Odysseus’s Navigation

Glorious Odysseus, happy with the wind, spread sails and taking his seat artfully with the steering oar he held her on her course, nor did sleep ever descend on his eyelids as he kept his eye on the Pleiades and late-setting Boötes, and the Bear, to whom men give also the name of the Wagon, who turns about in a fixed place and looks at Orion, and she alone is never plunged in the wash of the Ocean. For so Kalypso, bright among goddesses, had told him to make his way over the sea, keeping the Bear on his left hand. Seventeen days he sailed, making his way over the water, and on the eighteenth day there showed the shadowy mountains of the Phaiakian land where it stood out nearest to him, and it looked like a shield lying on the misty face of the water.

Odyssey 5. 269-81 (trans. Lattimore)

The aim of this paper is relatively simple: to discover whether there is any way in which the stars enumerated by
Homer in this passage from the Odyssey could have served as useful aids in navigation. Given the equivocal conclusion of a recent major commentary on this question, there is a need, I believe, to set the record straight: could Odysseus have navigated his way across the sea with these stars, or could he not even have got himself out of the proverbial paper bag with their help?

The seafaring navigator relies on the stars to direct him to a given point on or beyond the horizon. This goal is achieved through a knowledge of the apparent movements of the stars in the night sky. We need to adopt a purely geocentric perspective to understand the system. We have to be aware that the stars move in a circle around a celestial pole; northern hemisphere observers see only the northern end of the pole, while those in the south see


43 When asking whether, with the stars enumerated by Homer, it is possible to find some way in which they could be useful as navigational aids, and when contemporary evidence for the practice of stellar navigation is otherwise lacking, it seems to me appropriate first to establish the proper positions and tracks of the Homeric stars, and then to seek evidence for the use of such stars by navigators in other pre-scientific cultures. The geared device discovered on the Antikythera wreck just might be a navigational tool, but the poor state of preservation of its star calendar would seem to prevent any detailed analysis of the means by which the stars it lists were used by a navigator; see D. de Solla Price, 'Gears from the Greeks : the Antikythera mechanism, a calendar computer from ca. 80 B.C.', Transactions of the American Philosophical Society, n.s. 64: 7 (1974).

Instead, I have relied on the studies of Pacific Island navigators by D. Lewis, We, the Navigators: the ancient art of landfinding in the Pacific (2nd ed. Honolulu 1994) and K. Akerblom, Astronomy and Navigation in Polynesia and Micronesia, (Stockholm 1968). I have to acknowledge, however, that their world was a different one from that of Homer insofar as no Homeric hero—except Odysseus in this very passage from the Odyssey—deliberately traversed, without intermediate landfall, the vast distances covered by South Seas mariners. The Islanders' boats too are presumably of quite different form from, and capable perhaps of much greater speed than, their European counterparts. And of course their stars would necessarily be somewhat different, and even when they are not, they would still be viewed from a different perspective. Nevertheless, despite these differences, the Islanders' aims were the same as Odysseus': to get from one point on the globe to another across the sea, using celestial observations as a major component of their navigational techniques.
only its southern counterpart. For Homer's time, there was no accurate gauge of the position of the north celestial pole such as Polaris nowadays provides by being practically at that point.\textsuperscript{44} The situation then was analogous to that of southern hemisphere observers today, who lack a star marking the position of the south celestial pole, but who can estimate its position by using other 'markers' nearby.

The movement of the stars follows the same direction as the sun in daytime, in compass terms from easterly to westerly. But observers would soon become aware that a certain band of the stars never rises nor sets, but perpetually circles the visible pole without dipping below the horizon. And if they were to travel any great distance in the direction of the visible pole, they would discover that some stars in that direction which used to rise and set now no longer do so, but instead join the perpetually visible circlers, while some stars in the opposite direction disappear. Eventually they would suspect that the appearance or disappearance of stars is a reliable indicator of a movement north or south of their initial position. In other words, a change of latitude affects which stars they see and which stars rise or set. At the latitudes of the Mediterranean, say at latitude 38°N (the latitude of Athens), stars with a celestial latitude (called Declination) between 52°N (\(= 90° - 38°\)) and the north celestial pole (90°N) never appear to rise or set but circle the pole continually. And stars of Declinations between 52°S and the south celestial pole (90°S) will never be visible. A move north or south

\textsuperscript{44} Because of the phenomenon known as the precession of the equinoxes, star positions are very slowly but continually shifting westwards, so that the night skies of any given time of year in Homer's period are not those of the same time of year now; see D.R. Dicks, \textit{Early Greek Astronomy to Aristotle} (London & New York 1970) 15-16, for an explanation of the phenomenon. For the purposes of this paper, I have worked on an epoch of 700 B.C. for the time of Homer; a change of epoch to an earlier (Bronze Age) or later (Classical) date, to allow for suggestions that some aspects of the \textit{Odyssey} might be creations of those periods rather than of the Dark Age period conventionally presumed for the poem, would not materially affect the arguments presented here by more than a few days.
will correspondingly affect these limits of visibility.

A change of latitude also affects the apparent tracks of the stars through the night. On the equator, stars rise vertically from the eastern horizon and set vertically into the western. But at the more northerly or southerly latitudes, such as those of the Mediterranean, the course tracked out by the stars is noticeably oblique to the horizon, in fact at an angle dependent upon one's specific latitude, i.e. in the case of the latitude of Athens, for example, the stars appear to move at an angle of 52° (= 90° - 38°) from the horizontal.

The obliquity of the angle at which stars rise and set for Mediterranean climes leads to one important aspect of star navigation there which is somewhat less critical for equatorial or tropical navigation: as a star rises from the eastern horizon, it shifts its position fairly rapidly from its original point on the horizon (its azimuth). This shift is much less rapid at the equator or tropics, so a star can be used to provide a distinct directional goal for longer in the latter areas than in the latitudes north or south of the tropics.45 In the Mediterranean, the rise of the star is useful only for a relatively short time before following it alone will lead to increasingly serious errors in navigation. The Pleiades, for instance, appeared on the horizon at about 75° east of north in Homer's time (i.e. midway between 2 and 3 o'clock, if 12 o'clock stands for north); within two hours of rising they were not only higher in the sky, but directly east (at 90° east of north, or 3 o'clock), and therefore about 15° off their original horizon position. About nine and a half hours later, Arcturus, the brightest star within Boötes, would rise, and moved in its rising a similar angular distance from its original position on the horizon, from 45° to 60° east of north (i.e. from midway between 1 and 2 o'clock, to 2 o'clock). What this means in practical terms depends on how a navigator was using these stars. If he was treating them purely as horizon stars, and so looking constantly towards a fixed point on

45 Lewis (n. 2, above) 83.
the horizon towards which to sail, then neither the Pleiades nor Boötes would be of much use after an hour or so of rising. This is because in the Mediterranean they would no longer be indicating directly the point on the horizon at which they had risen. By this stage, a seafarer would have had to seek another star on the same azimuth as the Pleiades or Boötes to keep him on his original track, and over the night would have a series of half-a-dozen or so such stars keeping him on the correct track. But what is more, the Pleiades and Boötes rose at such different points along the northeastern horizon (at 75° east of north for the former, and at about 45° east of north for the latter) and at such different times (with about nine and a half hours between the rise of the Pleiades and that of Boötes), that it is most unlikely that they were ever intended to be understood together as successive horizon stars by Homer.

According to Hainsworth:

"The technique [of stellar navigation] depends on the observation that the rotation of the heavens pivots at a fixed point, the pole, by reference to which the ship was kept steady in a given direction. The mariner had to know, for he could not calculate, the relative positions of his starting-point and destination. ... If he used the northerly stars of Ursa Major as a fixed beacon, a navigator would be off course to the maximum extent of c.13°, hardly a serious matter for a single night's voyage amid the vagaries of wind and current." 47

This implies that an accurate navigator needs to have a distinct pointer to the north celestial pole, and Odysseus, by

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46 Not all such stars would have to have been explicitly named, the whole set of directions being denoted by reference to one star in the list: Lewis (n. 2, above) 82-3, 98-9.

47 Heubeck-West-Hainsworth (n. 1, above) 276-7.
lacking such an aid, is open to errors in direction. But even having a distinct point indicating the north pole, such as Polaris now provides, does not of itself provide the mariner with sufficient guidance if he is travelling anywhere other than directly north or south, and so can always hope to keep this star directly before or behind him, so long as the sky stays clear in that direction; intermediate directions would be more difficult to maintain without some other guide. Kalypso’s injunction to Odysseus to keep the Bear always on his left certainly indicates that he is travelling in a generally easterly direction, as the commentators agree. But if he is wishing to maintain a particular direction, somewhere between south-east and north-east, he is in some difficulty if he uses the polar stars of the Bear as his only aid. Odysseus’s use of the Bear alone, as Hainsworth proposes it, may not lead to great errors over a single night (depending on the distance covered), but it could lead to egregious errors over the lengthy period during which Odysseus is said to be at sea.

Using the Pleiades and Boötes as a balanced pair set opposite each other across the sky with one rising as the other set, in the way that others such as Austin have proposed, does not solve the problem. Certainly, as the Pleiades rise, Boötes is on its way to setting. But the two are not set sufficiently opposite each other for this characteristic to be of any immediately obvious practicable use to a navigator. The angular distance between the Pleiades and Boötes is an awkward 120°, rather than the optimum 180°. As Odysseus is often supposed to be steering towards the direction of the rising Pleiades (east-north-east but rapidly shifting eastwards), from the stern of his boat where he holds the steering oar, he would have to turn around to look back over his shoulder, but not directly behind, to see Boötes setting towards the northwest. Since Odysseus is at the rear of his boat, there would be no rigging against which the decline of Boötes could be mapped, so it

48 cf. Heubeck-West-Hainsworth (n. 1, above) 277.

49 N. Austin, Archery at the Dark of the Moon (Berkeley 1975) 241.
would be very difficult to know whether he was always keeping it in precisely the same position.\textsuperscript{50} Once Boötes had set, then both it and the Pleiades would be useless as distinct directional pointers, the one because it had set, the other because it no longer pointed in the direction it originally indicated.

Ideally, if Odysseus was using horizon stars as navigational aids, then, because of the obliquity of the angle at which stars rise and set in the Mediterranean latitudes, he would be looking for stars which rise an hour or so after the Pleiades in the same general direction. Orion might be thought to fit the bill, as it rises after the Pleiades and is mentioned by Homer (though not necessarily as a navigational aid). This constellation, however, is so large that its rising occurred from direct east to east-south-east. Were Odysseus to follow it, he would be up to $45^\circ$ off the course which he originally took. Such a degree of error might not be critical, if his journey was not long, and his expected landfall was broad enough to provide a very large margin of leeway. But he is said to have sailed for seventeen days with a good wind following, so his journey stands to have been well off course from its original goal.

Is there no way around all these problems? Perhaps there is, if we consider the stars listed by Homer as an interconnected group, and not individually. One immediately striking feature of Homer’s stars is that none of them is actually a single star.\textsuperscript{51} The Pleiades are a cluster of close-set stars, not very bright in themselves but sufficiently unique in the sky as to be easily identified and therefore used by many ancient cultures in both hemispheres as a calendrical marker. Boötes, the Bear and, if it is

\textsuperscript{50} Compare the example provided by Lewis, (n. 2, above) 90-93, for a voyage from Puluwat to Saipan; note, however, that his reference to Pollux (b Geminorum) must be a mistake for Alpheratz (a Andromedae).

\textsuperscript{51} A similar situation holds for the northerly points of the Caroline Islanders’ star compass: Lewis (n. 2, above) 105.
meant as a star guide, Orion are all large, bright constellations. These groups of stars have the great advantage for a navigator that even if the sky is only partially visible at night because of cloud cover, nevertheless the forms of the constellations are so distinctive as to allow the experienced navigator to be able to gauge the relative positions of these major groups and therefore of any other stars used for navigation.

Furthermore, it is possible to use such large groups of stars to indicate a number of compass points, depending on the positions of the constellations through the course of the night. Admittedly, if, as Hainsworth suggests, the navigator was using the stars like the sun in daytime and so gauging his course against the positions of these stars at critical points in their courses across the sky, then this would at first glance seem to be an extraordinary waste of the stars. For sun-steering is regarded as a less precise means of navigation than star-steering, and demands more analysis by the navigator of the visible phenomena. The reason for this is that the sun typically provides only three definite points of reference: its point of rising at dawn, of setting at dusk, and of culmination at noon. The first two points broadly indicate east and west, of course, but they change along the horizon with the season, and so are anyway less precise than they might seem at first blush. The sun’s position at noon indicates north and south. Intermediate

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52 It may seem curious that Boötes should be considered bright, since some of its major stars are of magnitudes less than 3.0, yet it was so characterised by Aratos in the third century BC: ἀριδηλος Phainomena 94. In its favour is the fact that it is outside the path of the Milky Way and indeed in a relatively empty sector of the sky. This of course adds to the relative brilliance of its most prominent star, Arcturus [ἐξ ἀλλων Άρκτούρος ἐλίσσεται ἀμφαδὸν ἀστηρ. says Aratos (Phainomena 95)], which is anyway the fourth brightest star in the sky (and for Homeric observers perhaps even the third, since Canopus was at Declination 53°S and therefore invisible at latitude 37°N or higher), a brilliance which helps the observer to locate the rest of the constellation.

53 Cf. Lewis (n. 2, above) 105.

54 Heubeck-West-Hainsworth (n. 1, above) 277.
compass positions between rising, culmination and setting can be determined by the skilled navigator, but they must of their very nature be less precise compared with the accuracy of the pinpoints of light which a series of rising or setting stars can provide throughout the night.\(^{55}\)

But perhaps there is some mileage in the idea, if it is a whole constellation or even a group of them, rather than the pinprick of a single star in the night sky, that is used in this fashion. Boötes, for instance, could plausibly have been used to indicate five compass points in the course of the night: north-west as Arcturus set, then west-north-west two and a half hours later as its uppermost triangle of stars began to dip below the horizon, north another two and half hours later as its topmost star grazed the horizon (or in reality disappeared briefly below the horizon), and finally both east-north-east and north-east a further two and a half hours later as Arcturus rose at north-east and the topmost star was in line with east-north-east (Figure 1, p.27).\(^{56}\) If we keep an eye also on the Pleiades, the Bear and—for the sake of argument—Orion at these significant points in Boötes’ course, we find some further directional guidance. At the moment of Arcturus’ setting in the north-west, the Pleiades have risen from their situation at

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\(^{55}\) Lewis (n. 2, above) 123-4. It is also true that a shift by the traveller to north or south results in a complementary change of altitude in the sun, so that for northern hemisphere observers, for every degree one travels north, the altitude of the sun at noon decreases by a degree. But within the Mediterranean sea, the north-south extension of which is at its extreme only about 15° and usually considerably less, it is hard to see this particular property of the sun’s position being much used by mariners.

\(^{56}\) Cf. the Carolinian use of the Southern Cross to indicate as many as five distinct directions from south-south-east through south to south-south-west as it rises and then sets: Lewis (n. 2, above) 105-106. Figure 1 is a composite of the different positions of Boötes setting and then rising from north-west (left) to north-east (right), as described in the text. For the sake of clarity, the principal stars within Boötes have been joined together, and all other stars deleted; the grey area represents the area below the visible horizon for the latitude of 38°N. The illustrations in this paper are based on readouts from the computerised planetarium, Voyager II (Carina Software, San Leandro).
east-north-east on the horizon to a point almost directly east; the Bear, meanwhile, is resting at its lower culmination due north; Orion is still invisible (Figure 2, p.28). When the top triangle of Boötes starts to set at west-north-west, we find the Bear now angled away from north and looking towards the fully risen Orion, whose lowest star (k) is at east-south-east on the horizon (Figure 3, p.29). When the topmost star of Boötes just sets at due north, the Pleiades are at their culmination on the meridian, and so indicate due south from Boötes; the Wagon within the Bear is running parallel to this north-south meridian line, and lying east-north-east of the observer; Orion, meantime, is indicating south-east (Figure 4, p.30). Finally, when Arcturus rises again in the north-east, and its topmost star indicates east-north-east at the same time, we find the tail of the Bear pointing also east-north-east; Orion has just passed the meridian, and is therefore indicating almost due south; and the Pleiades are lying about west-south-west (Figure 5, p.31).

It is demonstrable, then, that all the stars mentioned by Homer combine at critical points in their courses to indicate a wide range of specific compass points. The trick is to read them together, and to know where the others are going to be when the navigator can see only one, or part of one, because of cloud cover. Hainsworth’s belief in a navigator’s reliance on accurate knowledge of the north celestial pole is thus shown to be unwarranted. Instead, there is a remarkable abundance of useful navigational information embedded in the apparently simple list

57 In Figures 2-5, the viewpoint is that of an observer looking directly upwards towards the zenith on the night of 24 September 700 BC. The full circuit of the horizon is represented, with north at 6 o’clock, east at 3 o’clock, south at 12 o’clock, and west at 9 o’clock. The grey area indicates the limits of visibility for this particular latitude, 38°N. NCP stands for the North Celestial Pole, around which the stars appear to rotate. For clarity’s sake, lines join the principal stars of Boötes, the Bear (Ursa Major), Orion and Taurus (within which the Pleiades are situated), while the number of stars illustrated has been limited to those of magnitude 4 or brighter (in reality, stars down to magnitude 6 would be visible to the naked eye, but on the scale of these diagrams the inclusion of these fainter stars would render the Figures incomprehensible).
of stars provided by Homer.

That the list can be shown to be useful to a seafarer, furthermore, undermines Hainsworth’s final, dismissive suggestion that ‘the partial coincidence of these lines with those at II. 18. 483 ff. raises the suspicion that they supply general astronomical, not specifically navigational or seasonal, data’.\textsuperscript{58} Certainly the \textit{Iliad} lines resemble the ones under scrutiny from the \textit{Odyssey}. But they are not an exact replica, and indeed it is possible to argue that the stars enumerated in the \textit{Iliad} (the Pleiades, Hyades, Orion and the Bear) stand together as a unit to denote two quite specific times in the agricultural year.\textsuperscript{59} Thus, the similarity between the list of stars at \textit{Iliad} 18. 486-9 and that at \textit{Odyssey} 5. 272-5 should not delude us into thinking that the minor differences are insignificant, or that the lists are purely decorative. On the contrary, the subtle differences between the two sets of stars are sufficient to indicate that the list in the \textit{Iliad} is of agricultural importance, while that in the \textit{Odyssey} is of significance for a seagoing navigator.

What the stars might tell us beyond all this is perhaps just what the period of time was in which the sailing was imagined to have taken place. The clue to this lies in the much-discussed epithet for the constellation of Boötes, όψε δύοντα. Here, again, Hainsworth dismisses the epithet as decorative.\textsuperscript{60} But a passage

\textsuperscript{58} Heubeck-West-Hainsworth (n. 1, above) 277.

\textsuperscript{59} These times are: (1) the time of ploughing and sowing in November, when the Pleiades, Hyades and Orion set just before dawn, while the Bear was at its upper transit directly north; and (2) the time of harvesting in May-June, when the Pleiades, Hyades and Orion rose just before dawn, while the Bear was at its lower transit directly north. See J.H. Phillips, \textit{LCM} 5.8 (1980) 179-80, and my refinement of his ideas, summarised (and lightly corrected) here, in 'The Constellations on Achilles’ Shield (\textit{Iliad} 18.485-489)', \textit{Electronic Antiquity} 2: 4 (1994). Further to the differences between these lines from the \textit{Iliad} and the \textit{Odyssey}, see my paper, 'The Stars of Iopas and Palinurus', \textit{AJP} 114 (1993) 123-35.

\textsuperscript{60} Heubeck-West-Hainsworth (n. 1, above) 277-8.
from the *Phainomena* by the Hellenistic poet Aratos (to which Hainsworth actually alludes) provides, I think, useful information for understanding the Homeric epithet. At lines 581-5 Aratos says:

τέτρασι γὰρ μοῖραις ἀμυδίς κατιόντα Βοώτην
'Ωκεανὸς δέχεται, ὁ δ᾽ ἐπὴν φάεος κορέσηται.
βουλυτῶ ἐπέχει πλεῖον δίχα νυκτὸς ιουύης.
ήμος ὅτ᾽ ἡελίῳ κατερχομένοιο δύηται,
κεῖναὶ οί καὶ νύκτες ἐπ᾽ ὦσε δύοντι λέγονται.

For along with four divisions (of the Zodiac) does Ocean receive Boötes as he sets; and whenever he has had his fill of light, he holds back in the unyoking of his oxen beyond midnight, at that time when he sets as the sun goes down. Those nights indeed are called after his late setting.

(Trans. Hannah)

This passage refers to the time in the year when Boötes sets just after the setting sun, that is, to what is called the heliacal setting of the constellation. *Prima facie*, it would seem that Aratos means us to understand that those nights were called 'late setting', on which the whole constellation set after midnight, rather than, say, just its most prominent star, Arcturus. However, despite appearances, the difference is probably not significant. It is true that at the Mediterranean latitudes Arcturus, both the brightest star and one of the lowest in this large constellation, sets up to five hours earlier than the uppermost stars on any given night; and, because the constellation Boötes is so large and sets vertically, the heliacal setting of Arcturus occurs around three months earlier than that of the upper end of the constellation. Nevertheless, if Aratos is referring to the time of year when the whole constellation would set after midnight, then we are actually dealing with the period of the heliacal setting of Arcturus at the bottom of the constellation, because at that time the top of the constellation took till after midnight to disappear from view. Thereafter, the disappearance of the top of the constellation took place progressively and considerably earlier in
the night before midnight (and indeed Arcturus would then be setting in daylight).

Now, the heliacal setting of Arcturus took place in late October in Homer’s time. If Aratos’ testimony is accepted as useful in explicating the passage from the Odyssey, then Homer had Odysseus sailing at the very end of the sailing season.61 The rough conditions that Odysseus eventually encounters at sea are much as are described by Hesiod for those who delay their sailing until the time of the (September) vintage or the first winter storm (in early November).62

What the stars do not seem to indicate, however, is in precisely which direction Odysseus sailed, other than generally eastwards by keeping the Bear on his left. There does not seem to be any preponderance of readings from the stars towards any particular direction within the north-east— to— south-east sector. So while it looks possible to argue that Homer’s stars make perfectly good navigational aids, they do not necessarily tell us just where Odysseus is heading; only that he should have been capable of keeping on his course over a long period of time, and that he was probably sailing at a time beyond the end of the sailing season. To say more than that, we need more information

61 Various dates for the end of the sailing season are provided by Hesiod alone, ranging from mid-August through mid-September to early November: see M.L. West, ed., Hesiod, Works and Days (Oxford 1978) 322-3 to line 663, and Austin (n. 8, above) 242-3. J.A. Scott, The Unity of Homer (Berkeley 1921) 107-109, argued for the heliacal setting of Arcturus as the marker for the latest date for Odysseus’ sailing.

62 Austin (n. 8, above) 242-3 makes much the same point.
than the stars themselves provide.

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Figure 1  Composite illustration of the horizon positions of Boötes as it set and then rose, at latitude 38°N, in 700 BC.
Figure 2  Relative positions of Boötes, the Pleiades, the Bear, and Orion, as Arcturus sets.
Figure 3  Relative positions of Boötes, the Pleiades, the Bear, and Orion, as the upper stars of Boötes set.
Figure 4  Relative positions of Boötes, the Pleiades, the Bear, and Orion as the topmost star of Boötes passes direct north.
Figure 5  Relative positions of Boötes, the Pleiades, the Bear, and Orion, as Arcturus rises.