NAVIGATIONAL TECHNIQUES IN HOMER'S ODYSSEY

Although much has been published about how ships in the ancient Mediterranean were built, fitted out, manned, propelled, steered and fought (Morrison & Williams, 1968; Casson, 1971/1989; Morrison & Coates, 1986, for example), little has been published about how these ships were navigated. By *navigation* I mean the art and science of knowing where you are at sea, and how to get from A to B and back again. In this paper I aim to present what can be deduced from Homer's *Odyssey* about the pilotage techniques used by the ancient Greeks in coastal waters and about the navigational techniques they used in open sea conditions when out of sight of land. I do not read Greek and therefore have had to rely on translations, in particular that by Rieu (1946).

Greek Seafaring

It is clear from many passages in the *Odyssey* that Homer's seamen could undertake not only coastal and inter-island voyages, but also open sea voyages. There are, for example, two occasions when the choice has to be made whether to undertake one type of voyage or the other. On their return from Troy to Greece, Nestor, Menelaus and Diomedes paused at Lesbos Island to consider whether to choose the coastal and inter-island route east of the island of Chios and through the Sporades and Cyclades to their waters, or to take the direct route north of Chios, leaving the Island of Psyria to port, thence across the open sea to a landfall at the southern end of Euboea (3, 165-175). On another occasion, Odysseus recounts to Eumaeus how he sailed in a Phoenician ship from the Levant bound for Libya (14, 300-305). In a northerly wind, "they took the central route and ran down the leeside (i.e. the southern coast) of Crete". The alternatives to this central, mainly open-sea, route would seem to be coastal passages, either clockwise along the North African coast or anti-clockwise along the coast of Asia Minor.

Navigational Aids

Throughout the world, from earliest times until well into the medieval period, seamen used *non*-instrumental navigational techniques based on inherited traditions, personal experience and detailed observation of natural phenomena (McGrail, 1987, 275-6). The only navigational aid for which there is any evidence being the sounding lead - not mentioned in Homer, it is known from Middle Kingdom

Egypt in *c* 2000 BC (Landström, 1970, Fig. 238; Bass, 1972, Fig. 18); and Herodotus (2.5.2) of the 5th century BC tells us that the lead was used when approaching the Nile delta, not only to check the depth of water but also to bring up a sample of the sea bed, the nature of the sample giving an indication of position (Fig. 1).

Although Odysseus had no instruments and no chart or map, it is clear that he had a "mental chart" in his head. He knew, at least in a general way, the spatial relationships of the coastal lands and the islands of the eastern Mediterranean. For example, the direction of mainland Greece from Troy (3, 155-175), the relative positions of many Aegean islands and the relationship to each other of Crete, Egypt, the Levant and Libya (14, 250-260, 290-305).

Such spatial relationships are nowadays often defined in terms of directions and distances: *directions* in broad terms such as North, South, East, West and so on, or, with more precision, in terms of degrees within a 360° circle system; *distances* are given in nautical miles. How, then, did Odysseus, without compass or chart, define and estimate directions and distances?

Directions

Let us take Directions first. When sailing away from Calypso's island, Odysseus kept the Great Bear *(Ursa Major)* or Plough on his port side (5, 270-275). Now this constellation, like all stars, appears to rotate about the Celestial Pole (the heavenly null point), but it is one of the few constellations which, from the latitudes of the Mediterranean, do not go below the horizon. Throughout the night its pointers indicate the direction of this Pole which nowadays we identify as the position of *Polaris* the North Star. In Homer's time the star nearest the Pole was, in fact, *Kochab* (Taylor, 1971, 9-12, 43); nevertheless the pointers of the Great Bear showed Odysseus the Pole, thus providing a fixed direction in space from which he could get his bearings.

Once any one direction in space is fixed, the horizon can be divided into sectors by halving the azimuth circle again and again until, for example, after five of these divisions you have 32 sectors each one of 11 1/4° (in our units). These sectors were known to medieval seamen of North West Europe as points (Fig. 2) and to medieval Arabs as "*rhumbs*" (Tibbetts, 1971).

We may conjecture that Odysseus used a similar system, perhaps of only 16 points (each equivalent to 22 1/2°) - in our terms these would be N. NNE. NE. ENE. E. and so on. Thus when Odysseus kept the Celestial Pole on his port beam, as he had been instructed by Calypso, he was heading east. If he had kept the

Pole just forward of his port beam he would have steered NNE; on the port bow, NE; fine on the port bow, NNE; and so on, around the horizon.

Odysseus was also able to obtain his bearings by reference to the rising and setting directions of constellations such as Orion and the Pleiads, and prominent stars such as Arcturus which he carefully monitored as he steered eastwards from Calypso's island (5, 270-275). This implies that he had a relatively detailed knowledge of the movements of the heavenly bodies.

Odysseus also knew that winds from different quarters had recognisably different characheristics: for example, a wet wind was from the West, a cold wind from the North, and a hot dry wind from the South (12, 285-290; 14, 455-460, 476-480). Once a particular wind had been indentified Odysseus had another datum or direction in space - at least for as long as that wind continued to blow - and the horizon could be divided again, this time into a "wind rose" to give reference bearings (Fig. 2.). Eight elements of such a rose can be seen on the faces of the octagonal Tower of the Winds in Athens (Fig. 3). Away from the land, the swell, a surface undulation of the sea which is caused by the wind, persists in direction for much longer than the wind and thus can be relied upon for bearings over a longer period (McGrail, 1983, 316).

A "wind rose" and a "swell rose" can be used in daylight as a directional reference system, and also at night if the sky is obscured. Another fixed direction in daylight is that of the Sun when it is at its zenith (highest point), the direction we call South today. I may have overlooked a reference to the use of this in the *Odyssey* but as Homer (12, 310-315) refers to the stars at night reaching their zenith, it seems likely that the significance of the Sun's zenith was also appreciated. Other checks on directions can be made at sunrise and sunset (east and west at the times of equinox) even though their position on the horizon varies through the year, for, over the few days of a Mediterranean voyage, this change in direction is not great (McGrail, 1983, 316; 1987, 281).

Distances

Now to turn to the measurement of distance. As in many other maritime cultures (e.g. Viking, Arab) the ancient Greeks measured distance at sea in units of a "day's sail". For example, Menelaus tells Telemachus that from the R. Nile to Pharos Island is a day's sail "for a well-found vessel in a fair wind" (4, 355-360); and Odysseus tells Eumaeus that it is four day's sail from Crete to the R. Nile (14, 255-260). Thus a "day's sail" was some *average* distance, that achieved by the *usual* sort of ship in *fair* wind and sea conditions in a 24 hour period in the summer sailing season. To match this standard distance there was a corresponding standard speed which, from later evidence, appears to have been (in our terms) *c* 4 knots (McGrail, 1987, 262-4). Speeds achieved, and thus distances covered, on a *particular* voyage would have been estimated by Odysseus as faster or slower or equal to the standard.

Position at Sea

On open sea voyages Odysseus would have used all the environmentally-based methods available to him to determine the direction he had sailed and the distance he had gone since last losing sight of land. That is, he would be continually estimating his boat's deviation from the standard route, caused by variations in wind and sea from standard conditions, and secondly, by any abnormal performance (better or worse) by this boat, or thirdly, by himself as sailing master and helmsman. Thus he could "mark" on the mental chart in his head, his estimated position as a deviation from that usually expected, and could then decide whether to alter course to regain his desired track and/or revise his estimate of when he would next make a landfall.

Landfall

A good landfall is made when the navigator recognises the coast at a range when his boat is still clear of coastal hazards. When still out of sight of land, the sounding lead may be used to detect decreasing depths of water. Other signs of approaching land include: colour changes in the water where a great river meets the sea; orographic cloud rising over distant land; smoke from shore fires, and so on. Odysseus used *natural* landmarks whenever possible: offshore islands such as Pharos west of the R. Nile (4, 355-360), and Psyria when crossing the Aegean (3, 172); or prominent mountains such as the "wooded peak of windswept Neriton" when approaching his home land of Ithaca (9, 20-25). We also learn from Homer that artificial landmarks were sometimes built. Thus the bones of Achilles, Menoetius and Antilochus were buried under a "great and glorious mound on a foreland jutting out over the broad waters of the Hellespont, so that it might be seen far out at sea by the sailors of today and future ages" (24, 75-85). Moreover, Elpenor, one of Odysseus' crew, was buried under a similar mound on "the summit of the boldest headland on the coast" off Circe's island, and his oar was left sticking vertically out of the tumulus so that it would be even more conspicuous from seaward (11, 75-80; 12, 10-15).

Position Finding

When Odysseus arrived at previously unknown lands he got his whereabouts and onward sailing directions from local people, as for example from Calypso (5, 270-280) and Circe (10, 505-510; 12, 25-30). Furthermore, Telemachus, when he was searching for his father Odysseus, took Mentor with him, presumably because the latter had a detailed knowledge of the waters to be sailed (2, 395-435).

There were occasions, however, when neither local informations nor pilots were available to Odysseus, yet he was able to find his way home. How? I venture the possibility that he had a method of estimating his "latitude" by some form of celestial observation. Now, by *latitude* I do not mean what is understood by that term today; rather Odysseus' "latitude" would have been a relative assessment, some measure of his north or south displacement from his home port or from some other wellknown place. A measure of this displacement could be the relative *altitude* (vertical angle) of the zenith sun (if direct glare could be avoided) or of the Celestial Pole (in our times *Polaris*). These angles vary as one moves north: the altitude of the zenith sun getting less, that of the Pole getting greater.

Could such angles have been measured by Odysseus? The vertical angle or altitude of any heavenly body may be measured in thumbs, palms/fists or handspans: at arms length one handspan subtends *c* 16°; a clenched fist *c* 8°; and a thumb's breadth *c* 2°. At Crete, (36° N) for example, the vertical angle of the Celestial Pole would be 4 fists and 2 thumbs, whereas in the Nile delta (*c* 32° N) it would be only 4 fists. A corollary of this is that if, on an unknown coast, the Pole subtends fewer handspans or fists than it does at your home port, you know that you are south of home.

A related aspect is that, from the Nile delta, the Great Bear constellation just grazes the horizon as it orbits the Pole, whereas off Crete it is c 4° (2 thumb breadths) above it. Thus a voyage south across the Mediterranean is marked by the Great Bear getting closer to the horizon. Precise measurements if vertical angles in spans, fists and thumbs may be attempted on the open sea but generally such measurements would be more reliable when taken in sheltered coastal waters.

Instead of using fists and handspans a wooden tablet on a string calibrated with knots can be used to measure star altitudes (Fig. 4) - such a simple device, known as a *kamal*, was used by early medieval Arabs in the Indian Ocean with remarkable accuracy (Tibbetts, 1971; McGrail, 1987, 278-9). Whether such an instrument was used in earlier times is mere speculation, but perhaps one day such a navigational aid may be excavated from an early site in the Mediterranean.

Seafaring Lore

Descriptions of coastal landscapes and key landmarks, the directions and distances between frequently-used ports, the apparent movements of the stars and constellations, the weather to be expected seasonally and regionally - all these would have been transmitted to Odysseus by his seafaring forebears in easily remembered phrases and rules of thumb. Nowadays we write such things down or draw lines on charts; in Odysseus' time they were transmitted orally or by example. We can, for instance, imagine the following Homeric oral sailing directions (with some help from Herodotus) for the route between Crete and Egypt:

" Leave Cape Samonium, Crete with a NW wind, which is generally the case in summer. Keep this wind astern or fine on the starboard quarter for a period of four nights. At night, keep the Great Bear on your port quarter - you will notice this constellation getting nearer the horizon each night of your voyage. Use the sounding lead on the morning of the fifth day and, if you are on schedule, you will record 11 fathoms and a muddy bottom. Keep the distinctive outflow from the R. Nile on your port bow until you sight Pharos Island ahead. Then turn towards the direction of the rising sun and follow the coast for the delta of the R. Nile".

Concluding Remarks

I have tried to show how we can gain an insight into the methods used by early pilots in the Mediterranean, by applying a knowledge of the basic navigational problems to the tantalising glimpses that Homer gives us. For practical reasons I have restricted this paper to the *Odyssey*, but more can be learned from the *Iliad* and from Herodotus, Strabo and other Classical authors (McGrail, 1991).

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ILLUSTRATIONS

1. Sounding leads from the French Mediterranean coast, dated to the first half of the 2nd century BC (no. 4&5) and to the middle of the 1st century AD (no. 1&2). Note the cavity for recovery of a sample of the sea bed. Drawing: after Fiori & Joncheray, 1973.
2. A 20th century Greek compass card on which can be seen three methods of estimating directions:
   i. in degrees - on the outer circle
   ii. in points - 32 black triangles or diamonds on the inner circle
   iii. by reference to the wind direction - eight Greek names outside the degree circle.
   Phono: Aegean Maritime Museum.
3. An 18th century engraving of the 1st century BC Tower of the Winds below the

Acropolis of Athens. On the eight sides are carved symbols of the principal Mediterranean winds.
Photo: Aegean Maritime Museum.

4. Method of using an Arab *kamal* to measure the altitude (vertical angle) of a star. The further away from the eye the tablet is held (the fewer knots exposed) the smaller the angle. The knots on the line correspond to the altitude of the Pole Star (Polaris) i.e. latitude, of known places.
Drawing: Institute of Archaeology, Oxford.

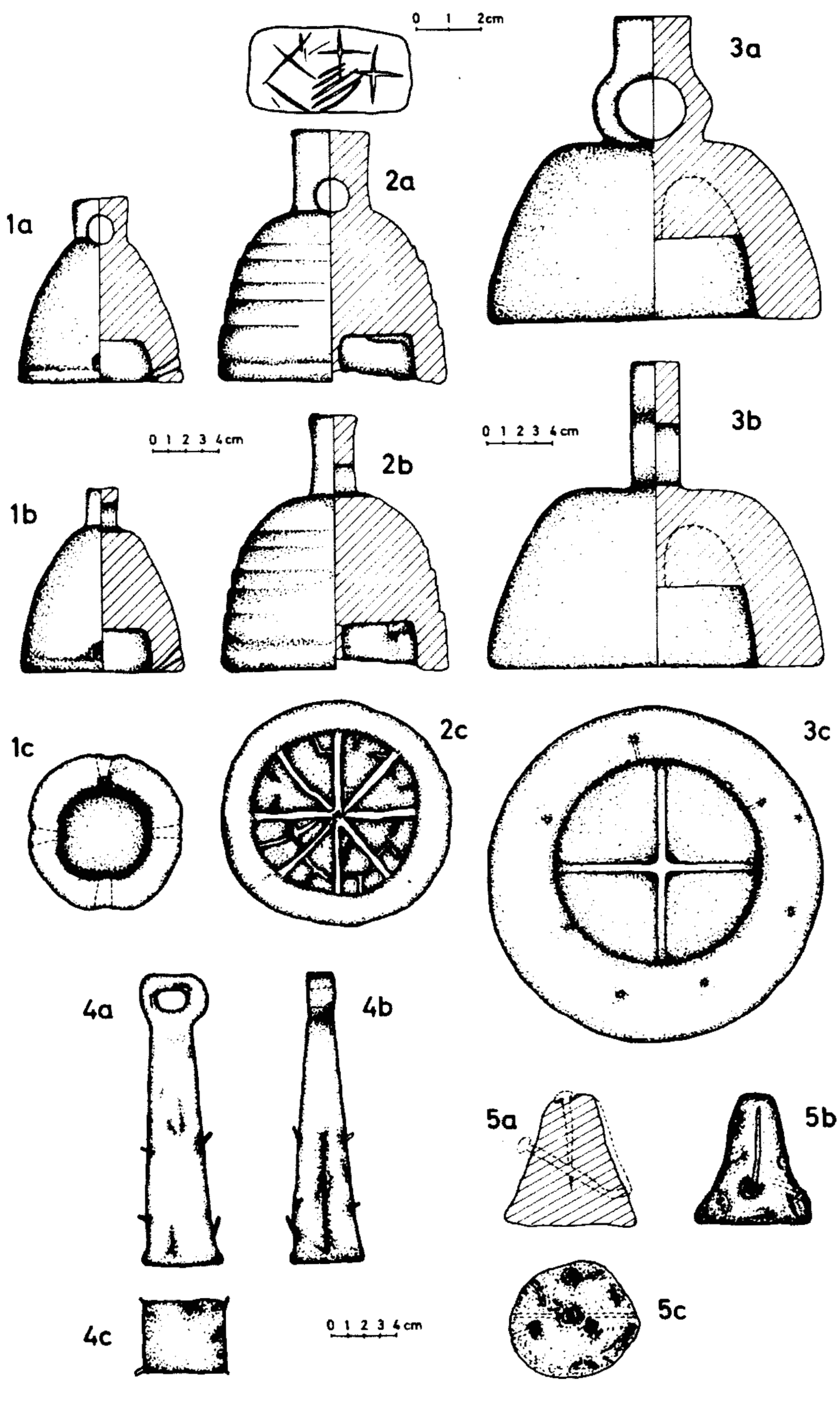
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Fig. 1

Fig. 2

Fig. 3

Fig. 4