., Renfrew, C., Reyman, J. E., Ruggles, C., Tsen, T. C. & Turton, D. 1981. Stone Age Science in Britain? [and Comments and Reply]. *Current Anthropology,* 22**,** 99-125.

Haslam, M. 1992. Hidden Signs: Aratus Diosemeiai 46ff., Vergil Georgics 1.424ff. *Harvard Studies in Classical Philology,* 94**,** 199-204.

Hunger, H. & Pingree, D. 1989. *Mul.Apin: An Astronomical Compendium in Cuneiform, Archiv Für Orientforschung. Beiheft 24,* Austria, Verlag Ferdinand Berger & Sohne Gesselschaft M.B.H.

Hunger, H. & Pingree, D. E. 1999. *Astral sciences in Mesopotamia,* Leiden, Brill.

Jacques, J. M. 1960. Sur un acrostiche d'Aratos *Revue des &tudes anciennes,* lxii**,** 48-60.

Jones, C. 2007. *Temples of Stone, Exploring the Megalithic Tombs of Ireland,* Doughcloyne, The Collins Press.

Kidd, D. A. 1981. Notes on Aratus, Phaenomena. *The Classical Quarterly,* 31**,** 355-362.

Kursh, C. O. & Kreps, T. C. 1974. Starpaths: Linear Constellations in Tropical Navigation. *Current Anthropology,* 15**,** 334-337.

Lewis, D. 1974. Voyaging Stars: Aspects of Polynesian and Micronesian Astronomy. Philosophical Transactions of the Royal Society of London. *Philosophical Transactions of the Royal Society of London. Series A, Mathematical and Physical Sciences***,** 133-148.

Porter, H. N. 1946. Hesiod and Aratus. *Transactions and Proceedings of the American Philological Association,* 77**,** 158-170.

Sale, W. 1966. The Popularity of Aratus. *The Classical Journal,* 61**,** 160-164.

Thomas, J. 1999. *Understanding the neolithic,* London, Routledge.

Zhitomirsky, S. 1999. Aratus' "Phaenomena": Dating and Analysing its Primary Source. *Astronomical & Astrophysical Transactions,* 17**,** 483-500.