

Shipbuilding in the Ancient Mediterranean

Approach to a better understanding of the relationships between ship technology and society

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Abstract

The study of ancient shipbuilding techniques and their development in the ancient Mediterranean has mainly been based upon a technical analysis of the archaeological and historical evidence available, concluding normally in a sort of logical and linear evolution. However, the new perspective given to the research of ancient maritime societies by the growing discipline of maritime archaeology and the study of the most recent archaeological finds lead us to reconsider the development of nautical technology in Antiquity and to understand the importance of the social component in its historical evolution.

Resumen

El estudio de las antiguas técnicas de construcción naval y su desarrollo en el Mediterráneo Antiguo ha estado principalmente marcado por un análisis técnico de los vestigios históricos y arqueológicos, resultando así en una visión lineal y lógica de su evolución. Sin embargo, el nuevo enfoque mostrado en el estudio de antiguas sociedades marítimas por la creciente disciplina de la arqueología marítima y el estudio de los hallazgos arqueológicos más recientes nos llevan a replantearnos el desarrollo de la tecnología naval en la Antigüedad y comprender la importancia del componente social en su evolución histórica.

Introduction

The different techniques used during the Ancient Mediterranean World in shipbuilding have long been assumed to manifest a sort of linear “evolution”. The research on ancient watercrafts and the field of maritime archaeology in itself, until very recently, have

studied and interpreted boats remains with a mere technical approach. Hence, the overview that has traditionally been given of the development of naval technology in the Ancient Mediterranean, from the first evidences of bundle rafts in Egypt to the construction of big plank boats, firstly using sewn joints as The Cheops Ship (2600 BC) and then the mortise

and tenon fastenings technique, used for instance in The Kyrenia Ship in Cyprus (300 BC), is that of a consecutive and related process.

In the last decade, however, the maritime archaeology discipline and the study of ancient boats have broadened its scope looking for the social patterns and anthropological traits behind the evident material culture. Furthermore, new archaeological finds and other sort of evidences are showing us that the nautical scene of the Ancient Mediterranean Sea was rather more complex than we had thought. Although it appears evident that shipbuilding techniques among mediterranean communities moved towards improvements in the manoeuvrability and the rigidity of the vessels, we often find that technology is restricted by the society that uses it, together with its socioeconomic systems, and also by the environment where they interact (Westerdahl, 1992 & 1994; Adams, 2001). Factors such as religion, tradition, political or economic system, which are in continuous relation with themselves, shape and constrain the ideas, symbols and uses that a specific society gives to its watercrafts.

Despite technological progresses in the mediterranean region new evidence shows that sewn-plank boats continued to be widely in use from the late centuries BC, in Roman times and even earlier, to the eleventh century AD, right into the medieval period (McGrail, 2001, pag. 136-137). At the same time, from the first century BC we can perceive a progressive abandonment in the use of the mortise and tenon fastenings, gaining crucial importance the internal structure of framing and longitudinal timbers. This appears to be clear in the evidence from the seventh century AD. By the beginning of the eleventh century AD the old shipbuilding technique of shell-first construction was completely abandoned and shifted to frame-first techniques, which were to be of great influence in the new social and political situation of Europe from the medieval

period onwards (McGrail, 2001, pag. 163-164; Muckelroy, 1978, pag. 64).

Throughout this paper it will be examined how the continuity of sewn fastenings and the evidence on the transition from shell-first ship construction to framing-first techniques can tell us about the social implications that their use entails. For that purpose it will be briefly summarised the shipbuilding techniques used in the Ancient Mediterranean until the Medieval Period and some of the evidence we have of them, analysing some specific examples to approach this better understanding of the relationship between ship technology and society in the Ancient World.

Shipbuilding techniques in the Ancient Mediterranean

Before the archaeological evidence

There is little evidence for the use of watercrafts in the Mediterranean before the Bronze Age. Iconographic and literary studies, however, suggest that during the Mesolithic times complex log rafts, as the ones that Hiram of Tyre used to send cedar to Solomon (I Kings 5:23), buoyed boats, as the ones described by Pliny used to transport elephant from Calabria to Sicily (NH 8. 16) or bundle rafts, as we see in some depictions in Malta or, for example, on a Minoan gold ring found at Mochlos, Crete (McGrail, 2001, pag.103; Johnstone, 1988, pag. 59) were in use. These bundle rafts, which were widely used in Early Egypt and Mesopotamia, continued in use in many parts of the Mediterranean during all the classical period as it is clearly shown in a graffito dated to the Roman Age from She'arim, in Israel, and in a boat representation from the rock-paintings group of La Laja Alta, Southern Spain, dated probably to the end of the Second Millennium BC (Almagro-Gorbea, 1988, pag. 398; Barroso, 1980, pag. 42; Dams, 1984; Luzón, 1988, pag. 455). Nowadays, bundle

rafts still in use in some marginal parts of the Mediterranean, in societies with long-standing indigenous traditions as for example in the Oristano Region, in Sardinia (McGrail, 2001, pag. 105; Riccardi, 1988, pag. 275-286). By Neolithic times it is probable that seagoing extended logboats or even simple plank vessels were technologically possible and took part in the colonization of Islands as Crete, carrying the obsidian, a clear indicator of early sea voyages (Johnstone, 1988, pag. 55). The direct evidence for these crafts, nevertheless, has to be found much later. Although there is evidence for seagoing travels in the Early Bronze Age (c.3800-2000 BC) we only count with iconographic material in order to interpret the type of vessels used at that time. The study of the lead models from Naxos, the terracotta models from Palaikastro and Mochlos or the depictions on the Cycladic "Frying Pans" suggests that the vessels used in the Early Bronze Age were either logboats extended in height and length or planked boats with cargo capacity and probably propelled by oars and with a helmsman (McGrail, 2001, pag. 106-111; Casson, 1995, pag. 30-39). Unfortunately, at present there are no excavated boats that can prove or give more light on the shipbuilding techniques used on these ships.

This iconographic and documentary evidence is more evident in the eastern Mediterranean at the beginning of 2000 BC, in what it is known as the Middle Bronze Age. This increase in the evidence comes associated to a growth in the number of seafaring activities, especially in the Levant Coast and in Crete. It is also in this time when we find the first evidence for the use of the sail in the Mediterranean, although it was probably in use much earlier in the late fourth millennium BC in Egypt. This first evidence is a Syrian cylinder seal from Tel el Daba (1800 BC). From these times are also the first depictions of masts and rigging features in the Mediterranean. They are on a series of Minoan seals dated to the beginning of the second millennium BC. On them, the mast appears amidships but normally the sail is not

shown. The hull used to be rounded with a higher end (may be the stern?) and they could have been propelled also by human force if we interpret the angular lines underneath the hull as oars (McGrail, 2001, pag. 113; Wachsmann, 1998).

But, without doubt, the representations that have raised more discussion on the Middle Bronze Age seafaring scene are those ones found at Akrotiri, in Thera. Leaving aside the controversies about its precise chronology or about the meaning of the scene itself, we have here vessels with a flat bottom whose ends curve upwards. The stern is slightly higher than the bow. They were probably plank boats, built with plank-first techniques. Whether if they had sewn fastenings or mortise and tenon ones, is impossible to tell from these depictions. They could be propelled by sail, oar or paddle, and were steered by a steering oar when it was necessary (McGrail, 2001, pag. 122). Although there have been many interpretations for the purposes of these ships (Wachsmann, 1980, pag. 287-295), their peculiarities, as for example the decoration, the stern cabin or the central awning, the old fashioned method of propulsion (paddling) and the stern projections (Casson, 1975, pag. 3-10), suggest that they were taking part in a sort of special event or ceremony instead of being intended for long-distance crossings.

Sometimes, the practical and technical shipbuilding methodology is placed in the background when facing profound cultural manifestations or needs (Adams, 2001). We can appreciate in this example how the society exerts a big influence on the use of boats, and therefore, in the way they were depicted.

Mortise and tenon plank fastenings

The end of the Middle Bronze Age is usually taken to be the fall down of the Minoan "thalassocracy" based on Crete. This event is

been related to the volcanic explosion of the Island of Thera dated to 1628 BC and by Egyptian correlation to 1450 – 1500 BC. Thanks to the excavation of several eastern Mediterranean wrecks dated between 1550-1100 BC, the evidence and data that we have from the Late Bronze Age is more extensive, making the picture more complex at the same time. Two of these shipwrecks, The Cape Gelidonya and the Uluburun (1200 and 1300 BC respectively), excavated off the south-west Turkish coast by George Bass, are the first planked vessels remains to have survived. The planking of both ships was fastened together by mortise and tenon joints, with the tenons locked in position by treenails (McGrail, 2006, pag. 60) (**Plate 1**). The Romans called to this

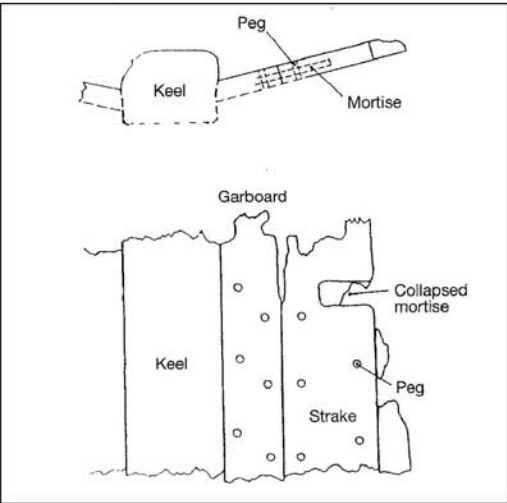


Plate Uluburun wreck remains (after McGrail, 2001, Fig. 4.22)

way of joinery *Coagmenta punicana*, which means “the Phoenician joint”, and it may have been transferred to the eastern Mediterranean World from Egypt via the Levant. The earliest known use of this type of joints in the Levant region is in a table from a middle of the second millennium BC tomb at Jericho. (Casson, 1995).

This fastening technique, certainly, is quite similar to the one used in Egypt in the third and early second millennium BC. The Egyptian

mortise and tenon joints, however, were not locked. Therefore, it was used together with other types of fastenings in order to give more rigidity to the hull. One example of this is the Cheops Ship (2600 BC). Her cedar planking was fastened together by unlocked mortise and tenon and, mainly, by two types of lashings: between adjacent strakes and, transversally,

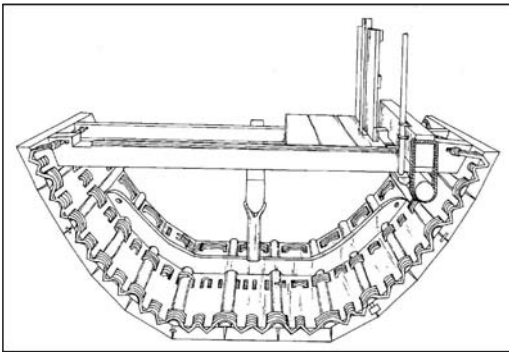


Plate Section of the Cheops Ship, with sewn fastenings (after McGrail, 2001, Fig 2.10)

from sheer to sheer (McGrail, 2001, pag. 26-54; 2006, pag. 58) (**Plate 2**). In 1850 BC the boats found at Dashur also had unlocked mortise and tenon joints, which were deeper than those in Cheops, and some of the objects found with them had locked ones. As Haldane has suggested (1996) is more than probable that this way of shipbuilding went on in Egypt for millennia and it was not until when the strong influence of the phoenicians was felt in the Eastern Mediterranean that the Egyptians began to build their vessels with locked mortise and tenon. One example of this is the mid-first millennium Egyptian boat found at Matariya, which not only has locked mortise and tenon plank fastenings but also contains frames (McGrail, 2001, pag. 40).

The Phoenicians could have developed therefore this technique of using locked mortise and tenon fastenings (influenced by the Egyptians), which gives to the hull more structure integrity, around the Middle Bronze

Age. The wrecks of Cape Gelidonya and Uluburun, according to the current evidence available, were Levantine in origin (Bass, 1997, pag. 269; Wachsmann, 1998, pag. 206-208). Then, with the enrichment of their city-states in the Levant coast and the consequent development of their maritime trade among the Eastern Mediterranean and beyond, this technique was widespread and generally used by the mid-first millennium BC.

During the fourth and third centuries BC Greek culture and technology dominated the eastern and central Mediterranean while Rome began to gain force in the Italian Peninsula. From this period we have a wreck site found off the shore of Cyprus, near Kyrenia, that represents the general nautical features that were to persist for half a century or so in the Mediterranean: Shell-first construction, planking fastened together by locked mortise and tenon fastenings and framing mostly fastened to the planking by metal nails. The Kyrenia ship (300 BC) is quite similar in shape to the one found in Ma'agan-Micheal (400 BC) off the Levant coast but her hull is solely fastened by mortise and tenon joints, without the help of any sewing technique. The Ma'agan-Micheal wreck presents sewing fastenings at the bow and the stern what has been interpreted as to gain further strengthening of the hull and to prevent lateral opening of the strakes on the sides (Kahanov, 2004, pag. 45).

The continuity of sewing techniques

During the mid-first millennium BC, however, most of the archaeological evidence that we have from wrecks, especially from the Central and Western Mediterranean, suggest a rather different picture. Several ships dated from the sixth century BC right into Roman times, which are either fully or partially sewn, have been excavated in the last decades giving new light and more complexity to the study of watercrafts in the Mediterranean World. Ancient sources,

as for example Homer (*Iliad* 2:135; *Odyssey* 5:234-257), Virgil (*Aeneid* 6.413-414) or Pliny (*NH* 24-65), suggest that Greek fleets had sewn planking and that the use of sewn techniques remained in Classical times (Casson, 1995, pag. 43-68). The wrecks dated to this period have been found off the Eastern Mediterranean shores, as the mentioned Ma'agan-Michael wreck; in Italy, as the ships of Giglio, Gela or in the Venice Lagoon; France, as for example the shipwreck Bon-Porté or Place Jules-Verne, in Marseilles (**Plate 3**); and in Spain, as the greek wreck of Cala Sant Vicenç, off the northern coast of the Island of Mallorca (Nieto, 2002), or the seventh century BC Carthaginian wreck of Playa de La Isla (Negueruela, 1995), although this latter only has lashed framing whereas her planking is fastened together by mortise and tenon joints.

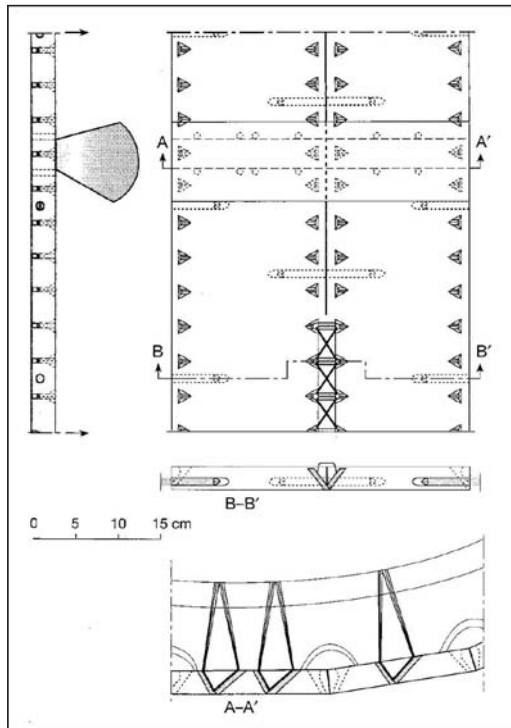


Plate Sewn fastenings on the Place Jules-Verne 9 wreck (after McGrail, 2001, Fig. 4.32)

Sewing techniques were still in use during Roman times until the Medieval Period as we can see in the wrecks of Cavaliere (100 BC), Jeanne-Garde B (Second century BC) or in the Cap Bear C shipwreck (First century BC). In these times, when the mortise and tenon technique was the main way of plank joinery and the influence of frames within the hull construction was growing, sewing was used mostly for repairs and in areas of the vessel where leaks were most likely to occur (underwater hull and ends) (McGrail, 2001, pag. 138). Nevertheless, several entire sewn-plank boats have been excavated from coastal sites in the Adriatic, in Croatia, and in the delta of the River Po despite the advances in nautical technology (Plate 4). Probably, these late sewn-vessels are the answer of indigenous societies to their environment and to the importance of their economical position within the Mediterranean community. Normally they are found in rivers, lakes, lagoons or deltas, being very improbable their use in long-distance voyages.

At first, mortise and tenon joints were used together with sewn fastenings. With the improvement of woodworking in the Eastern Mediterranean Sea, the technique of locked mortise and tenon joints was used as the only plank fastening in the hull. Also, the subsequent change to metal-

fastened frames instead of being lashed needed better skills in the way the timber was elaborate. The development of these techniques increased the cohesiveness of the planking shell, both in strength and watertightness (McGrail, 2001, pag. 148).

These changes in the hull structure and in the shipbuilding techniques from mid-second century until the Roman times are directly related to the social and cultural transformations that were going on in the Mediterranean World. The growth of the cities-states in the Levant Coast and in The Aegean region and the increase in the maritime trade competence led to the necessity of more rigid vessels, with major capacity and better

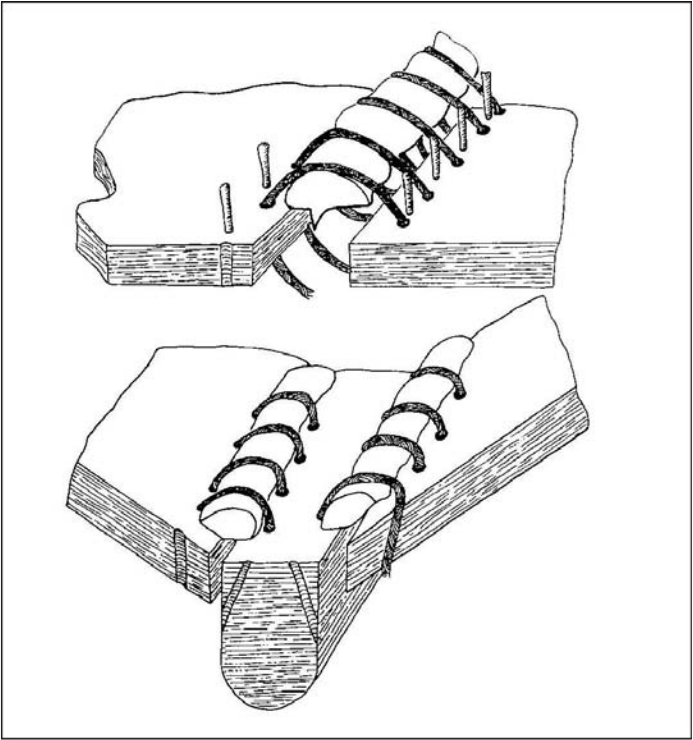


Plate Sewn fastenings details of the Nin boats, in Croatia (after McGrail, 2001, Fig. 4.35)

manoeuvrability. This also led to a need of protection of the trading goods and of the wealth of the cities-states. As McGrail has pointed out, some of these changes would have been stimulated by warship requirements. A ship built shell-first with a fastening system of locked mortise and tenon would have been “a better fighting machine than one with sewn-planking and lashed framing” (2001, pag. 148).

Transition from Shell to Skeleton Construction

The Roman Age, from mid-second century BC to the fourth century AD, was characterized in nautical technology by a general continuity in building techniques from the Hellenistic period (Muckelroy, 1978, pag. 65-75; McGrail, 2001, pag. 154; León & Domingo, 1992, pag. 199-218). To this period belongs most of the archaeological evidence that we have from Mediterranean shipwrecks. And, certainly, the increasing domination of Rome over the Mediterranean World, defeating Greece and Carthage at the end of the first millennium BC, influenced in the quantity and quality of the ships the were built at this time.

During this period, apart from small boats which followed the same shipbuilding techniques observed in the Kyrenia Wreck, the increasing demand for cargo space can be seen in the bigger tonnage of the merchant ships. Examples of this are the first century BC shipwrecks of La Madrague de Giens (400 tonnes) or Albenga (500-600 tonnes) (Parker, 1992). This resulted in the use of thicker planking or in the construction of a hull with inner and outer planking leaving some wool or other fabric saturated in wax in between. This would have given more strength to the hull structure and integrity (Steffy, 1994, pag. 62-65; León & Domingo, 1992, pag. 199-218), being thus more capable of carrying bigger and heavier cargoes. At the same time, planking strength was increased, either in double-planking ships or in single-planking ones, with the use of more fastenings per unit length, as we see in wrecks like La Madrague de Giens or Antikythera I, in Greece (First century BC) (McGrail, 2001, pag. 156). With these greater hulls we also observe an increase in size of the frames and in its use. They are internal and discontinuous and begin to be fastened to the keel giving more structural strength to the vessel.

While the construction technique of shell-first was still generally used in the Mediterranean

in shipbuilding, we begin to have some evidence from the third and fourth century AD of the new importance given to the frames in determining the ship's lines (Muckelroy, 1978, pag. 64). At the end of this period there were several changes in the social and economic prevailing systems along the Roman Mediterranean that were reflected in the technology used in shipbuilding (León & Domingo, 1992, pag. 199-218). Certainly, there was a tendency during the Roman Empire to look for less costly and faster methods of construction, giving less importance to the durability of the vessel herself (Muckelroy, 1978, pag. 65; Casson, 1995, pag. 141-148; McGrail, 2001, pag. 158). With the decline in slavery at the end of the Roman Empire, the expensiveness of shipbuilding process increased making the ship-owners prefer smaller and cheaper vessels. Wrecks of big

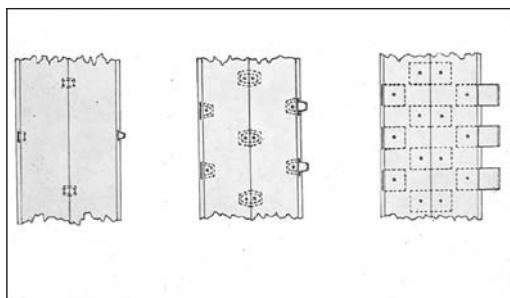


Plate Mortise and tenon joints from (right to left) Kyrenia (300 BC), Yassi Ada 2 (Fourth Century AD), and Yassi Ada 1 (Seventh Century AD) (www.).

merchant ships are uncommon after the second century AD. Furthermore, other social and natural factors that could have influenced this change in ship technology could have been for example: new types of goods that were traded, improvements in tools and techniques used for construction, deforestation or the introduction of fore-and-aft sail, what would have reduced also considerably the use of human force in the propulsion of the ships (McGrail, 2001, pag. 158).

All these social and economic changes can be implied in the study of a wreck found off Turkish shores, The Yassi Ada 2, dated to the fourth century AD, and of other ones from the fifth century AD such as Fiumicino I or Dramont 5 and 6 (Parker, 1992). These ships were small cargo vessels, built shell-first with planking fastened by mortise and tenon joints and frames alternately floors and half-frames. The major importance given to the frames can be seen in the bigger distance that can be appreciated between the joints and their smaller size. Finally, we find mortises and tenon joints not locked whose mere purpose was to help the plank alignment, as it was when they first appeared in Egypt.

The frame-first construction technique was known by the Greeks in the fifth century BC, as we can infer from Herodotus (1.194) but only in relation to the building of skin boats (Basch, 1972, pag. 47). It is, however, in the seventh century AD when we find the first archaeological evidence for ships built frame-first. Wrecks as St. Gervais 2, Tantura I or Pantano Longarini had their planking treenailed and nailed to a pre-erected framing instead of being fastened together (McGrail, 2001, pag. 161). Other wrecks, as Yassi Ada I (c. AD 625), were plank-first built in their lower hull, while frame-first in the upper part where there were simpler shapes. By 1025 AD, the technique of fastening planks by locked mortise and tenon joints was abandoned almost completely. The best evidence that we count with from this period is the Serçe Limano wreck, entirely built frame-first (Steffy, 1994, pag. 85-91) (**Plate 6**).

The consequences of frame-first construction can be followed during the next centuries, with the disintegration of the Roman Empire and the development of the Medieval Europe. The technological changes that have happened during the first centuries AD were influenced by the new social and economic systems that were being shaped at that moment. Now, the new shipbuilding method of frame-first construction, consequence of the continuous

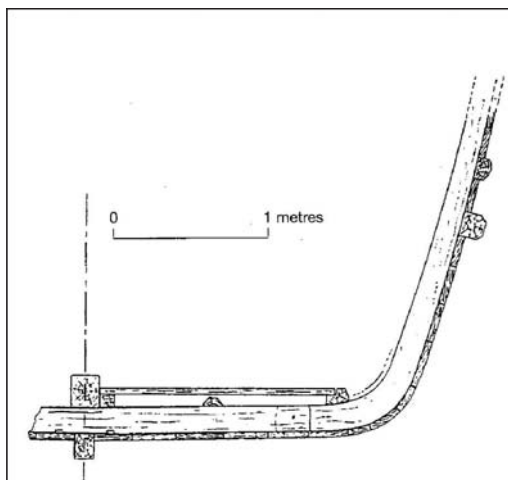


Plate Half a Section of the Serçe Limani ship (after McGrail, 2001, Fig. 4.45)

social interaction with the technology, was going to play an important role in the history of the incoming centuries. Frame-first construction made possible to build bigger ships in a quicker way. The resulting vessels had more seaworthy hulls appropriate for the ocean crossings that later on were going to take place (McGrail, 2001, pag. 160; Muckelroy, 1978, pag. 65; León & Domingo, 1992, pag. 199-218).

Conclusion

According to Seán McGrail, Maritime Archaeology can be defined as “the study of the nature and past behaviour of Man in his use of those special environments associated with lakes, rivers and seas” (2001, pag. 1). This relationship between human societies and water environments can take many different forms. One of them, probably the most evident and difficult to interpret at the same time, is the use of technology to interact with such environments. Along this paper we have tried

to summarise the development and complexity of techniques employed in the Ancient Mediterranean Sea to build that product of the interaction between society and environment that ships are. The study of boats, and their building techniques, does not have to answer only questions about their technical construction and their operating systems; it has to take us to wonder the foundations upon which maritime societies are based.

In the Mediterranean, the method of fastening planks together by sewing, appreciated firstly in Egypt, in The Cheops Ship, seems to have spread to the Aegean during the Bronze Age and from there to the Western Mediterranean where we find great number of sewn wrecks dated to the mid-first millennium BC. The other technique, also found in Egyptian vessels with the purpose of aligning the planks and reinforcing the sewn fastening, was the method of mortise and tenon joints. This system was taken and improved by the Canaanites, in the Levant coast, and spread over the Mediterranean with the development of the Phoenician cities-states and their trade expansion. These shipbuilding methods influenced peoples with different cultures settled along the Mediterranean shores. The access to them, as well as to their use, was constrained in many cases by the sources available in determine environments and by the societies themselves. Analysing this statement can make us understand for example the continuous use of bundle rafts or sewn-plank vessels in times when more sophisticated techniques were already developed.

Changes in the Mediterranean ship structure did not follow any evolutionary track. Shipbuilding techniques were developed according to the demands and needs of the societies that were using them. It is true, though, that nautical technology seems to have moved towards a greater complexity and, indeed, towards a bigger diversity in the Mediterranean. This variety can be seen, for instance, in the panel represented in a rock

shelter of southern Iberian Peninsula. La Laja Alta is located right in an area of cultural contacts between eastern mediterranean people and indigenous groups and dates to the end of the Second millennium BC and the beginning of the first millennium BC, when there was an increase in the eastern influences and presence in Iberia (Almagro-Gorbea, 1988, pag. 391). The panel represents seven different types of boats approaching what is interpreted as a port structure (**Plate 7**).

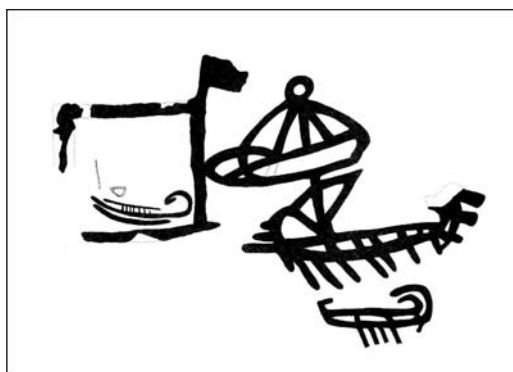


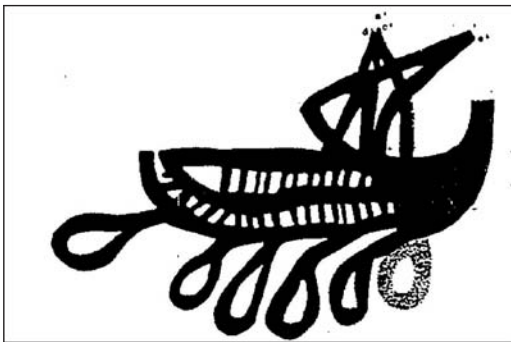
Plate 7. Three ships approaching a harbour. Another one, with the sail lowered, is docked inside the structure (after Barroso, 1980).

Although the quality of the paintings is very vague we can distinguish several sorts of rigs, propulsion methods (paddles, oars or different types of sails), and hull structures. Some of them seem to have rams (single one or triple), lateen sails and some emblems or figureheads in their stem-posts. A boat propelled by paddles seems to have a hull built of bundle reeds (**Plate 8**).

This panel was possibly made within the Tartessian horizon. The representations were depicted by people who were still impressed by the first ships of westerner seafarers who they traded with and were settled in the south of the Iberian Peninsula. Without doubt, this

panel represents the great complexity of ancient mediterranean seafaring (Almagro-Gorbea, 1987, pag. 398) and also makes us wonder about the especial significance that the author, and the society to which he or she belongs, gave to these boats and why did they chose this specific and remote location to depict them, as if their understanding of boats joined some other social practices, as religious ceremonies or offerings (Rey da Silva, 2006).

attract attention about how different traditions and necessities converged together to form a rich and varied technical panorama.



Vessel with paddles and a bundle reed hull (after Barroso, 1980).

Again, we appreciate that a mere study of ancient boats and their technology can take us to address more profound issues about the people who construct them and use them, even indirectly.

The new evidence of the continuous use of sewing techniques in vessels of the first millennium BC and even later, and the study of the long process that led to a shift in the way of shipbuilding from shell-first to skeleton or frame-first construction, make us understand how technology and its changes are directly related to the social interaction and the series of historical events which past human cultures went through. The nautical picture of the Mediterranean Sea in Ancient times is not longer considered to be that of a static and unilinear process. Instead, this paper tried to

Notes

- ¹ Temple of Hal Tarxien
- ² The earliest known use of this type of joints in the Levant region is in a table from a middle of the second millennium BC tomb at Jericho.

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