Sailing to windward in Roman times: the Spritsail legacy

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Abstract: The iconography of Roman period merchant ships reveals them to have a different sail-plan to those of earlier times because they often have a small square sail rigged near the bow called a *spritsail*. The significance of the spritsail ceased to be appreciated in the early nineteenth century soon after it became obsolete. This paper discusses the role of the spritsail especially as it assisted Roman period ships to sail to windward.

Introduction

The Roman Empire enjoyed a high level of maritime economic activity primarily because of the security that was maintained in the Mediterranean Sea (Meijer 1986: 211ff). However, there may also have been technological and practical grounds why this commerce was sustained, although traditionally the period has been considered to be without maritime innovation.

To make a consistent contribution to the international economy seaborne trade had to be reasonably predictable and reliable; it could not be at the mercy of the vagaries of the wind and pirates. While the capacity to anchor or to make port during periods of adverse weather and knowledge of seasonal wind patterns and currents were important, it was the capacity of ancient ships to make progress toward the wind that partly freed them from the dictates of wind-direction. On occasions oars could be used, as they were on warships, but they were not appropriate for long-distance merchant shipping.

Ships had to be able to make progress toward the wind by sailing a zig-zag course, sometimes called *beating*. This practice involves sailing as close to the wind as possible with the wind coming over the forward quarter as shown in Figure 1; this is known as being *closehauled.* The ship then changes course so that the wind comes over the other forward quarter. This change of direction is called *going about* or *tacking* and can be a challenging manoeuvre as the bow of the ship must pass through the eye of the wind.

However, there has been a general belief that Roman period ships had little windward sailing capability as expressed by scholars such as Meijer (1986: 224). The lateen sail, still known from Arab sailing craft called *dhows*, was thought to have been of Indian Ocean origin and to have replaced the Roman period square-sail rig by the sixth-century (Hourani & Carswell 1995: 103). Ships with lateen sails are recognised from modern experience to have good windward sailing capabilities (Villiers 1940 (1966)). This understanding led to the assumption that the Roman period square-sail was replaced by the lateen sail because of its technological superiority. Recent research has questioned nearly every aspect of this hypothesis. It is therefore apposite to review this research before addressing the specific question of the spritsail.

Recent research

Ancient maritime research has been driven by literary and iconographic analysis, and the systematic underwater excavation of shipwrecks that has facilitated the building of replicas for actual sailing tests. Whitewright summarises twelve square-sailed ship replica tests revealing windward headings of 70^{o} from the wind or better, up to 60^{o} (2011b: 7, Table 2). Only two of the ships were of Mediterranean derivation, the Kyrenia II, which achieve a heading of about 61^{o}, Figure 1 (Cariolou 1997: 92) and the trireme *Olympias*, which under sail could head between 65^{o} and 72^{o} from the wind (Morrison et al. 2000: 200).

The sail-plan may enable the craft to point close to the wind; but if a ship has leeway, that is it goes rapidly sideways, the course-made-good may not be to windward at all. The shape of the hull is important for limiting leeway. Ships with keels may expect less lateral drift than those with flat bottoms when sailing with the wind abeam or on the forward quarter. Maritime archaeology has shed much light on the issue of hull design and construction. The fourth-century BC Kyrenia shipwreck revealed that comparatively deep keels were in use well before the

Figure 1: *Kyrenia II, a replica of a fourth-century BC merchant ship found near Kyrenia, Cyprus, seen here sailing to windward in light air. The wind is coming directly toward the camera. Image: courtesy Kyrenia Shipwreck Collection Restoration Program.*

Figure 2: *Black figured kylix showing merchant vessel. Athens 520-500 BC, found in Tomb at Vulci (central Italy) GR 1867.5-8.963 BM Cat Vases B 436. Image: C.J. Davey, courtesy of the Trustees of the British Museum.*

Roman period (Steffy 1985; 1994: 42-59). The seventh-century Yassi Ada shipwreck had a keel 22cm x 35.5cm, which would have promoted windward performance (Steffy 1994: 79-83). This evidence may not be definitive, but it is consistent and indicates that square-sailed ships during the Roman period and before had hulls with a capacity to sail toward the wind.

To allow for leeway it is common to measure the velocity-made-good toward the wind, not the speed of the ship itself. Seven replica Viking ships had GPS measured windward velocities of 1 knot or more (Whitewright 2011b: 9, Table 3). Whitewright's analysis of seven recorded ancient Mediterranean voyages by square-sailed ships in adverse wind conditions gave an average velocity to windward of 1.8 knots and thirteen voyages in favourable conditions, with a following wind, gave an average speed of 4.4 knots (Whitewright 2011b: 15). Using this data and known wind patterns, Leidwanger has modelled sailing times in the Eastern Aegean (2013).

Whitewright also assembled similar data for lateen rigged ships in the Mediterranean and found that from eight recorded voyages, ships averaged 1.4 knots to windward and in favourable conditions 4.5 knots. He concluded,

> *The evidence currently available would therefore seem to indicate that there is very little difference in the overall performance of a sailing vessel with a Mediterranean square-sail rig when compared with a similar vessel with a lateen/settee rig from the late-antique, medieval or modern era (2011b: 14).*

This conclusion runs counter to the generally held belief that the lateen rig was introduced because of its technical superiority. Castro has argued that the situation was more complex and that the transition from square-sail to lateen sail may have involved other factors such as changes in hull size, shape and construction (2008: 348). However, Castro's claim that ships rigged with a lateen sail could point closer to the wind than those with the Roman period square-sail is now questionable (Whitewright 2011b: 13).

Whitewright has also argued that there were many other factors influencing the transition from square-sail rigged to lateen-rigged ships in the Mediterranean (2008). In fact he has suggested that the lateen sail itself was developed in the Mediterranean between the second and fifth-centuries and that it was not of Indian Ocean origin. Whitewright supports his case with a comprehensive and sophisticated hypothesis of technological change to explain how and why the lateen sail was developed from the square-sail. He also draws on literary and iconographic evidence revealing that the earliest images of the lateen sail come from the Mediterranean (2009; 2012). His proposition is compatible with the archaeological evidence, which shows the concurrent development of frame-first hull construction and the obsolescence of brail-rings. Significantly, it is the growth of private trade and reduction in state-sponsored bulk commodity trade that he sees as a significant driver of the change (McCormick 2002: 64; Whitewright 2008).

The fourth-century Yassi Ada shipwreck reveals that half-frames, probably fitted simultaneously with the planking, was a significant change in hull construction. Steffy comments on the need for this development,

> *Technology had progressed, but more importantly economics and politics had changed so radically as to require a different shipbuilding philosophy. Shipowners were often independent businessmen with limited assets operating under what amounted to a free enterprise system. The decline of slavery had changed the labor market, too, so that time-consuming processes, such as cutting deep and frequent edge joints and meticulous shaping of planks, became even less desirable* (1994: 85).

Lateen rigs seem to have been adopted in parallel with the introduction of framed hull construction and both changes were driven by developments in politics and commerce (Whitewright 2011a).

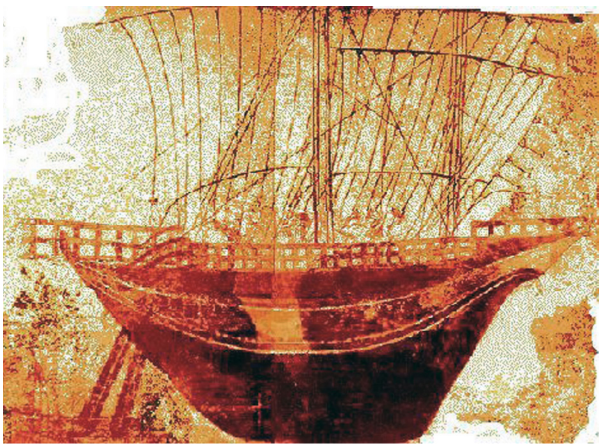

Figure 3: *A restored wall painting from the Tomba della Nave, Tarquinia, dated to the early fifth-century BC that depicts a second sail between the mainsail and the bow. Image: from Moretti (1961).*

Iconography

Modern scholars tend to be sceptical about ancient images. Throckmorton, for example,

> *..helpful as are the many extant wall paintings and mosaics of Roman provenance, in which ships and their rigging are depicted, one must make allowance for the fallibility of the artist. Many apparent variations in detail may well be the result of imperfect observation or faulty execution* (1972: 72).

Most known ship images have been found in maritime contexts ashore. The idea that people living and working in these places would tolerate their esteemed seafaring technology being misrepresented in commissioned work is highly unlikely. The artists certainly applied drafting conventions in their depictions and it is important to allow for these, relative scale for example is not strictly adhered to; the depiction of out-of-scale sailors strategically stationed may identify those who were in control of the ship, not that the boat was small. The artists were representing and commemorating the significant technological achievements of the maritime industry or memorable nautical events for the satisfaction of a knowledgeable audience. Graffiti may not be so disciplined, but if it is a choice between the ancient observer and a modern scholar, it would be wise to start by giving the former the benefit of the doubt. It would, however, be imprudent to draw significant conclusions from that which was not illustrated by the ancient artist, especially if those conclusions differ from the clear intention of the image.

Most commentators refer to the comprehensive documentation of ancient ship images in Lucien Basch, *Le Musée imaginaire de la marine antique* (1987). Unfortunately this publication is not generally available so a selection of images accompanies this paper.

Warships, with oarsmen and a ram at the bow, are by far the most common vessels represented by Classical artists; however, there are occasional depictions of merchant ships. The best known image of a Greek merchant ship is found on a late sixth-century BC kylix, Figure 2. The scene depicts the ship being stalked by pirates possibly at night, its sail appears to be reefed and only the helmsman is on deck unaware of the imminent attack. The hull has a distinctive concave bow and there is a 'kind of lattice bulwark' and a 'landing ladder prominently displayed at the stern' (Casson 1971: 68, 128 n.114). Measured on the waterline, the mast is nearer the bow than the stern and the yardarm is about twice the length of the mast. This sail configuration had been used for millennia by Egyptian and other Bronze Age sea-goers such as the Phoenicians. The reconstruction of the fourth-century BC shipwreck found near Kyrenia, Cyprus, the Kyrenia II adopted this sail-plan. Sailing trials found that it had a capacity to sail to windward, especially when the tack of the sail was sheeted near the bow and the yardarm canted upward toward the stern as in Figure 1 (Cariolou 1997: 94).

The restored wall painting from the Tomba della Nave, Tarquinia, dated to the early fifth-century BC, Figure 3, depicts a ship with a second sail between the mainsail and the bow (Casson 1971: 240, fig 97; Basch 1987: fig 880; 1976; Moretti 1961). While the restoration is not entirely certain, it does appear that the second sail forward of the main mast was not small. Casson believed this image to be 'conclusive' evidence that the foresail originated with the Etruscans in the fifth-century BC (1971: 70).

There are three images from Pompeii that must predate the city's demise in AD79. The graffito of the ship called *Europa,* Figure 4, is very detailed. It depicts a small square sail at the bow with a crew member in attendance possibly indicating that it needed adjustment. The drawing also shows the hull shape, sailors, deck facilities, timberheads fore and aft, and the ship's boat being towed.

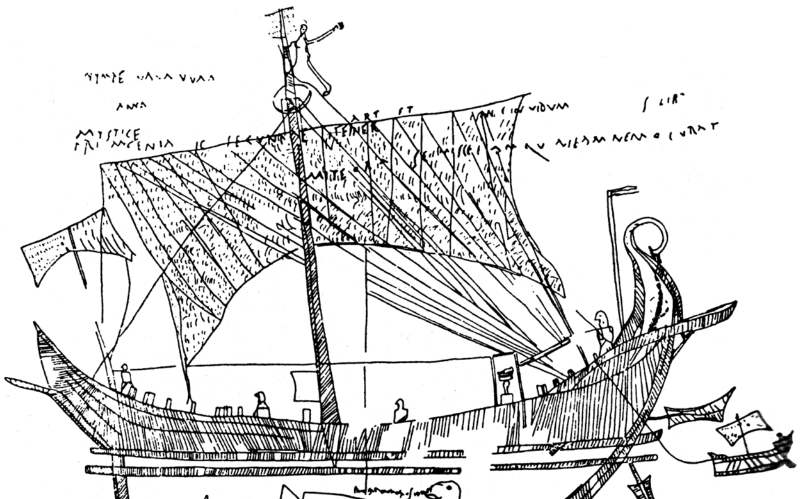

Figure 4: *Graffito from Pompeii of a large cargo ship, depicting two sails and other interesting details such as the underwater hull shape, rudder usage and the trailing boat. Image: from Benoît (1961: fig 73).*

Figure 5: *Wall painting of a ship with a small sail at the bow, Pompeii no later than AD79. Naples, Museo Archeologico Nazionale. Image: C.J. Davey.*

While the wall painting, Figure 5, appears to be venerating the larger than life ship-owner depicted at the stern, the sail-plan is complete with a small square sail on a sloping mast at the bow. A relief on the Tombstone of Naevoleia Tyche, Pompeii, not reproduced here, shows a ship shortening sail as it enters port (Basch 1987: 459, fig 1018; Casson 1971: fig 151). It has a prominent foremast but no sail is set on it.

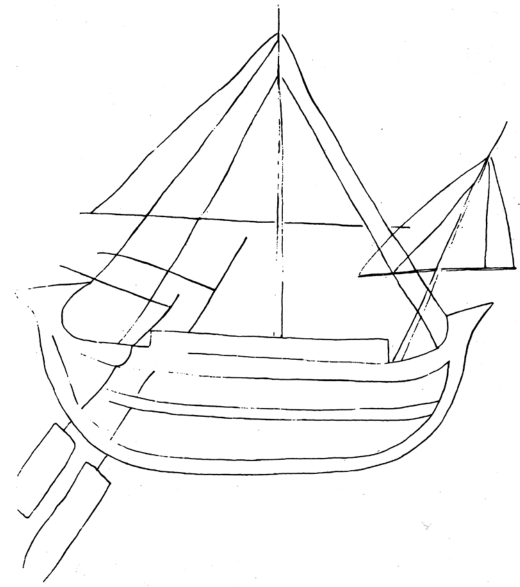

Figure 6: *Graffito of a ship from the arch in the Leptis Magna market (built c 8 BC). Image: Basch 1102, from Vergara Caffarelli & Caputo, 1966 pl 64 A.*

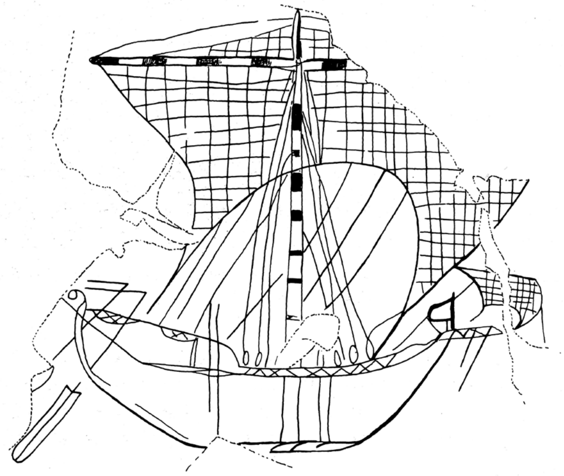

Figure 7: *Graffito from Sidi Khrebish (Berenike) near Benghazi dated by the excavtiors to late second-century. Image: Basch 1103, drawing from a photo by F. Sear (Pye 1974:pl 4)*

Graffiti depicting ships have been found at a number of other places. The drawing from Leptis Magna, Figure 6, shows a ship as it would appear in port with yardarms lowered. The ship has a forward leaning mast with a short yardarm on which a small sail would have been rigged. A graffito scratched into a plastered wall at Sidi Khrebish, Figure 7, shows a ship under sail, which includes what appears to be a topsail above the mainsail and a small sail set at the bow.

A graffito from the Palatino in Rome, Figure 8, is of a ship sailing with a small sail set at the bow. An interesting detail is the base of the mast carrying though to the keel indicating that the artist had probably been aboard such ships to observe this internal detail. Timberheads, used for securing shore- and anchor- lines, can also be seen on the gunwale at the bow and the stern. There is some uncertain detail at the bow and some writing on the side, which gave now lost meaning to the image.

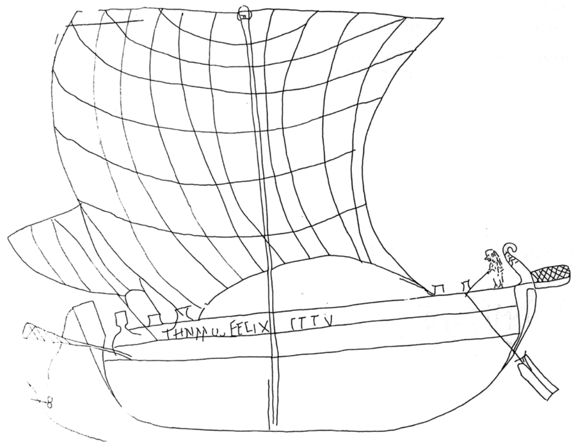

Figure 8: *Graffito of a Roman period ship rigged with a mainsail and a small sail at the bow. Image: from Castrén & Lilius 1970: 109.*

Figure 9: *A mosaic of two ships from Station 23, Square of the Corporations, Ostia c AD 200. The ships have contrasting rigs and hull shapes. Image: from http://www.ostia-antica.org/piazzale/corp.htm accessed 20.7.2015 (Becatti 1961: 73, Tav 179).*

A large number of maritime images come from the port of Ostia. The Square of the Corporations, Ostia, has black and white floor mosaics of 23 ships, only four of which do not have a second sail near the bow (Becatti 1961). The ships depicted in Figure 9 represent two different hull shapes and sail-plans. The ship on the left has a cutwater convex bow about which little has been written; a hull of this shape was excavated at Madrague de Giens (Tchernia 1978). The sail-plans are contrasting and the fact that the ship on the left with a relatively large foresail and the ship on the right with a small square front sail appear together demonstrates that these were two different sail-plans at the time. It may be concluded from this mosaic that where a larger foresail is depicted, it should not immediately be deemed an out-of-scale small sail. Also worthy of comment is the presence of a third mast and a mizzen sail on the left-hand ship.

A second scene, Figure 10, found on a third-century sarcophagus thought to have come from Ostia and now in Ny-Carlsberg, Glyptothek, Copenhagen, depicts two vessels with small sails near the bow, and one other with a sprit-rig (not shown), negotiating the harbour entrance. Sailors are portrayed to be busy at their stations exhibiting behaviour that led Casson to interpret the scene as a depiction of 'a crisis at sea' (Casson 1996: 50f).

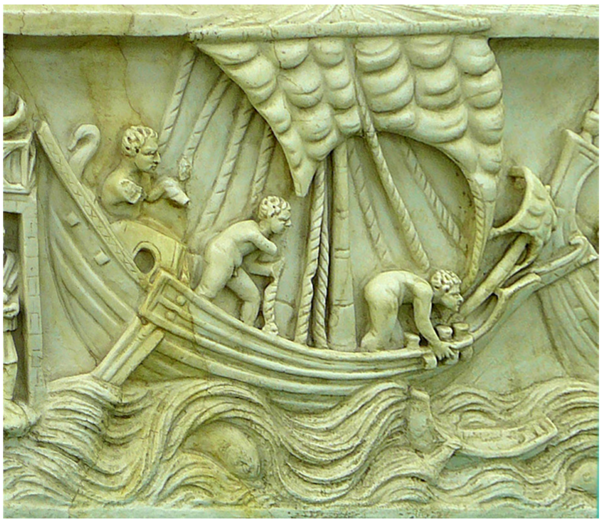

Figure 10: *The two vessels with small sails at the bow from a relief on a third-century sarcophagus, find spot allegedly Ostia. The ship on the right has a cutwater bow. Image: Wikicommons image of a replica in the Museum für Antike Schifffahrt, Mainz (Original at Ny-Carlsberg, Glyptothek, Copenhagen).*

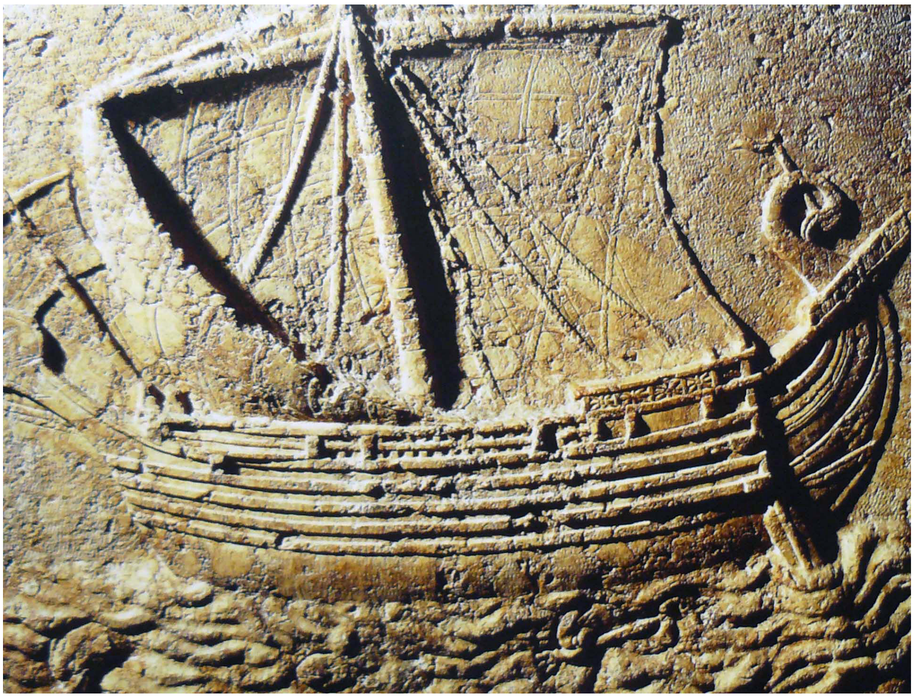

Figure 11: *Relief of a large merchant ship on a sarcophagus from Sidon, second-century, National Museum, Beirut. Image: Wikicommons.*

The relief of the large merchant vessel from a sarcophagus found at Sidon and dating to the second-century, Figure 11, has a small square sail on a sloping mast depicted at the bow. The absence of human figures in the depiction helps to give a sense of the massive scale of Roman period grain ships. Such vessels could displace over 600 tonnes; it is not hard to imagine the awe that they inspired and the reasons why artists drew them. A rope can be seen coming from the deck amidships and running forward, it would appear to be the sheet of the small sail at the bow.

The marble relief of Portus, dating to the late second-early third-century, now in the Musée de la Villa Torlonia, Figure 12, shows two ships, one entering port and one alongside unloading cargo. Both have forward leaning masts at their bows, but are without sails set on them. The context of the scene is that of port services and activity including the lighthouse, religious rituals and cargo handling.

A marble relief dating to about AD 200, Figure 13, depicts a coastal vessel with two similar sized sails (Casson 1971: fig 142; Basch 1987: fig 1104). Some commentators have made much of this depiction, but its sail-plan is much less common in the Roman period iconography than the sail-plan with a large square mainsail and small square sail near the bow, which is portrayed on the coins of Figure 14.

Images of ships with a lateen rig, sprit-rigs, single square mainsails, and three mast rigs from the Roman period could be shown, but they are not prevalent and are not relevant here. The preponderance of the iconographic data, some of which has been included above, reveals that in the first few centuries AD Roman period merchant ships had at least two distinct sail-plans both with additional

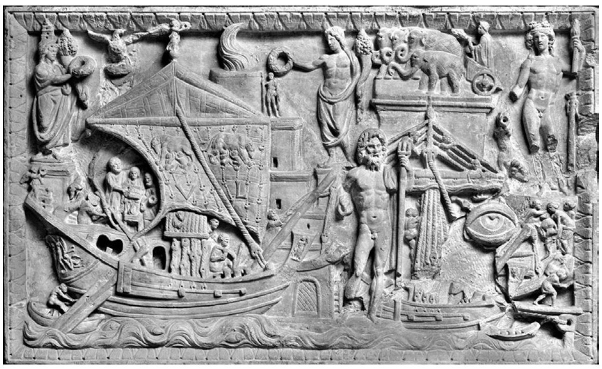

Figure 12: *The marble Torlonia relief of Portus, late second-early third-century, marble 1.22 x 0.75m Musée de la Villa Torlonia No 430. Image: Schreiber (1896: 99, abb 6).*

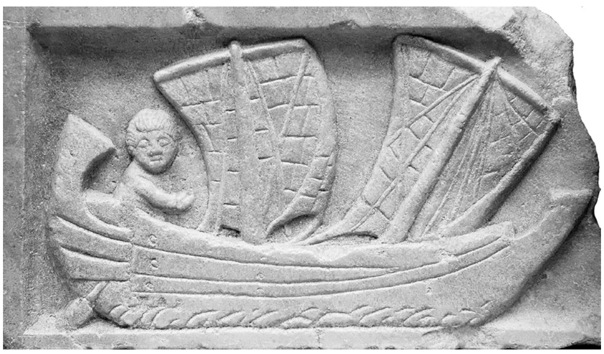

Figure 13: *A marble relief found at Carthage dating to about AD 200 depicting a coastal vessel with two similar sized sails BM GR 1850 3.4.32. Image: C.J. Davey, courtesy of the Trustees of the British Museum.*

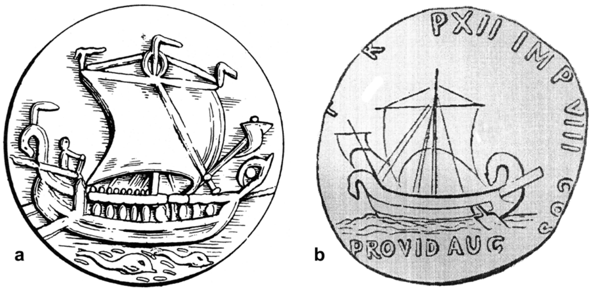

Figure 14: *Two coins depicting ships with a small sail at the bow, (a) from Alexandria AD 67. Image: from Torr (1895: pl 6 No 27) (b) time of Emperor Commodus drawn from a coin in the Avignon Museum. Image: from Smith & Smith (1880: 201).*

sails in front of the mainsail. Figures 3, 9 left and 13 show sail-plans with comparatively large foresails, while Figures 4, 5, 6, 7, 8, 9 right, 10, 11 and 14 show sail-plans where the front square sail is comparatively small. This second sail-plan is the focus of this paper. Some ship images, one included here, Figure 12, prominently depict a forward sloping mast with no sail set; many of these scenes are associated with port facilities where shortening sail was necessary.

The presence of a second sail has always been clear to observers however some have argued that the iconography was wrong while others have overlooked it. The otherwise excellent website *General Information on Ancient Roman Ships* (http://alkedo.wikispaces.com/General+Information+on+Ancient+Roman+Ships accessed 10.8.2015), for example, does not mention sails other than the mainsail.

Ancient references

Ancient Greek and Latin literature mentions a number of sails in addition to the mainsail. These include the ἀκάτειον - *akateion*, the σίφαρος - *sipharos,* the δόλων - *dolon*, and the ἀρτέμων - *artemon*.

The *akateion* is a sail at the front of the ship (Aristophanes, *Lysistrata* 61-64; Plutarch, *de audiendis poetis* 1; Lucian, *quomodo historia conscribenda sit* 45). The Aristophanes reference is in a play dating to 411 BC, the context is military and in fact Torr, a still useful analysis, notes that 'to hoist the *akateion*' was a proverbial expression for running away (1895: 86). He suggested that the sail was of Athenian military origin and that the term ceased to be used with the demise of the Athenian navy (1895: 86). However, the Lucian reference relates to a merchant ship indicating that there may be more to the matter. Torr does not resolve the names of sails situated in front of the mainsail, 'there is not anything to show what difference there was between the akateion and the dolon, and the dolon and artemon' (1895: 88).

The fact that the *akateion* was used as a sail to hasten a retreat means that it must have been large enough to generate power and been located where it did not threaten the command of the ship. A course away from the wind would offer the speediest retreat and a reasonably sized sail hoisted at the ship's bow would achieve a quick downwind get-away with straightforward directional control. The foresail depicted in Figures 3, 9 left and 13 would satisfy all these prerequisites raising the possibility that this foresail was called an *akateion*. Casson however has argued that this sail was a 'topsail' (Casson 1971: 241 n.72). The *sipharos,* Latin *suparum* is described as the 'highest of the sails' and is unquestionably a topsail (Seneca, *Epist*. 77:1-2; *Medea* 323-328; Lucan, 5.428-9; Statius, *Silvae* 3.2.27). This renders Casson's identification of the *akateion* problematic.

A *dolon* is a small sail mentioned in connection with warships in battle (Polyb. xvi. 15. 2; Diod. Sic.xx. 61; Pollux, i. 91; Liv. xxxvi. 44, xxxvii. 30; Isidor. *Orig*. 19:3; Procop. *Bell. Vandal*. i. 17; Torr 1895: 87). These references range in date from 201 BC to AD 533. Warships are often depicted with a small sail hoisted near the bow. They derived their ramming power from oarsmen, but their strategic advantage was achieved with rapid manoeuvring, which would have been greatly assisted by the *dolon.* The main mast and sail were generally left ashore during battle, but it seems that the foremast was carried. The *dolon* would have been set on the foremast to assist manoeuvring during the battle; and the *akateion* could have been hoisted from the same mast if a retreat was necessary.

A sail with the Latin name *artemo* is mentioned by Lucilius (*apud Charisium*, 99) a little before 100 BC (Torr 1895: 88). Torr also refers to Labeo and Seneca the Elder, who lived in Rome at the time of Augustus. Seneca (*Controversiae*, vii. i. 2) distinguished between the ordinary sail (*velum*) from a sail called an *artemo*, while Labeo (*The Pandects*, 1. 16. 242) distinguished the ordinary mast (*malus*) from a mast referred to as *artemo*. Casson was inclined to call all foresails *artemons* distinguishing between those that were large and small (Casson 1971: 240). This paper suggests it was the small square-sail at the bow depicted in Figures 4, 5, 6, 7, 8, 9 right, 10, 11 and 14 that was an *artemo.*

In Greek the sail was called an ἀρτέμων - *artemon* and occurs only once in Acts 27: 40. Smith's discussion about the identity of the *artemon* as a spritsail and his explanation for its mistranslations, including the King James Version 'main sail', seems to be generally accepted (Smith & Smith 1880: 192-201). The already mentioned Latin references support a second-century BC introduction of the spritsail-*artemon*.

The story of the shipwreck in Acts 27: 27-40 describes every sailor's nightmare, coming upon an unknown lee shore at night when running before a gale-force wind with a strong following sea. The incident has been considered in detail by Smith (1880) and Hemer (1990: 132-152). Anchoring from the stern (v. 29) was the correct response, and as the hull had a fine or pointed stern, the ship would have ridden the waves comfortably. Indeed, Cariolou's experience on the Kyrenia II led him to conclude that this procedure was normal (1997: 97). Bringing the ship around head to wind to anchor from the bow would have been challenging. Smith comments,

> *The advantages of being anchored in this manner are, that by cutting away the anchors (τὰς ἀγκύρας περιελόντες), loosing the bands of the rudder (ἀνέντες τὰς ζευκτηρίας τῶν πηδαλίων), and hoisting the artemon (ἐπάραντες τὸν ἀρτέμωνα), all of which could be, as they were in effect, done simultaneously, the ship was immediately under command, and could be directed with precision to any part of the shore which offered a prospect of safety* (Smith & Smith 1880: 136).

The decision to run for the shore and beach the ship was the best option in the circumstances. When approaching a lee shore or sailing over a bar where the water depth reduces, waves become steeper and may throw the stern of the ship forward and to one side in an unintentional manoeuvre called *broaching* leaving the ship side on to the waves where there is a danger of capsizing. The *artemon* was well suited to this situation as it was comparatively small and manageable in the windy conditions and was positioned at the bow of the ship where it could help steer a course away from the wind.

Paulinus of Nola (AD 354 – 431) *Epist.* 49.2 wrote to Macarius relating a story about an elderly man who was abandoned by the crew on a ship in circumstances not unlike those of St Paul. His miraculous escape was somehow associated with the *artemo* (Walsh 1967: 259f).

Augustine (AD 354 – 430) *Enarratio in Psalmum* 32.4 describes the *artemo* (often mistranslated as 'topsail') being used by a confused mariner to steer his ship,

> *Fac enim hominem optime gubernare navim, et perdidisse quo tendit; quid valet quia* ***artemonem*** *optime tenet, optime movet, dat proram fluctibus, cavet ne latera [some mss: lateri] infligantur; tantis est viribus, ut deterqueat navim quo velit, atque unde velit: et dicatur ei, Usquequo is: et dicat, Nescio: aut non dicat, Nescio: sed dicat, Ad illum portum eo, nec in portum, sed in saxa festinet? Nonne iste quanto sibi videtur in navi gubernanda agilior et efficacior, tanto periculosius eam sic gubernat, ut ad naufragium properando perducat?* (Augustin 2015)

> *For consider one who is expert at steering a ship, and yet who lost his direction: what benefit is it, if he maintains the spritsail firmly, deploys it with facility, keeps the prow facing into the waves, takes care that the sides of the ship are not battered in—indeed has such great facility that he can turn the ship where he wills, and away from where he wills, and someone says to him: 'Where are you going? And he replies: 'I do not know', or he does not say 'I do not know', but says: 'To that port over there', even as he hurries not to the port, but onto to the rocks? Is not such a one, the more he thinks himself active and effective in steering the ship, steering it all the more dangerously, by his haste bringing it to shipwreck at last?*

The illustration is of a strong and skilled mariner who steers his boat by using the spritsail but who does not know his destination. Augustine believed that it was preferable for a ship to be piloted by a weaker person who knew where to go and who would seek help to command the ship. The passage accurately describes steering a course over the waves to windward ensuring that the boat was not swamped, battered to pieces or brought to a standstill when control would be lost and nearly anything may happen. The passage clearly identifies the *artemo* as a sail associated with steering a ship.

There is the potential for confusion because the term 'spritsail' also refers to a fore-and-aft square sail used on barges and is popular today in recreational wooden dinghies. Casson discusses sprit-rigs used on harbour and coastal craft during the Roman period (1971: 243f, 333, 337). The subject of this paper is the small square sail carried by larger sea-going vessels; it was rigged on a yardarm that was attached under a bowsprit or a forward sloping foremast. To avoid confusion it will be referred to in ancient contexts from now on as a spritsail-*artemon*.

Theoretical perspectives

Ancient and modern writings refer to the spritsail-*artemon* in connection with the steering of the ship. The comments may be unintelligible or simply not significant for non-sailors, who no doubt assume that sailing ships are steered by their rudders. Sailors, however, know that the most important influence on the direction that a boat travels is the sail-plan and sail setting; and if these are incorrect no amount of rudder movement will bring the craft to the desired heading.

The diagrams in Figure 15 show the influence of the Centre of Lateral Resistance (CLR), which represents the point at which the hull's resistance to sideways movement theoretically acts and the Centre of Effort (CofE), which is the point where the aggregate force of the sails is deemed to act. As Palmer has argued (2009), the theoretical calculation of these points does not have much bearing on reality; however, all sailors are only too well aware that to effectively use a rudder, or steering oar, the real-world CofE and CLR have to be almost aligned as shown by Diagram B Figure 15. There is a strong preference for the CofE to be slightly aft of the CLR so that when left without interference from a steering device, the ship will turn head-to-wind and stop. The alternative is potentially disastrous as the boat bears away and careers out of control and unstoppable before the wind. Champion dinghy sailors often practise sailing without a rudder; they manipulate the attitude of the hull and adjust the sail to steer their boats so that when sailing normally they can minimise the use of the rudder, which slows the craft.

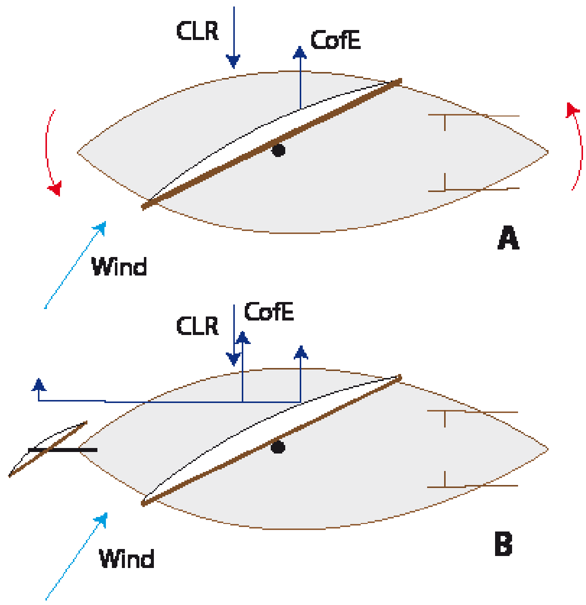

Figure 15: *Diagrams illustrating the interaction between the Centre of Lateral Resistance (CLR) and the Centre of Effort (CofE): **A**, mainsail only, and **B**, with the addition of a spritsail-*artemon *where the CofE is the aggregate of the two sails.*

However, ancient ships were not as finely tuned as modern racing dinghies. When the mainsail of an ancient craft was rigged as close to fore-and-aft as practical the CofE would move aft producing a strong tendency for the ship to round-up into the wind and remain there, Diagram A Figure 15.

The addition of the small spritsail-*artemon* at the bow changed the balance by bringing the CofE forward and causing the bow to swing away from the wind, Diagram B Figure 15. Being a small sail, the spritsail-*artemon* could be easily trimmed to alter its power. When the spritsail was sheeted in, its power increased and the CofE would move forward, causing the ship to bear away from the wind, while easing its sheets would move the CofE aft and the ship would tend to turn toward the wind. There is no suggestion that ancient sailors thought in terms of these theoretical concepts, but they clearly did appreciate the effects of sail adjustment and hull attitude. The ships depicted in Figure 9 right and Figure 4 are trimmed for windward sailing with sails set fore-and-aft and the mainsail tack (front bottom corner) sheeted near the bow.

In *Mekhanika* ('Mechanical Problems'), a short treatise on levers and the circle written by a Peripatetic and included in the Aristotelian corpus, but not by the latter himself, the writer describes in Problem 7 how sailors of the Classical period, when boats only had a mainsail, tried to address this problem,

> *7. Διὰ τί, ὅταν ἐξ οὐρίας βούλωνται διαδραμεῖν μὴ οὐρίου τοῦ πνεύματος ὄντος, τὸ μὲν πρὸς τὸν κυβερνήτην τοῦ ἱστίου μέρος στέλλονται, τὸ δὲ πρὸς τὴν πρῷραν ποδιαῖον ποιησάμενοι ἐφιᾶσιν; ἢ διότι ἀντισπᾶν τὸ πηδάλιον πολλῷ μὲν ὄντι τῷ πνεύματι οὐ δύναται, ὀλίγῳ δέ, ὃ ὑποστέλλονται. προάγει μὲν οὖν τὸ πνεῦμα, εἰς οὔριον δὲ καθίστησι τὸ πηδάλιον, ἀντισπῶν καὶ μοχλεῦον τὴν θάλατταν. ἅμα δὲ καὶ οἱ ναῦται μάχονται τῷ πνεύματι· ἀνακλίνουσι γὰρ ἐπὶ τὸ ἐναντίον ἑαυτούς. (851b7-14)*
>
> *Why, if the wind is not favourable when (sailors) wish to go about for a favouring breeze, do they shorten/furl the section/part of the sail that is towards the helmsman, but loosen/slacken the forward (part of the) sail at the foot? Is it because the rudder cannot hold the vessel back against a strong wind, whereas they draw it up when it (the wind) is light. So, whereas the wind carries them forward, the rudder settles the boat into the following breeze, holding back and making the sea heave. As well, the sailors at the same time are struggling with the wind, for they lean against its opposite direction* (Aristotle 1936: 361 amended).

The Loeb translation by W.S. Hett about sailors who 'wish to run before' the wind makes no sense in the context (Aristotle 1936). Going about to a desired course on the opposite tack where the wind may be deemed favourable is a better rendering. In fact, the passage is a good description of the struggles associated with going about in strong winds when sailing ships are inclined to go head to wind and to stay there. It describes how sailors tried to get ships to turn away from the wind, they reefed ('shorten') the aft part of the sail, which would move the CofE forward, they 'loosened' the forward part of the sail, maybe to backwind it, while the crew moved their body-weight to counteract the heeling of the hull, which prevented the CLR moving forward. All these actions reduced the turning moment toward the wind making the steering oar effective.

Backwinding involves reversing the sail at the bow to deflect the ship away from the wind. The description here may indicate that after the yardarm was braced (swung) round the tack of the mainsail, that is the front bottom corner, was loosened and temporarily sheeted from the opposite side to make the ship turn, Diagram A Figure 16.

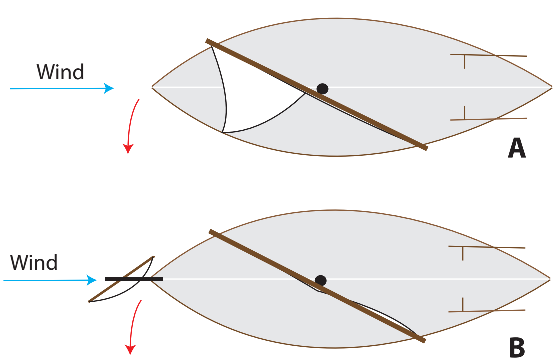

Figure 16: *Diagrams illustrating turning away from the wind when tacking: **A**, backwinding the mainsail, **B**, backwinding the spritsail-*artemon.

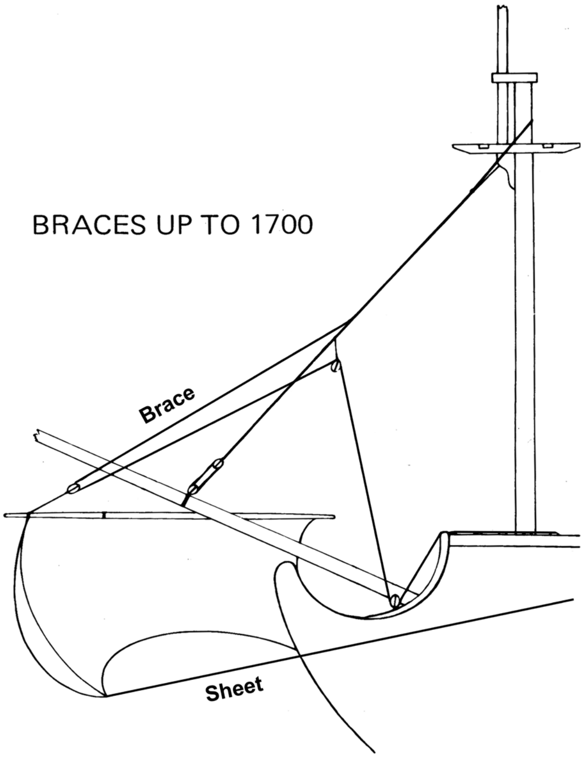

Figure 17: *A diagram of the rigging of a spritsail on an English ship of 1700, with only the portside brace and sheet shown. Image: after Lees (1984: 100)*

Smith comments that the spritsail-*artemon* was rigged not for speed but for assistance with steering when tacking, 'a small sail at the bow would be indispensable for making her 'pay off'', that is to help turn the bow of the ship away from head to wind (1880: 201). Rather than adjusting the mainsail, Smith is indicating that it was the spritsail-*artemon* that was backwinded.

By contrast Cariolou says of the Kyrenia II,

> *Tacking was found to be difficult but possible. We successfully tacked twice without using oars in winds between 2-4 Beaufort. Tacking in winds above 4 Beaufort proved difficult and very dangerous for the integrity of the sail and was therefore not practised* (1997: 93).

A wind of 4 Beaufort is a moderate breeze, 10-15 knots. During its sailing trials the Kyrenia II broke a number of steering oars while sailing closehauled and tacking demonstrating that significant turning forces were generated when going to windward. Ships with a single square sail and steering oars were clearly not very manoeuvrable and could be dangerous in winds exceeding a moderate breeze, especially when tacking.

The arrangement of the spritsail-*artemon* to turn the ship away from the wind is illustrated in Diagram B Figure 16. The sheeting of the sail may have been an issue. Figures 4 and 8 show bumpkin-like projections at the bow, which could have been associated with the sheeting of the spritsail-*artemon*.

Modern knowledge of the Spritsail

A few years ago I crewed on the *Endeavour* replica and had the opportunity to steer the ship to windward. The foresail was sheeted from the cathead, because the ship was not rigged with bumpkins as was the original when sailed by Captain Cook. Bumpkins are provisional bowsprits that allow the foresail tack (the windward bottom corner) to be sheeted near the centreline of the boat. The reefing ties proved to be excellent tell-tales to assist with determining wind direction. The exercise was only partially successful because of the flukiness of the wind and the fact that we did not set the spritsails. Indeed for the entire voyage the spritsails remained firmly furled, even though the ship had weather helm (a tendency to turn into the wind) and needed more sail set at the bow.

Contemporary illustrations of seventeenth and eighteenth-century ships at sea nearly always show the spritsail to be set. The details associated with rigging a spritsail continue to be described in rigging manuals, Figure 17 (Anderson 1955: 111-120; Lees 1984: 99-105; Marquardt 1992: 54-59, 186, 224f; Anderson 1994). Although many of the world's sailing historians were involved with the *Endeavour* replica and some were on board at the time of my voyage, they had no experience with the spritsail; the standing orders barely mentioned it. Knowledge of the spritsail's use had been lost.

Harland's comprehensive study *Seamanship in the Age of Sail* states that 'it is difficult to get much information about how the [sprit-]sail was actually used' (1984: 86). He quotes sixteenth-century Dutch experience that the spritsail was never set at night, in rough weather or when approaching land or sailing in convoy. When set, the spritsail obscured the forward view of the helmsman; but in most ships an unreefed mainsail also did that. The reason for these restrictions is more likely to indicate that the spritsail could be hazardous when sailing in rough seas or constricted waters. Communication between the officer of the watch on the quarterdeck and those operating the spritsail on the foredeck would have been difficult, especially when sailing to windward.

The power of the spritsail is described by Alan Villiers (1903-1982), a Melbourne-born seaman and author. In 1957 he gained experience with it when he skippered the *Mayflower II* on its re-enactment of the 1620 passage to America, Figure 18. He wrote,

> *As for the spritsail, this was so good a manoeuvring sail that I could well understand how it had persisted down the centuries, even after the use of jibs, set on stays from the fore-mast to the bowsprit and jib-boom, had long been general. Jibs were all very well, but a square-rigger man looked on his square canvas as his real sails. The spritsail was square, and the pressure it could exert, and so the swinging power it imparted in ship-handling, was immediately apparent. Our spritsail threw the ship's head off the wind far more effectively than a bowsprit full of fore-and-aft headsails could do,*

when we required it. You could see it at its work and the ship responding, and there was no doubt about it (1958: 253).

Villiers' attitude to square sails as 'real sails' is in contrast to many recent commentators who regard the square-sail in antiquity as inferior to fore-and-aft sails such as lateen rigs (Campbell 1995: 2). But the handling of the spritsail was not so straightforward. Villiers again,

The spritsail was harder to trim and to handle, but off a wind the sail set quite well even though the tack - the weather clew - was in the empty air, and could be bowsed down [hauled in with tackle] *to no place. The sail set with two sheets, one on either side, led well back along the ship's sides and, as long as the weather clew was well out to windward (which was contrived, as in any other square sail, by trimming the yard by means of the braces more towards the fore-and-aft line), the sail stood well and did its work. Because of the bowsprit's entire lack of standing rigging, it was also possible to improve its set by canting the spritsail yard, even to the vertical, and then setting the spritsail as a sort of quadrilateral jib. We tried this and it worked quite well. The multiplicity of the spritsail gear made this always a rather difficult sail to trim but, once trimmed, it stayed set very well and worked splendidly. To secure the spritsail, we clewed and bunted it up* [furled with buntlines] *to the yard like any other square sail, and worked at the canvas on the hoisted-out yard, from footropes. It could also be run in to the beak. Here again, the multiplicity of the necessary gear, and its unavoidably awkward leads, made this a difficult business, especially on a black night, and that was why we rarely tried to handle the sail in that manner. I suppose that was the real reason why the spritsail finally went out of fashion, leaving the ship's headsails to the staysail and jibs …* (1958: 254f).

The jib was introduced in 1700 and by 1800 the spritsail had become obsolete. As bowsprits became less elevated, the use of the spritsail was increasingly restricted by sea-state and this combined with the handling complications described by Villiers led to its demise. However, where the *Mayflower II* was concerned Villiers was impressed with the control the sail afforded,

With the spritsail, the lateen mizzen, and the good positioning of the masts carrying the real driving sails, our Mayflower both tacked and wore quite well, swinging either across the wind or round before it very fast, with little loss of way. Although such a chunky little ship and - to our eyes - so disproportionately high aft, there was nothing wrong with her manoeuvring ability. She handled as well as the sweet old iron barque James Craig *ex*-Clan Macleod, *which was the best handling square-rigger I had been in. She went to windward*

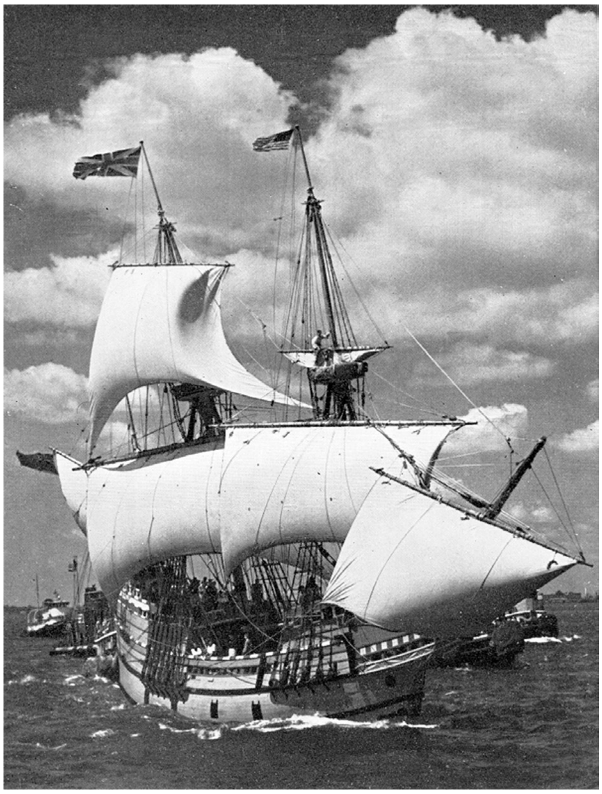

Figure 18: *The Mayflower II arriving in New York harbour on 1 July 1957. It is sailing to windward with the assistance of the spritsail, which is the front sail nearest the camera. Image: from Villiers (1958: frontispiece), courtesy NYC Municipal Archives.*

well in a good sailing breeze, and she could be made to lie up six points (1958: 255).

If only Alan Villiers had lived long enough to sail the *Endeavour* replica! After his discussion of classical terminology and iconography, Smith addressed the windward performance of Roman period ships,

We have no information as to the exact angle with the wind at which an ancient ship could sail. It must, however, have been less than eight points, but more than six, the usual allowance for a modern merchant-ship in moderate weather. I have, therefore, in my calculations taken seven as the mean between these extremes; and I cannot suppose it would be much greater (1880: 215).

A point is 11.25° and it is measured from the direction of the wind, so Smith estimated that Roman period ships could point 78.75° from the wind. His opinion appears to be based on the experience of mid-nineteenth century ships that could sail at about six points (67.5°) from the wind, and an assumption that Roman period ships must have been less capable. Like most current commentators, Smith did not offer reasons why the Roman period square-sails would be less effective than contemporary square-sailed vessels (1880). The Kyrenia II achieved a heading of about 61°, demonstrating the capability of ancient square-sailed Mediterranean vessels (Cariolou

1997: 92). Villiers indicated that the replica of the 1620 *Mayflower* had no difficulty achieving six points suggesting the possibility that all square-rigged ships with a balanced sail-plan could achieve this heading. Indeed, Villiers was impressed that the *Mayflower* handled as well as a 20th century clipper ship, testifying to a consistency in performance of square-sailed ships.

Discussion

Recent research comprising replica sea trials, wind-tunnel experiments and voyage analysis from ancient records has confirmed that ships with square mainsails could sail to windward. Pre-Roman period sailors managed windward sailing by varying the setting and reefing of the mainsail, a task that would have become more challenging as ships and mainsails increased in size. Even the comparatively small Kyrenia II had problems manoeuvring in strong winds. Aristotle's *Mekhanika* indicates that when going about Classical seamen 'loosened' the front portion of the mainsail thus altering the tangential forces near the bow and by so doing implying the logic of a small sail permanently rigged at the bow to assist with steering.

Iconography reveals that Roman period sail-plans were more complicated than those of earlier periods and that large Roman merchant ships, in particular, were consistently depicted with forward a sloping foremast at the bow, often with a spritsail-*artemon* set on it. This sail had limited power in comparison to the mainsail, but its position at the bow and its configuration as a square-sail on a yardarm, meant that it was able to exert a significant turning moment on the ship. The controlled application of this tangential force to the ship enabled it to sail to windward effectively and efficiently and go about without damaging the steering gear.

The rigging of a small sail permanently at the bow was dependent on securing the base of the foremast so that the tangential forces generated by the sail would be transmitted to the hull. The securing of the foremast had to be achieved within the hull structure as there was no practical way to hold it in place with stays. In any case, stays would restrict the way the spritsail-*artemon* could be set. As a result the spritsail-*artemon* mast became a permanent feature of the ship and is often shown, even when even no sail is set on it, Figure 12 for example. By contrast the mast used for the foresail, as depicted in Figures 3, 9 left and 13, was not raked so far forward and could be secured with standing rigging, like the mainmast.

This paper has focussed on the spritsail-*artemon* and as a result a number of significant issues have been passed over. The issue of the foresail, Casson's 'large *artemon'* and this writer's suggested *akateion,* has not been resolved. This sail may have enabled the size of the mainsail to be reduced, making it more manageable. The variations in the ship images in the mosaics of the Square of the Corporations, Ostia, offer much more information worthy of study. The ship shown in Figure 9 left has three sails, a smaller than usual mainsail, a comparatively sized foresail and a small mizzen sail probably used to assist with steering.

The French *artimon* was a sail set on the mizzen mast where it was used to help steer the ship. This raises the distinct possibility that the name *artemon* actually referred to its function as a steering sail, not its design or location. The derivation of the name *artemon* is not clear, it may not originally be a Greek word as its earliest known usage is in a Latin form. Casson's discussion of the term does not help because he believed that it was the name applied to all foresails after the fifth-century BC (1971: 240-243). He considered all foresails had substantially the same purpose and that some were large and others small.

While the spritsail-*artemon* and the 'large' foresail may have both been sails in front of the mainsail, their purposes were different and their masts were so different that the arrangements for the spritsail-*artemon* mast had to be made in conjunction with the construction of the ship itself. To act as a steering sail the spritsail-*artemon* had to generate tangential forces and effectively use its mast as a lever. Casson may be right that foresail depicted in the Tomba della Nave, Tarquinia, Figure 3, is 'conclusive' evidence that the foresail originated with the Etruscans in the fifth-century BC (1971: 70), but the spritsail-*artemon* was not a foresail in the sense that Casson meant.

This writer is inclined to think that the spritsail-*artemon* was devised as a steering sail from the outset and that it was unrelated to the larger foresail depicted in Figures 3, 9 left and 13. The Aristotle *Mekhanika* reference reveals that Classical sailors tried to use the mainsail to manage tangential forces at the bow; a small sail rigged permanently to do this would not have been such a great leap of imagination, then needed was a structural scheme to secure the spritsail-*artemon* mast and the tackle to operate the sail. The context that drove such a development is a potential subject for another paper.

A discussion of Whitewright's theory that the lateen rig was developed in the Mediterranean during the Roman period is also beyond the scope of this paper, except to suggest that it may have been experience with the spritsail-*artemon* rather than the mainsail that led to the idea of the lateen sail. Figure 18 shows the *Mayflower* sailing to windward with the spritsail rigged in a lateen-like configuration. However, the mainsail of the Kyrenia II as depicted in Figure 1 was also operated in a partial 'lateen' style when closehauled (Cariolou 1997: 94).

Whitewright's research does put the character of Roman period maritime trade and sailing technology into context. The replacement of the square-sailed Roman period ships was not driven by the need for improved performance. The State-sponsored grain trade between North Africa and Rome was dependent on large, square-sailed ships and was integral to the administration of the Empire. With the decline of that trade and a changing structure of the maritime economy, craft appropriate for the new circumstances were developed.

The spritsail-*artemon* does not appear to have a continuous history, it was for example not needed on lateen-rigged ships. However it is not always clear why it ceased to be used and how its technology was retained during periods of non-use. The loss of the spritsail knowledge-base since the nineteenth-century is significant. Practices deemed 'common' were often not the subject of written record because they were considered mundane and not worthy of comment; they do not enter the historian's purview. It is an aim of modern archaeology to discover the lives of ordinary people, and while this has often focussed on female domestic activity, there is a similar need to investigate the working environment of men. The 'reclaiming' of the spritsail-*artemon* is an example of this investigative process.

Conclusions

Contrary to general scholarly belief that Roman period seafaring was largely unchanged from earlier times, maritime iconography has shown it to be technologically diverse. Underwater archaeology is also revealing a variety in Roman period hull construction.

Analyses of the windward sailing capacity of ancient ships has moved beyond theoretical possibilities to the evaluation of sea trials of full-scale replicas constructed from plans based on underwater archaeological discoveries. Researchers, especially those associated with the University of Southampton, have argued that Roman period ships had significant windward sailing potential, overturning traditional ideas about the history of seafaring.

The main practical issue facing ancient mariners sailing to windward was directional control when closehauled and going about. Iconography reveals that a spritsail-*artemon,* a small square sail at the bow, was often included in the Roman period sail-plan. This sail had a powerful turning moment suitable for large ships; and while mainsails became cumbersome, the small spritsail-*artemon* was comparatively easy to manage. As the wind strength and direction varied, the spritsail-*artemon* could be conveniently tweaked to balance the ship's dynamic motive forces enabling the helmsman to steer an optimum course without the steering gear failing. When tacking, the spritsail-*artemon* was used to turn the ship away from the wind, to get the mainsail drawing and the ship underway.

Sailors in earlier periods had some ability to sail to windward, but they did not have the level of control that the spritsail-*artemon* afforded Roman period seafarers. Indeed, recent analysis and research is raising the possibility that Roman period ships' windward performance and manoeuvrability were equivalent to anything that followed, maybe even to the end of the age of sail itself.

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Table of Contents

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