Ancient Lighthouses - Part 3: Early Greek Aids To Navigation

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Abstract: This paper offers an analysis of the methods of navigation used by the earliest Greek navigators and their contributions to the building of lighthouses.

Introduction

This paper will consider groups of people who populated the central Mediterranean over thousands of years and who proved to be expert mariners. The landscapes in which they made their homes were rugged and littered with thousands of reefs, rocks and islands from the very small and barely habitable to the large, resource-rich isles like Cyprus, Rhodes, Crete and Sicily where whole new societies could seed and grow to maturity. Travel by sea between these widely separated colonies was of the utmost necessity, and where sea travel was so perilous, the finest skills of technology and expertise were honed. Diverse at first, these small centres of wisdom and progressive ideas grew into a unified whole that we now identify as Greek, and that had a profound impact on the western civilization that many of us enjoy today.

Objectives

The objectives of this paper are:

1. To describe the practices of sea travel in the different periods of ancient Greece.

2. To identify the methods by which Greek mariners navigated the seas.

3. To determine sites where artificial aids to navigation were constructed.

Periods of Ancient Greece

Our understanding of the stages and development of what is generally called the Greek civilization is as good as any other in history and therefore it makes a good place to start looking at early aids to navigation. Fig. 3-1 summarizes the periods under review, and readers should note that despite the apparent dividing lines of the different time periods, there is always a 'fuzziness' at times of change, especially in earlier times.
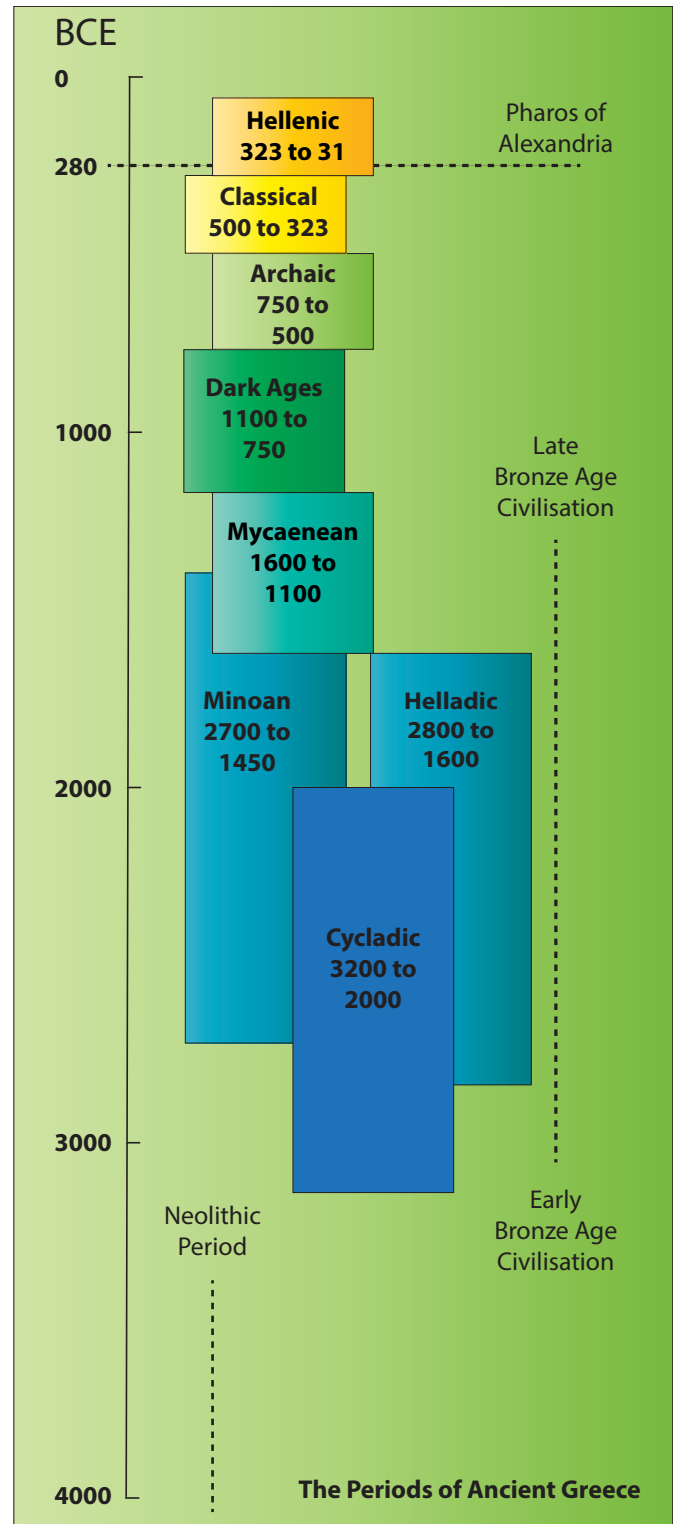

Fig. 3-1: The Periods of Ancient Greece.

The broadest periods of human history have been most commonly marked by the materials of the tools we used. For Greece, the Stone (Greek: lithos) Age is generally considered to be divided into 3 periods; Bronze and Iron ages followed approximately thus:

> *The Stone Age:*
> *Palaeolithic (Early): from ca. 2500 kya to 10 kya*
> *Mesolithic (Middle): from ca. 11 to 9 kya*
> *Neolithic (Late): from 10 kya to around 5.3 kya - 8000 to 3300 BCE.*
> *The Bronze Age: from 3300 to 1200 BCE*
> *The Iron Age: from 1200 BCE*

It is important to note that dates corresponding to these Ages can only ever be approximate, for they vary depending on the geographical region because civilizations developed at different times in different regions. Neolithic times were characterised by early farming activities - the domestication of plants and animals - and there is evidence of human agricultural activity on mainland Greece at Thessaly (Aeolia) in central mainland Greece, and on Crete at Knossos (or Cnossos) around the early 7th millennium BCE, though we should remember that earlier sites may yet be discovered on mainland Greece. The settlement of the Cyclades islands of the Aegean occurred in the late 6th and early 5th millennia BCE, but the period known as the Cycladic Period was essentially more advanced than Neolithic and took place in the early Bronze Age.[1] The term 'Helladic' is used to denote an equivalent stage of development on the Greek mainland. To have reached Crete and the islands of the Cyclades, humans were clearly using the seas for travel from an early time. For example, the exploitation of obsidian from the island of Melos (or Milos) took place before it was settled.[2] Archaeological investigations of the search for obsidian in the Mediterranean have shown that travel to Melos was difficult for early travellers, but long, open-sea journeys were motivated by the need to find new sources of this stone that could be made into sharp edges for cutting tools. (See Part 2 and Fig. 2-4.)

The earliest civilization of significance in the Mediterranean as a whole emerged on the island of Crete around 3000 BCE at Knossos and is known as Minoan. Although the great palace of Knossos was built around 1900 BCE, it was constructed on top of earlier layers of settlement. (A separate culture developed independently in Egypt, where the Nile Valley was settled by *homo sapiens* around 7000 BCE, and upper and lower Nile kingdoms came together as one civilization around 3000 BCE.) It was here that two very early forms of writing were discovered, known as Linear A and B. Because they were generally concerned with financial records, Linear A and B scripts contain no contemporary statements of history of the Minoan (or Mycenaean) cultures, and a clear idea of the roles of these scripts remains elusive. Our understanding of these earliest civilizations relies heavily on archaeological evidence and interpretations of the earliest Greek myths and Homeric epics, which were written many years later.

Before 3300 BCE, traditional archaeology regards the entire region as being in the Stone Age, a period of very modest technology without the benefits achievable from the possession of metal tools. There is evidence for the building of monumental buildings and fortifications in the so-called pre-palatial period on Crete of 3300 – 1000 BCE, but these are always attributable to buildings of high significance.

In numerous publications Heyerdahl has proposed the export of a Mediterranean culture across the Atlantic Ocean, based upon the construction of rafts made from papyrus reeds in the period before 3000 BCE.[3] There is no reason to disagree with this hypothesis, except to say that such craft, though paddled, relied on being carried along by wind and tides and were only crudely navigable. They were not practical for regular journeys for the purposes of trading across the entire Mediterranean. Additionally, it is hardly likely that the amount of sea travel involved in the use of papyrus rafts merited any kind of navigational aid worthy of description as a lightstructure.

Seagoing vessels in the Aegean first used sail around 2000 BCE. Trading by sea between the Minoan and Egyptian peoples between 2000 BCE and 1750 BCE is supported by finds of lapis lazuli from Mesopotamia, gold, ivory and alabaster from Egypt, ostrich eggs from Egypt and Libya, and amber from the north.[4]

The geography of Greece played a big part in determining its early history because the south-

ern mainland is essentially an island, joined to the northern mainland only by a small stretch of land 6.4 km in length, centred on Corinth, a location that will be considered in more detail later. This peninsula is called the Peloponnese.

The Minoan culture flourished unchallenged for about 1250 years from 2700 BCE until 1450 BCE. Over four centuries, a new power arose at Mycenae in the Peloponnese around 2000 BCE and was in significant competition with the Minoan people by 1600 BCE. A struggle for power between them was inevitable and by 1450 BCE the Minoan civilization was in serious decline, replaced by the more powerful people of Mycenae.

There was significant interaction between Knossos and Mycenae, separated by over 200 km of sea, and it is clear that travel across such distances was common. Whilst much of the distance could have been covered by navigation along the coast from one point of known land to the next, there was also a portion of voyage across open sea. Such distances could not have been covered in one period of daylight and the ships must have used celestial navigation or some other kind of night navigation. In all of the history of these times, there is no known written or archaeological record of any structure resembling a lighthouse as we might know it today.

By 1450 BCE, the Mycenaean sphere of influence extended across southern and eastern Greece, the Aegean islands, the western shores of Asia Minor and Cyprus. Regular embassies were exchanged with Egypt, Mesopotamia, Anatolia and the city-states of present-day Syria and Palestine. Trading was commonplace throughout the eastern Mediterranean. By 1300 BCE Mycenae was by far the richest place in the north Mediterranean lands and the king was overlord to much of Greece.

The origins of the Hellenic people - often referred to as Dorians - are thought to have been migrations or invasions from the lands to the north of Greece to occupy the entire mainland of Greece around 2000 BCE. Some scholars believe that the final invasion by the Dorians around 1200 BCE brought about the destruction of the Mycenaean civilization and the mass migrations of people expelled from regions surrounding the Aegean - the Invasions of the Sea People. Others maintain that the Dorian invasion did not actually take place and that the Sea Peoples were in fact mercenaries from

Sardinia. These conclusions remain the subject of debate today.[5] Whatever, the cause, the effect was destruction across a wide area of dozens of major cities, including Mycenae, in a narrow time-window sometime around 1100 BCE. This event is often referred to as 'The Bronze Age Collapse'.[6] The culture that is today referred to as the 'Western Culture' is a direct derivative of the blending of the Hellenic culture with the remnants of the Eastern Roman Empire that took place around 300 AD, and about which more will be written later. However, we need to briefly consider what is known about 'the Sea Peoples.'

The Invasion of the Sea Peoples

There is a well known period of history during which a series of great - some might say, cataclysmic - events brought about major changes to the human social order in much of Europe and western Asia.[5] The details of those devastating events are beyond the scope of this short description, but two of them included the termination of the Minoan and Mycenaean civilizations and major displacements of populations out of geographical areas they had inhabited for centuries. The sequence of events - the Bronze Age Collapse - likened perhaps to the falling of lines of dominoes, started in the twelfth century BCE and the consequences lasted, in some cases for more than two hundred years. In the history of the Greek peoples, the invasions of aggressive, irresistible but 'unidentified' people from the north created a 'Great Migration' out of mainland Greece and the near islands, across the Aegean Sea to the coastal strips of western Turkey - a region that for many decades has been called Asia Minor. Some refugees set sail for the southern shores of Italy and what later became Sicily. A major dispersal of people identified in history books as Ionians, Dorians and Achaeans - all of whom today are identified as ancestors of modern Greeks - took place, and led to upheavals that took more than two centuries to recover from. The period from around 1100 BCE to 750 BCE is often known as the Greek Dark Age. But dominoes toppled much farther afield too. The Levant suffered major incursions from aggressive people who arrived in ships. These people have still not been identified, except to be aggregated
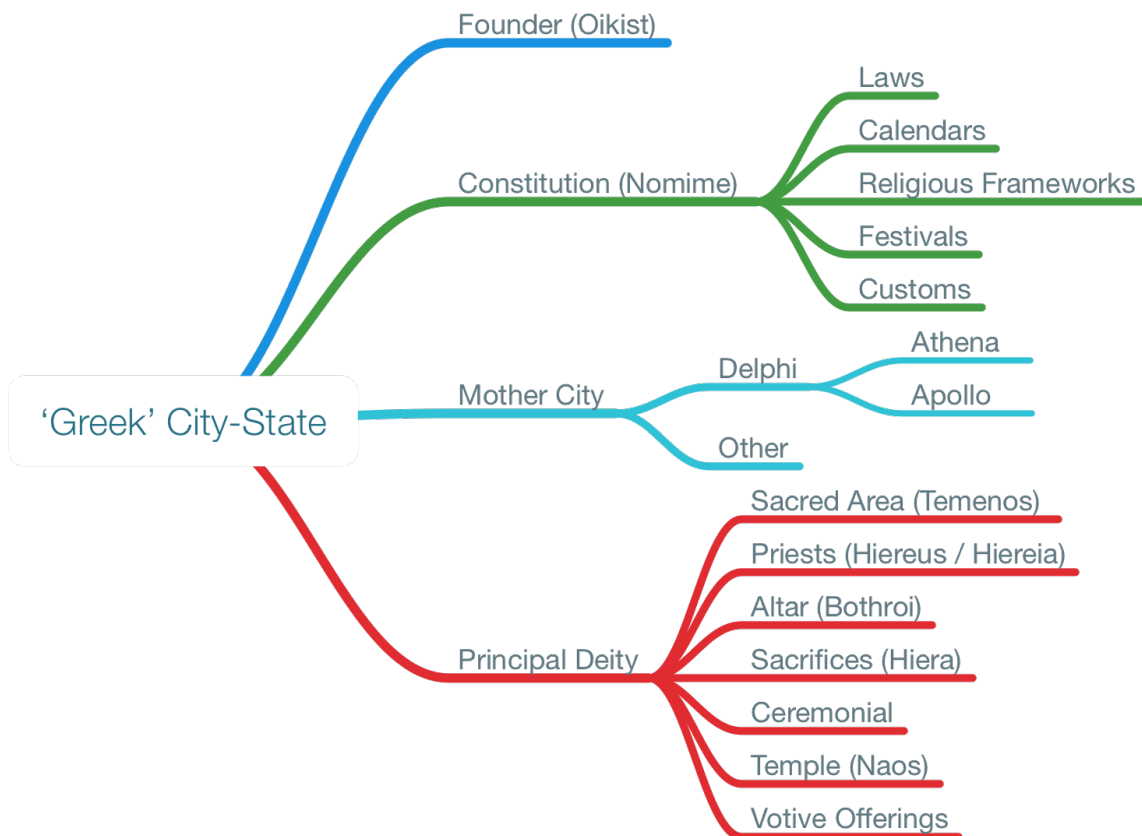
Fig. 3-2: Topic Taxonomy for the 'Greek' City-State, known as a polis.

under the broad title of 'The Sea People'. They had a profound impact in the Levant region, not least in Phoenicia, that will be discussed in the next Paper. They attacked Egypt too, but were finally repelled there by superior Egyptian forces and strategy.

It is surprising that such a turbulent period of human history remains shrouded in mystery. Historians have had to content themselves with descriptions of the effects instead of the causes, which were clearly spread over vast areas of land. With climate change so much on our minds today, there is, possibly, a so-far unexplored explanation. Inspection of data relevant to the Earth's average temperature during the period 1600 BCE to 1200 BCE shows us that there was a gradual increase in temperature of Greenland Ice Cores showing a rise of almost 2°C during the period from 1600 BCE to 1200 BCE, followed by a similar fall over the next two hundred years. This considerable rise in temperature was the greatest in the past 8000 years.[7] Bond has called it the 'Minoan Warm Period.'[8]Today we are well aware of the effects on our climate by a change of temperature of this size. Drastic changes to the climate under which established civilizations had thrived for years could well have caused drought, famine and pestilence,

with pursuant mass migrations and the toppling of the first dominoes. Furthermore, if this occurred in those civilizations having access to iron tools and weaponry, they could easily have overcome those peoples who lagged behind in technology. Broodbank has reported that iron objects were readily available in the Caucasus, Anatolia and North Mesopotamia, well ahead of other civilizations, and therefore these peoples would have been at considerable advantage over any competitors.[9] The cause of the temperature rise is not known but may have been the result of gigantic release of greenhouse gases caused by the volcanic eruption on Santorini around 1600 BCE.

Early Communities: The 'Greek' City-State

We are inclined to forget that 2500 years ago, the unit we now call a country was entirely different. Mostly, the largest societal groupings were what we now call city-states, i.e. an identifiable community living in organized groups of peoples about the size of a small town of several thousand inhabitants today. Greeks called them *polis* (singular) or *poleis* (plural) and the features
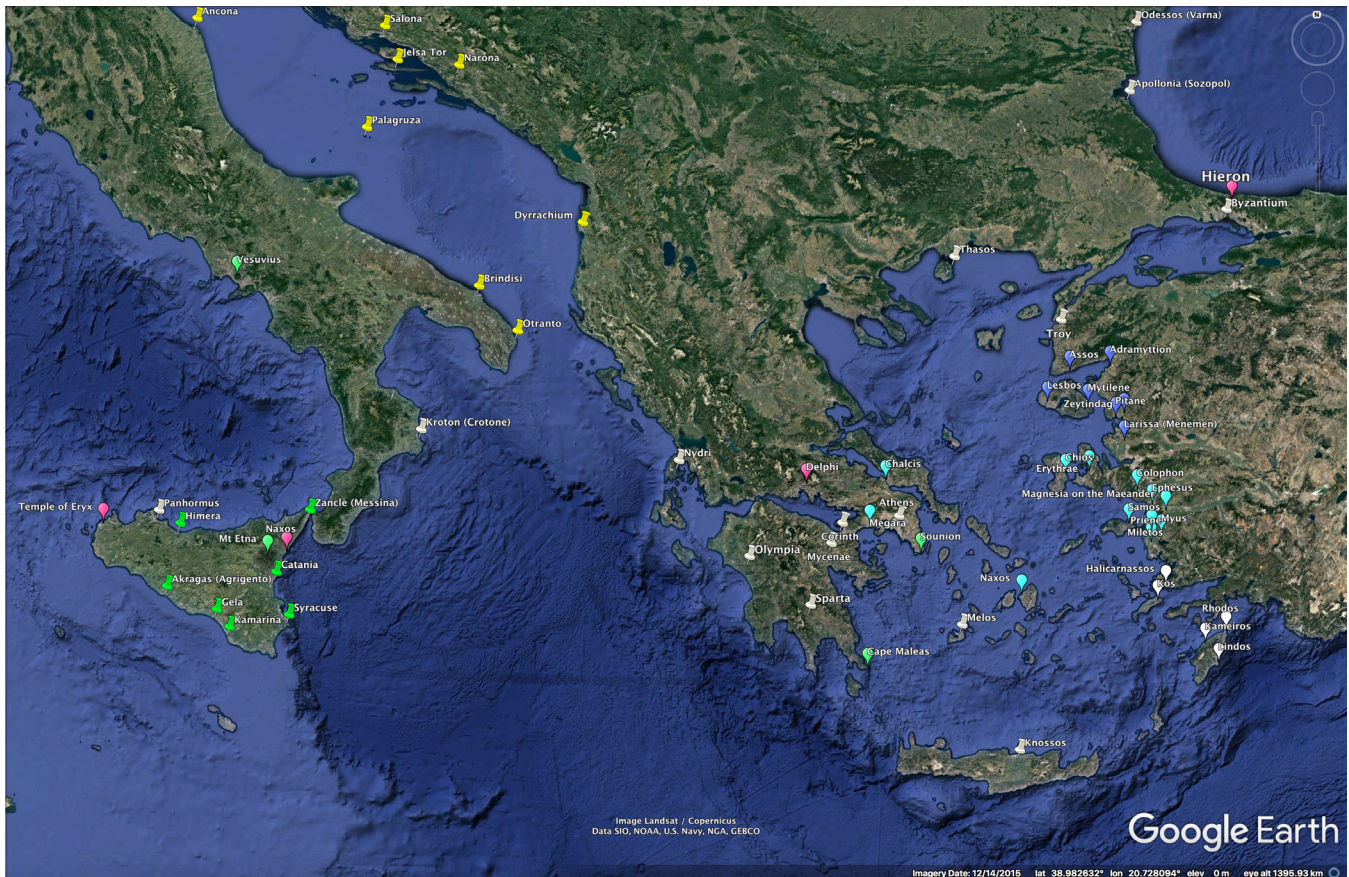
Fig. 3-3: The distribution of 'Greek' (and other) poleis in the mid-1st millennium BCE.[60] Ionia is represented by blue balloons; Greek colonies in Sicily by green pins; purple balloons are in Aeolia; white balloons are Dorian city-states; white and yellow pins are general locations; pink balloons are notable sacred sites.

that made them 'Greek' are shown in Fig. 3-2. In the Archaic period of 750 to 500 BCE, Mediterranean Society was a scattering of *poleis* and *emporia* (commercial entities such as markets). Naturally, those in coastal locations had strong maritime cultures and the long-distance export of products from their place of manufacture was mostly by sea in the first instance.

After the lands had initially become populated by the earliest hominins from the first dispersal out of Africa, the earliest peoples to arrive in mainland Greece at the start of the Bronze Age called themselves Ionian or Aeolian. Later, a third group, the Dorians arrived; some called it an "Invasion". This was, in part, to account for the population displacements we have attributed to the Sea Peoples, but there is no agreement that the Dorians were responsible. They were a more competent, more powerful people who influenced the other ethnic groups in many ways. Their precise origins remain unknown, but they first settled throughout the southern Peloponnese and western Greece, as well as on Crete. Corinth, located at the focus of important overland routes of communication was

a Dorian city. On the other hand, Athenians claim Ionian ethnicity.

The great shifts of population involved emigrations of people from the city-states they had created over centuries to new ones across the sea. A whole new array of 'Greek' City-States appeared along the shores of Asia Minor - present-day Turkey. Some regions were largely Dorian, others Ionian or Aeolian. Each *polis* had a founder and a constitution that varied depending upon the culture that had already been developed in the mother-city. There was always a principal deity that acted as a physical focus for all the day-to-day activities in the colony.

In this way, during the period from 750 BCE onwards, what later became the 'Greek' civilization grew out of a widely separated diaspora of large and small colonies with local variations in customs, but an overarching reverence to their centre of the world at Delphi, the mother of all mother-cities. A map showing the general distribution of some Greek poleis is given in Fig. 3-3. We note that there was no 'Hellas' (Greece) in geographical terms – the name served to describe wherever people

who identified themselves as 'Greek' happened to be living.[10] The diaspora was spread much farther than indicated in Fig. 3-3, not just across what we call Greece, but also parts of Turkey, Italy, France, Spain, Bulgaria, Ukraine, Russia and Africa. It is a remarkable distribution of similar peoples and took place thanks to a mastery of sea travel.

Readers might expect such widely separated, scattered communities would go their own ways, later to form countries of their own, but this is not what happened. Greek settlements consisted of both urban and less densely populated rural hinterlands. There was a general spirit of co-oper-ation at first, and mixing of clusters occurred freely and at random - Greek, Etruscan, Phoenician items were all carried together on trading ships. Some-times Greeks lived and worked alongside other Greeks, but quite often not - except on mainland Greece. In some centres such as Rhodes and Sicily, clusters developed regional identities, and general-ly retained their Dorian, Ionian or Aeolian features. Sometimes, adjacent poleis merged.

Rhodes, for example, became a single political entity only at the end of the fifth century BCE but its identity was forming much earlier. The first emigrant Dorians from the mainland built three important cities: Lindos, Ialyssos and Kameiros. (Together with Kos, Cnidus and Halicarnassus they made up the so-called 'Dorian Hexapolis' - white balloons in Fig. 3-3.) Though independent at first, they agreed to build a new capital named Rhodes at the island's best port location, and thereupon embarked upon a period of even greater success marked by the building of the Colossus already described in Part 1.

The merging of different Hellenic cultures was, in a sense, catalyzed by the gift to the Greeks of an area of Egyptian land by Pharaoh Amasis in the 6th century. Egyptians found the merchandise being traded by Greek ships from all over the Mediterra-nean highly desirable, and it was decided to allow these 'foreigners' to build their own enclave. A new settlement in Egypt called Naukratis emerged in 530 BCE as an *emporium* for Greeks, but which was highly prized by Egyptians too. The site was formalized in 570 BCE around a sacred site called the Hellenion - a great temple that was available to all. Even for a small minority of Greeks living among non-Greeks, temples were essential.[11] Tem-ple-building is a subject to be considered shortly,

but for now we should note that the period of the ancient Greek temple (*naos*) did not begin until the Archaic Period around 700 BCE; the Temple of Isthmia, built in 690 - 650 BCE was perhaps the first true Archaic period temple. So, at Naukratis, the Hellenion was a great catalyst in the coalescing of sub-ethnic cultures into a broad-based Hellenic identity.

Naxos (Sicily)

During the Great Migration, proto-Greek people left their traditional homelands and travelled by sea to find new settlements.[12] In 734 BCE Naxos was the first place of landing on Sicily for a party of Ionian emigrants, often referred to as Chalkidians, originating from Chalcis in Euboea. Ships making use of the common northeasterly winds and sailing west past Italy from southern Greece would easily have come across the eastern Sicilian coast, and Naxos became the point of interception. Surpris-ingly, the new settlement was not named Chalcis but Naxos after the island in the Aegean from which some of the party had come. And because the principal deity of the mother-city was Apollo, under their founder (Oikist), Theocles of Athens, they immediately dedicated an altar at the new Naxos to Apollo Archegetes.[13] As the first stepping stone for Greek settlement in a new island, Naxos became a very important focus for much of the hu-man traffic to and from Sicily, and, in particular, the Sanctuary of Apollo Archegetes remained intact for around 700 years even though the city-state of Naxos had been largely destroyed for the previous four centuries because of battles over its strategic location. For example, the Roman general Octavian took his fleet to Naxos around 30 BCE, prior to his assault on Cleopatra in Egypt, so that he could visit the sanctuary.[14] We can say with confidence that, over all those centuries, seamen would have relied upon light coming from the *temenos* at Naxos as an aid to navigation. Whilst extensive archaeologi-cal investigations have not been performed here, it is not thought that a major temple was built here, perhaps because of the fighting over the land. By comparison, ruins of the Temple of Apollo at the mother city in the southern Aegean remain today, proud and upstanding to receive the many visitors who come to see them.

Fig. 3-4: Replica of the Greek trireme Olympias on display at the site of the ancient port of Phalerum, shown in Figs. 3-5 and 3-6. These ships formed the basis for Themistocles' powerful navy.[61]

Athens and its Ports

Athens is located at the northwest corner of the great peninsula of Attica that stretches south-eastward into the Aegean Sea. Today, the large city covers an area of 15 square miles (39 square kilometres), the metropolitan area, 167 square miles (433 square kilometres). The core of the ancient city consists of a flat-topped mass of rock known as the Acropolis, where a citadel was built. Northeast of the Acropolis, the pointed summit of Mount Lycabettus (Likavittus) rises to a height of more than 1100 feet (330 meters).

The location of Athens was favourable for its early growth. The Plain of Attica provided good conditions for farming, while the surrounding mountains gave protection against enemies. There were good natural harbours, yet it was distant enough from the coast to prevent surprise attack from the sea. The site has been inhabited since before 3000 BCE. The earliest buildings date from the late Bronze Age, about 1200 BCE, when part of the town spread to the south of the citadel on the Acropolis. The 6th century BCE was a period of great growth. The old, primitive shrines began to be replaced with large stone temples, thus changing the Acropolis from a citadel to a sanctuary. In 480 BCE the city was captured and destroyed by an army of Persians. The Acropolis buildings were burned and the houses in the lower town mostly destroyed. When the Athenians returned the next year they immediately began to rebuild their city, and over the next 30 years they built only fortifications and some secular buildings. The Acropolis and its destroyed temples were left as a reminder of Persian atrocities until a peace with Persia was reached in 449 BCE.

There is a strong tradition in Greek culture for the marking of tombs with a stone-built memorial. Such artifacts when located close to the coast were inevitably useful to navigators and may often have been marked with 'eternal' flames, making them secondary lightstructures.[15]

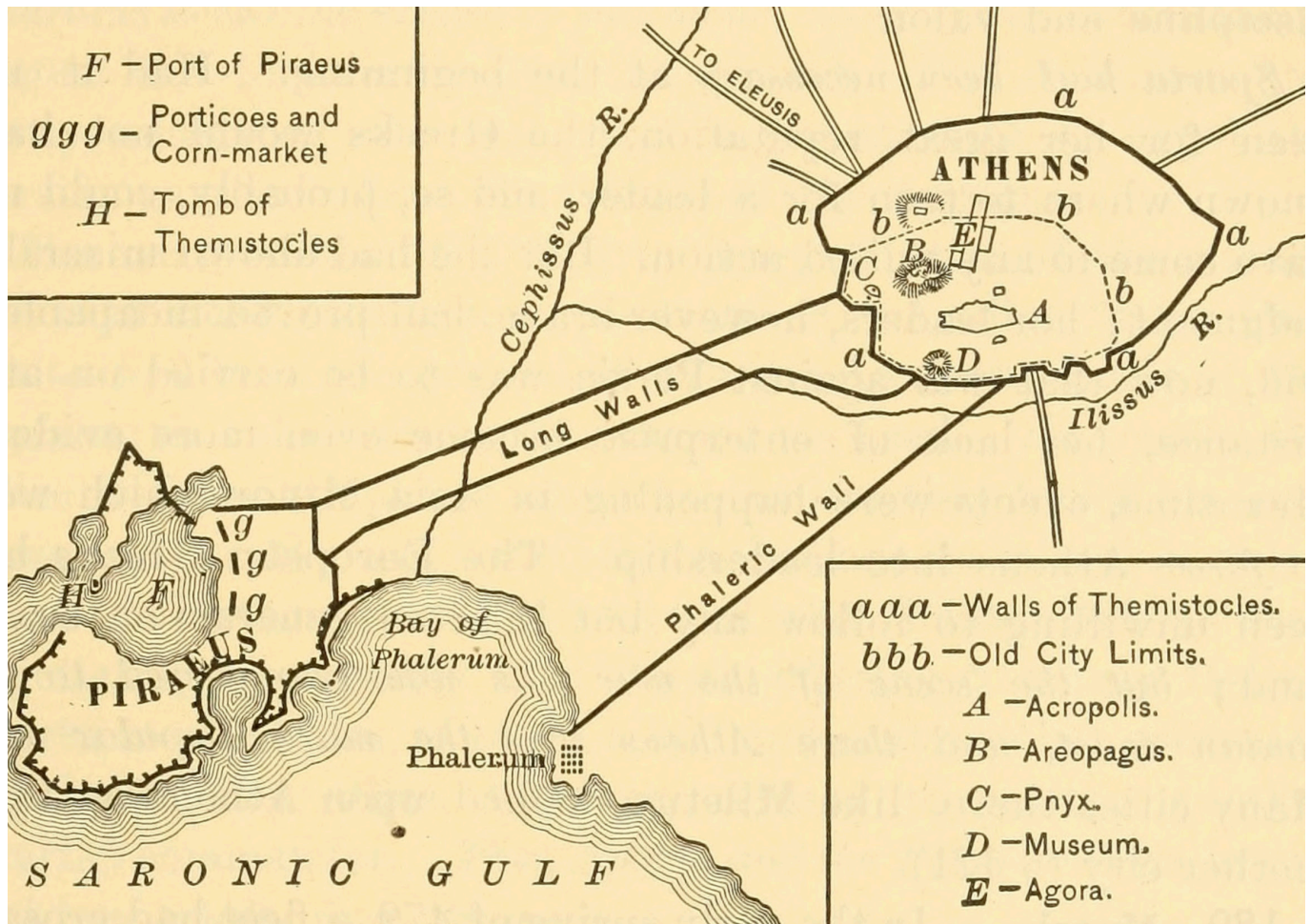Athens was at the zenith of its power and in-

Fig. 3-5: An old map of Athens and its ports, Piraeus and Phalerum. Piraeus began on the island of Akte, now joined to the land (bottom left). Readers should note the position of the Acropolis, and the long protective walls between the city and the port. Comparison with the layout shown in Fig. 3-6 is instructive.

fluence by 500 to 400 BCE. Greek travellers could cross the entire Mediterranean and Black Seas in ships of up to 500 tons. Whilst the largest ships, like the trireme shown in Fig. 3-4, were generally used for military purposes, ships of 100 tons were common and merchant cargoes of the same weight were the norm. The wealthiest Greek city-states were all ports: Athens, Corinth, Syracuse and Miletos, for example, compared to inland cities that were generally poorer. The reason was simple: sea trade.

> *"A Greek oil dealer who, every summer, transported two or three hundred 5-gallon (23 litres) jars weighing some 100 pounds (45 kg) each to a market hundreds of miles away, was able to load them all into a single ship of only moderate size, but he would have needed an endless file of donkeys or ox-carts to carry them overland."[16]*

And it would have taken far longer, too. Casson's detailed work describing travel in the ancient world

discusses the dangers of travel too, most notable of all being the threat from piracy. However, the dangers posed by the lack of navigational aids are not discussed.[17]

Athens' great modern seaport, Piraeus, is 5 miles (8 kilometres) away on the coastal plain and has serviced Athens for 2500 years. In history, several sites have been used as ports - Figs. 3-5 and 3-6 compare an old map and the latest satellite imagery. The first site chosen as a port for Athens was a shallow harbour at Phaleron (Phalerum). In view of our etymological studies in Part 1 regarding names beginning with 'Pha' we might speculate about the significance of the name of this port and that it might have indicated a light at the port entrance. Sadly, there is no evidence in support. To the west of Phaleron lay the rocky island of Akte on which the city of Piraeus began. The marshy land between this island and the mainland soon dried to form an isthmus that itself became enlarged; three useful harbours were created from
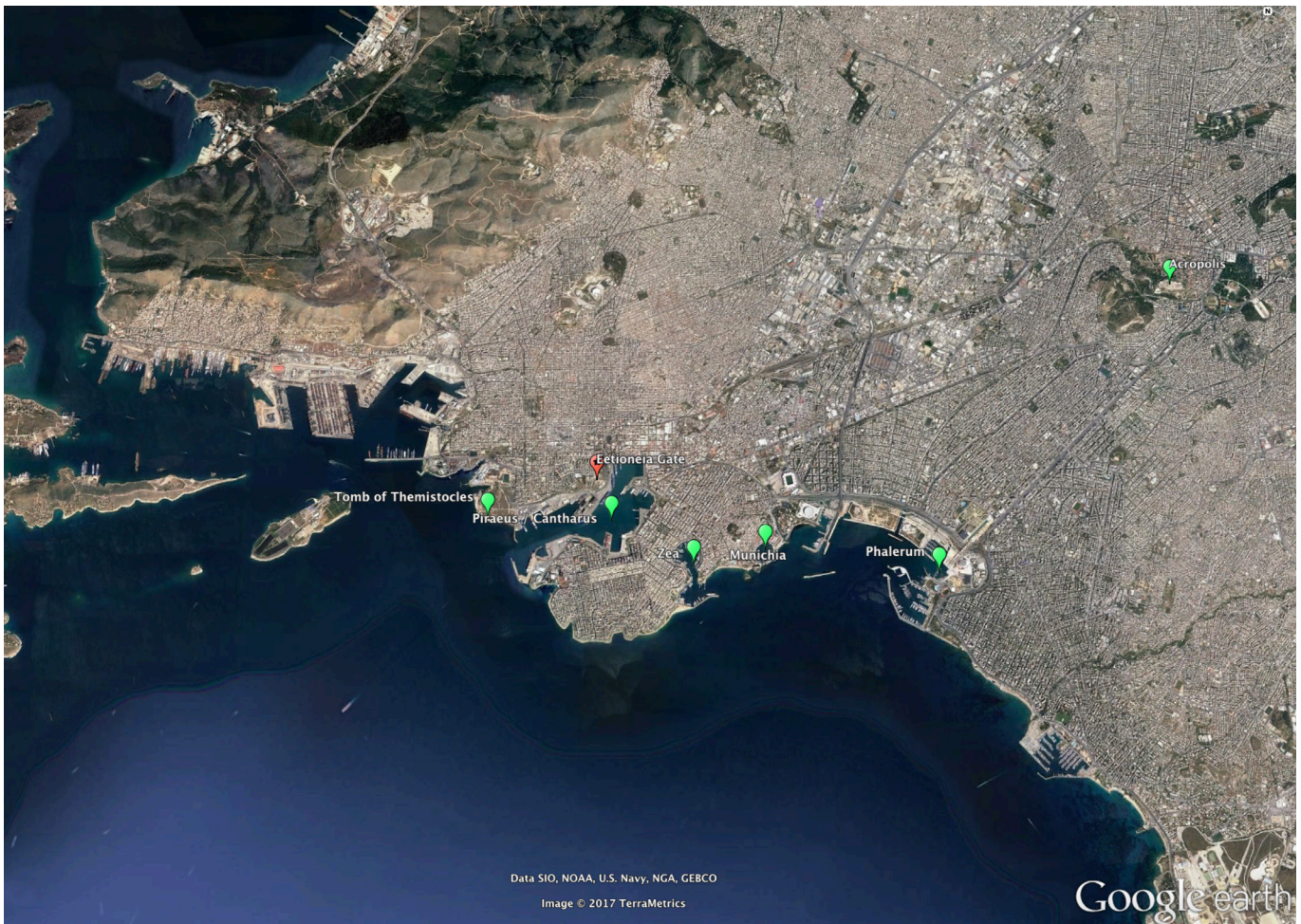
Fig. 3-6: Locations of the old sites from Fig. 3-5 on a modern map. The long walls can be seen preserved in the modern Greek streets layout; also the location of the proposed Tomb of Themistocles and the Eetoneia Gate, both of which could have been lit as aids to navigation.[62]

these geographical changes. Two harbours, Zea and Munichia, lay to the southeast; the third and larger harbour, Cantharus, became the main port. The three ports together formed a composite Piraeus.[18]

The most striking features from the study of ancient maps of Athens are the Long Walls that were built to provide protected access between Athens and its ports. The Phaleric Wall was constructed between the city and the first port, while two others ran to the fortified area that surrounded Piraeus. All were part of a series of great military structures protecting the people of Athens and their access to the sea. These great harbour developments took place around the start of the 5th century under the leadership of a great Greek called Themistocles (524-459 BCE). He was a populist politician and general who rose through the ranks to command the armies of Athens and her allies through difficult times of war with both Persia and Sparta. His reputation was built upon a strong emphasis on the navy, which he made powerful by building hundreds of fighting ships like the one shown in Fig. 3-4. To provide suitable facilities for his navy he directed a great expansion of the docks, and was largely responsible for the layout we see today. His career met with mixed success, with a great victory at Salamis in 480 BCE, but also defeat to Sparta that brought destruction to Athens and ended in his own disgrace and death in exile. He was reportedly buried in his death place, Magnesia on the Maeander in Ionia. However, there were reports that his remains were returned to Athens:

> "His bones are said by his kindred to have been brought home by his own appointment and buried in Attica unknown to the Athenians, for it was not lawful to bury one there that had fled for treason."[19]

The truth of this has not yet been established. Burial sites are suggested and marked in ancient

Fig. 3-7: Part of the ancient Eetioneia Gate in the Long Wall of Piraeus, Greece (2008). The structure looks very like a similar one at Thasos, shown in Fig. 3-8 and in illustrated form, Fig. 2-18. It is not intended to imply that this structure was used as a lighted aid to navigation, although it might have been in a secondary role.[63]

texts and maps, two of which are shown in Figs. 3-5 and 3-6. Fig. 3-5 shows a site close to the narrow entrance of the inner harbour, but it would have been logical to site the grave overlooking the Straits of Salamis where Themistocles celebrated his greatest victory. This would place it in the land recently used for a fertilizer factory, where remains have now been found, Fig. 3-6. Here an eternal flame would have acted as a lighthouse marking the entrance to the main port of Piraeus. Levi has suggested that Munichia exhibited at least one harbour light from the end of a mole at the port entrance. It is unfortunate that Levi's suggestion is not referenced.[20] De Graauw's carefully researched document suggests that there was a 'lighthouse' on each mole.[21] There are no suggestions of lights shown at Zea or Phaleron, but there were, without doubt, ancient sanctuaries at numerous positions around this much used ancient port that we can be confident would have shown lights.

Malkin's Small Greek World

In 2011, one of the foremost experts in the history of the Greek civilization proposed a novel theory for its emergence throughout the Archaic Period, 750 to 500 BCE.[22] During these centuries there was a strange dichotomy that mixed divergence with convergence. The divergence was when communities of people of 'Greek' (Doric, Aeolian and Ionian) ethnicities were separating geographically and forming new settlements across the wider Mediterranean area. Convergence, however, was also occurring as the proto-Greek civilization evolved from those three ethnicities into a unique identity. Historians have traditionally concluded that the Greek civilization developed "in spite of" its physical divergence. Malkin's thesis is that it occurred "because of" it. His explanation is that it was due to the effects of network theory. Malkin describes the 'Small World' concept whereby a network produces effects that appear to make

Fig. 3-8: A small cylindrical structure at Thasos that is thought to have been a simple lightstructure marking the entrance to the port. Its similarity to the Athenian tower shown in Figure 3-7 is notable. Some believe this to be an ancient lighthouse in its primary function, whereas the tower in Athens could only have been so in a secondary function, if at all.[64]

large geographical distances seem smaller. It is an idea that is familiar to us in other contexts. For example, much airline travel today is based upon the idea of routes, nodes and hubs. Nodes are airports, but some airports are used as focal points for many routes. These 'hubs' link travel between nodes more efficiently. The airline industry has identified this business model as the most efficient and economical way of transporting people. In the digital world, we are familiar with the World Wide Web, a communications network that began with nodes and links scattered at random. After a period of growth and consolidation it has now changed so that much activity is channeled through a few highly connected nodes. For example, Google, Facebook, and Twitter, act as hubs of information. When hubs are formed they need to find new places to link to and the linkage process prefers points with more links. In real social networks there are other human reasons why new links may or may not be formed.

In our study, a network is an inter-connected collection of ports and harbours – nodes - for the use of mariner-traders. Ships connect the nodes by daily journeys from one port to the next, carrying out their business along the way. Locations of ports and harbours are determined by favourable conditions for those living in them, and their distribution along coastlines can be viewed as regular, determined by the distance comfortably covered by a day at sea. These marine networks were created by the need for trade and travel by sea. Thus, from the sixth millennium BCE a network of locations was gradually established that traded in commodities such as tin and amber. A network did not necessarily have a centre or a capital. It is enough to join only a few of the network's potential links to connect to every node in the network. The addition of just a few random links drastically reduces the longest direct path between any two nodes. The result is a 'small world' – i.e. easier to cross than it would otherwise have been. Network

dynamics shape the network. What goes on seemingly independently in one node spreads around the network quickly. For example, think of a network where one ant finds food: soon all ants are heading towards it, forming fewer busier routes.[23] Malkin describes the network set up in the Mediterranean and Black Seas as a "Greek Wide Web" - a network with no focal point (unlike the Romans who established a similar network, but with a very strong focus at Rome.)

The first Greek settlements of the Dark Ages before 750 BCE were in the Aegean Sea and Asia Minor. Because of the great emphasis placed on travel by sea, in the Archaic period in the Mediterranean and Black seas there existed a 'ship-to-shore' world-view.[24] It encouraged settlement along coasts not hinterlands. Whilst the process in 750 BCE may have started out as a free-for-all with many-to-many linkages, by 500 BCE it had become preferential - through elements of competition in trade. Increased competition and the growth of ethnic identity led to the wars that took place in the middle of the millennium.

The growth of a colony involved the congregation of second level settlers around the nucleus of first arrivals. Thus the addition of non-Greeks to Greeks in a colony created a larger Greek colony.[25] Carthage grew out of Carthaginians; Massalia (Marseilles) grew out of Phokaians who had abandoned Asia Minor for their version of the New World. There was much individual human mobility around the Mediterranean during the Archaic period.[26] Maritime connectivity obviously depended upon the technology of ship building and ship related matters.[27] Ships offered great opportunities of expansion for they could avoid controlling hubs, which they could not on land.

From earliest times, the Mediterranean Society began as a sea of connectivity among unstable nodes such as temporary Emporia to a sea of colonization - whether Greek or Phoenician. This was an emergent process. Commonalities became consolidated into identity.[28]

Malkin summarizes his small world phenomenon thus:

> *"What we see here is the self-organization of a complex system through the formation and rapid dynamics of decentralized, accessible, non-hierarchical, multi-directional, expansive and interactive networks. Network*

> *connectivity became faster and more efficient because … it was enough for several random links to appear among distant nodes for the overall system to be connected. This connectivity had little to do with geographical distance, but rather with the decreasing degree of separation between the nodes. The result … is the creation of a 'small world' or, in our case, of a Greek civilization."[29]*

Malkin discusses in detail the mechanisms by which this occurred. He uses the term '*nomime*' to describe the set of characteristics that defined each new settlement – for example, their laws, customs, calendars, festivals and religious frameworks (Figure 3-2). He describes how some of these were brought from the mother settlement to the new one and whether new *nomime* were adopted to introduce novel features that characterised the new settlement. Of these, it is most notable how, from the moment of landing in their New World, the first settlers would set up religious sites that linked with the homeland they had left. There was always at least one god to whom they had dedicated their journey and who was expected to provide guidance to reach their destination. Once they had arrived, a home was created for that god and sacrifices made accordingly. As we shall see, this has a great bearing on our search for the earliest lighthouses.

Just one of many examples used by Malkin is of the association of new settlements in the western Mediterranean, viz. Massalia, Rhodes, Hemeroskopeion and Emporion, with the goddess Artemis Ephesia. He writes:

> *"Both Massalia and Hemeroskopeion built their Artemis temple on the promontory that marked the entrance to the port. A promontory temple 'speaks' to those seeing it from the sea. It is a widespread phenomenon and the temple serves as a daytime lighthouse (Hemeroskopeion, for example, means 'day watch') since it is conspicuous from the sea. The deity responsible for the sanctuary suggests familiarity and hoped-for benevolence for those arriving from afar."[30]*

Yet we are clear from other scholars that the frequent religious practices of sacrifice in the many *temene*, sanctuaries and temples were accompanied by use of fire. I would suggest that Malkin's restriction of the temple of Hemeroskopeion to

Fig. 3-9: The Greek temple at Sounion, built ca. 450 BCE on the site of an earlier sanctuary and dedicated to Poseidon, God of the Sea.[65]

the role of a daytime lighthouse is too severe. There is little doubt in my mind that most or all of these sites played active roles in navigation by day *and night*. They offered guidance to inbound ships and therefore played a significant role in Malkin's mechanism for networks to shrink the world. An excellent example is the one discussed above at Naxos in Sicily.

Greek Sanctuaries and Worship.

In its simplest form a sanctuary is a plot of land having a fence around it (*temenos; pl. temene*) and an altar. In its fully developed form it is a temple that is home to a monumental statue of the deity. The *temenos* was always open to the public, and offered a safe haven from danger to anyone seeking refuge within it.[31] For all Greeks, Poseidon was the master of the sea, but other gods could be called upon to provide protection and guidance for seamen and sea travellers.

By 450 BCE the Athenians had such a fully developed sanctuary of Poseidon at Sounion (or Sunium), shown in Fig. 3-9, although there was undoubtedly something of a more primitive nature for centuries before that. Sites for sanctuaries were selected on the basis of the availability of land and the role of the god in the affairs of society adjacent to it. It is clear that, for mariners, the most important sites would be promontories and other obviously visible sites close to harbour entrances. These sites would be dedicated to those deities considered most appropriate for the mariners who relied upon them. It was not necessary for a site to be already sacred; a site was made sacred by the establishment of a sanctuary.

The balance between peacetime and wartime scenarios could also have determined the evolution of the site. For example, in peacetime, Sounion was strategically placed for much sea traffic, not just for mariners entering and leaving the Piraeus ports, but also for passing ships. In times of heightened tension, an imposing structure could indicate the might of the people who owned it to potential aggressors. In times of war, it could be

used as a lookout for the approach of enemy ships, or even to act as a garrison for defending troops, and in the case where the defenders lost the battle, the structure could be struck down.

All sanctuaries had altars, and in cases where the deity was thought to dwell in the ground these might range from a simple hole in the ground or low-lying structures with openings to the bare earth. Many deities were to be found in the heavens so offerings were directed at the sky on raised altars. Large boulders were suitable if they had flat tops, but man-made altars could be of any shape. Altars were outdoors where the gods could see the sacrifices, and generally oriented to the east. Offerings were often made at dawn so that the priest could look towards the rising sun. The name of the deity was inscribed on the stone of the altar so that it belonged to no other god. Metal plates or bowls were used on the upper surface so that the stone was not damaged by the fire.

All sanctuaries had a dedicated priest or priestess who held the job for life until it was passed on to another member of the family. The priest was entirely responsible for the management of all the sacrifices (*hiera*), the sanctuary itself and any property it might contain. It was a crime to take anything out of the *temenos*. The priest was not obliged to be there constantly, or to wear special clothes, but he had a special role in society.

Sacrifices usually involved the killing of an animal as part of a longer ceremony in which many people might take part and might last for hours. There was a significant dependence upon fire. A procession might precede the ceremony, with communal games afterwards. Whilst some of the animal was given up to the god, much of it was used for a feast attended by many people. The sanctuaries held special feast days that might last all day, or there might be variations in the style of worship but there would be regular sacrifices at dawn. Special 'votive' offerings might be made by dedication of tablets or *objets d'art* to the deity, after which they would be the property of the sanctuary. Sometimes more buildings would be constructed to house the increasing amount of property.

It was believed that Greek gods wanted honour and respect from those in their care. Love was not involved, neither was the god playing the role of father or mother. Fundamental Greek conceptions of the relationship between god and man were conservatively maintained during the entire period from 2200 to 1100 BCE (Mycenaean Age) and from 1100 – 750 BCE (Dark Age) right through to the current era.

> *Deities were expected to contribute towards:*
> *1) Fertility of crops, animals and humans*
> *2) Economic prosperity*
> *3) Good health*
> *4) Safety from the dangers of war and seafaring.*

For safety in war, Greeks looked to Athena, whilst on water it was Poseidon who was respected most. In any case, life was carried on in the daily oversight and influence of a number of gods, each of whom was associated with certain aspects of life. In the Greek culture, Zeus was in the senior position of a hierarchy of other gods, and Heracles (Hercules) was his son. Poseidon (Neptune) was the god associated with the sea. (It is thought that the statue adorning the top of the Pharos at Alexandria was of Zeus himself, thus emphasizing the importance of the structure; see Part 5.) When citizens were about to embark upon a sea journey (or when they returned safely from one) sacrifices were made to Poseidon (or Apollo who had dominion over colonists). Ritualistic offerings were made to the gods on altars situated close to (but not in) the points of arrival and departure.

We can imagine how an altar, usually situated in an open-air location at the end of promontories enclosing harbours, or on adjacent hilltops, could have acted as a lighted aid to navigation, even on a temporary basis. Thus, the idea of the function of a lighthouse is at once derived from the culture of religious worship associated with travel by sea. This was probably the case for the five centuries leading up to the building of the Pharos, and may have been so for centuries before that during the Ages of the Mycenaeans and the Minoans from whom the traditions and practices were obtained. Similar traditions were carried out by the Phoenicians, as far as we can tell, throughout the entire period of their activities, as described in Part 4.

The Roman poet, Silius Italicus, described the visit of Hannibal to the Temple of Melqart-Herakles in Gades (Cadiz), and gave more details than any

Fig. 3-10: The Christian churches of Agios Ioannis (left) on the island of Skopelos and Panagia Thalassini (right) on the island of Andros: examples of religious sites in positions of advantage to mariners.[66]

other author about the rituals carried out:

> *"Thereafter he worshipped at the altars of the god who bears the club, and loaded them with offerings lately snatched by the conqueror from the fire and smoke of the citadel of Saguntum. Men said — and it was no idle tale — that the timber, of which the temple was built at first, never decayed, and for ages never felt the handiwork of any others than the first builders. Hence men take pleasure in the belief that the god has taken up his abode there and defends his temple from decay. Further, those who are permitted and privileged to have access to the inner shrine forbid the approach of women, and are careful to keep bristly swine away from the threshold. The dress worn before the altars is the same for all: linen covers their limbs, and their foreheads are adorned with a headband of Pelusian flax. It is their custom to offer incense with robes ungirt; and, following their fathers' rule, they adorn the garment of sacrifice with a broad stripe. Their feet are bare and their heads shaven, and their bed admits no partner; the fires on the hearthstones keep the altars alight perpetually. But no statues or familiar images of the gods filled the place with solemnity and sacred awe."[32]*

We note the clear statement that the altars were constantly lit and would have therefore provided a lighted aid to navigation for mariners.

The great height of the Pharos (Part 5) was deliberately chosen because of the knowledge that it would be seen from a great distance, a property that was not normally possible in Egypt because of the absence of high ground along the Egyptian coast near the mouth of the Nile. The value of having a light at high elevation had already been demonstrated by the Temple at Sounion (Figure 3-9), where its grand position, high up with the sea on three sides, made it a welcome navigational landmark for seamen arriving at or leaving Athens. The temple was built there in 444-440 BCE, but over the site of an earlier one for which there is no date at present. Here is clear, solid evidence of the existence of a structure that must surely have been easily identifiable at night and of great benefit to navigators, but a structure in the form of a temple and not of a lighthouse. The navigational use would always be secondary to acts of worship.

Buildings were not necessarily grand or large. The period of temple building did not commence until the Archaic Period. Before then, many smaller shrines were constructed in positions where, with a light burning at night, they were useful to mariners. Those at low level would have been particularly useful for providing a guide into port at night, for example.
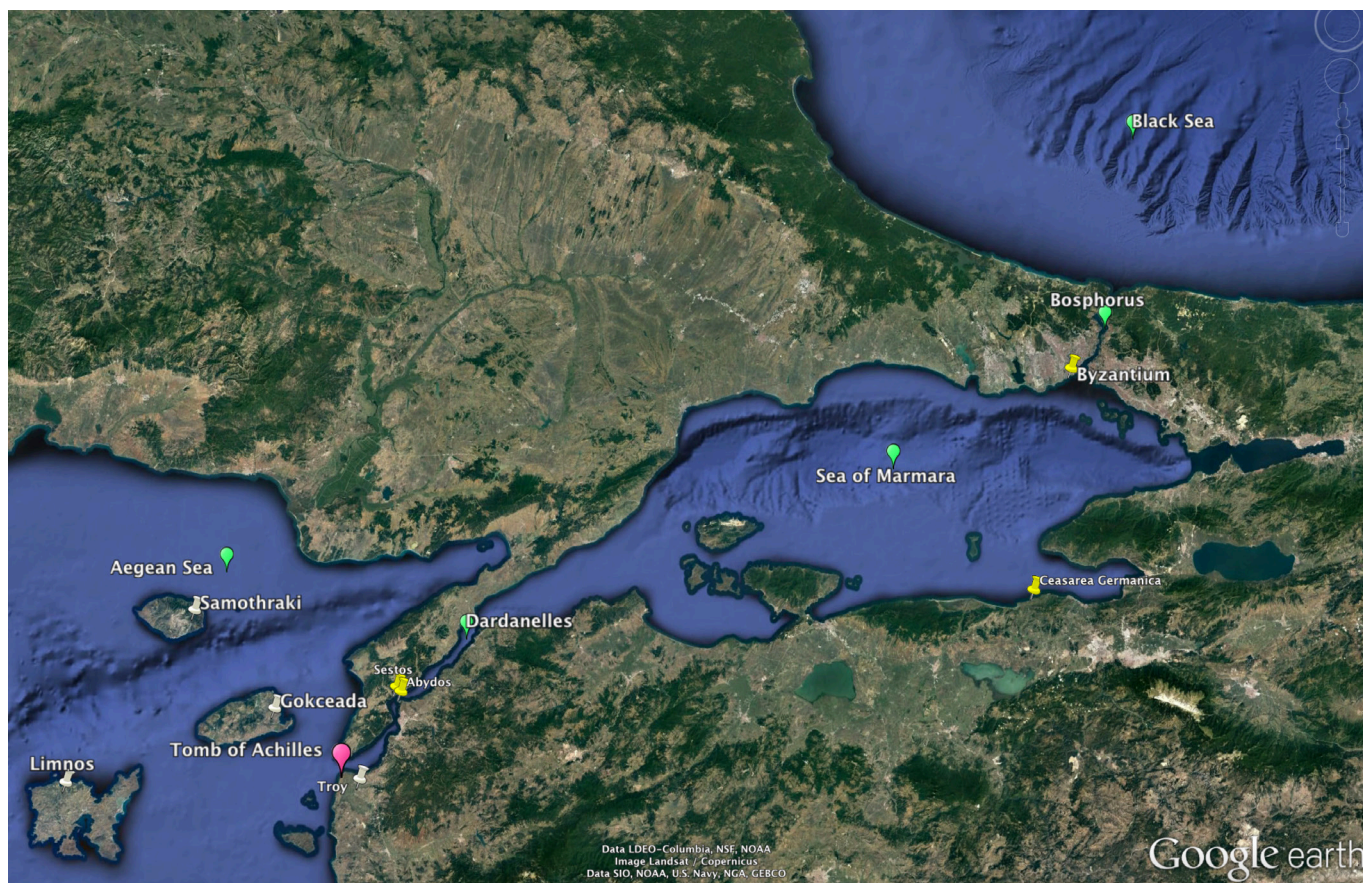
Fig. 3-11: Satellite image showing the waterway connections between the Black Sea and the Aegean.[67] Yellow pins mark possible ancient lighthouse sites; Purple pins mark modern lighthouse sites; White pins mark locations of general interest; Green balloons mark geographical features; Pink balloons mark sacred sites that were probably secondary aids to navigation.

We note a significant practical difference in the way lighthouses were used. It had been the long-established practice of the Phoenicians to build their ports in sheltered locations where the lights of night-time activities were not necessarily visible to approaching ships. The idea of a harbour lighthouse at a height of about 10 metres led to a situation in which a mariner needed to be quite close in order to see it, especially if it were obscured by a tall headland nearby. On the other hand, a light exhibited from the top of that high headland could be seen from a great distance and was therefore a navigational aid to passing ships, as well as to those heading for the port. These two aspects of geography identify two conditions in which lighthouses function - as 'harbour' lighthouses and as 'landfall' or 'waypoint' lighthouses.

On the Greek island of Thasos two structures of similar design cast their shadow over the last rocky outcrops at sea. One of them dates from the 5th century BCE, and is a cylindrical tower 3.5 m in diameter and about 2.54 m high (Fig. 3-8).

It was topped with sandstone slabs on which a fire was maintained. Built of stone, the structure seems to have been destroyed by an earthquake. It has a dedication indicating that it was erected for the safety of those at sea. Was this a wealthy family's monument in loving memory of a member deceased at sea, offered for the safety of many others? It was most likely a lighthouse indicating the presence of a safe harbour.[33] We do not yet know how many of these towers once existed and are now destroyed. They would have made excellent beacons for ships engaged in coast-hopping, especially amongst the hundreds of small harbours of the Aegean Sea.

It seems that such minor constructions were too insignificant to attract the attention of contemporary writers so that such building works went unmentioned in the surviving texts. However, there is an uncanny similarity between the low level cylindrical tower at the port entrance and the equivalent section at the top of the Pharos.

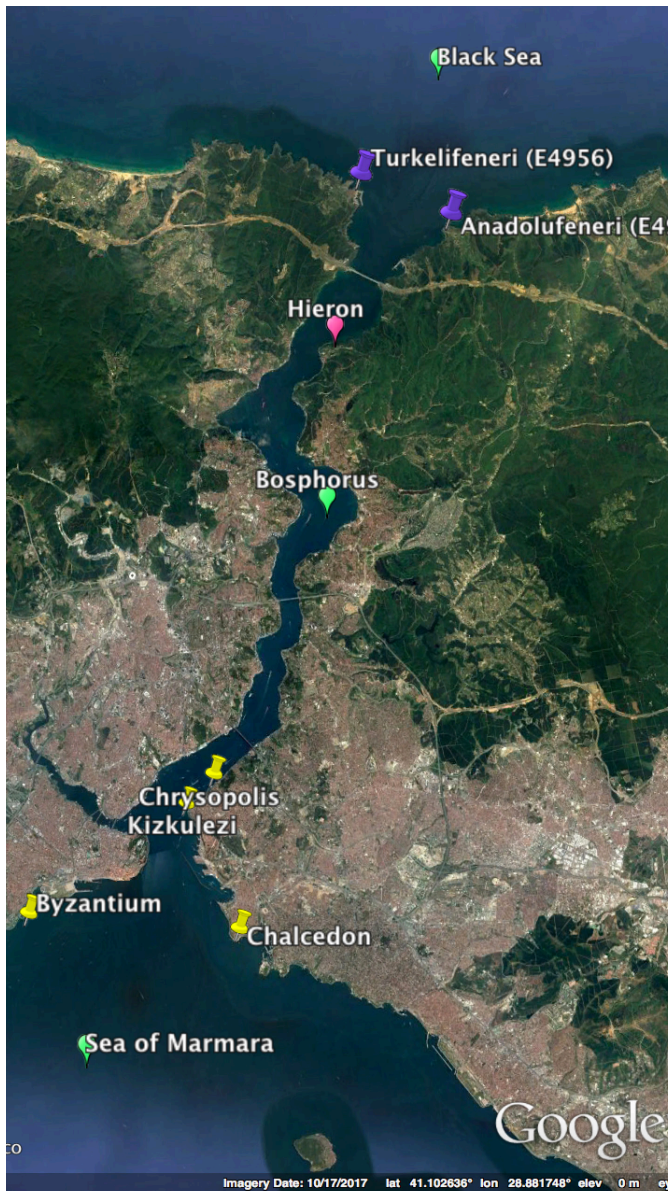Some readers will immediately associate the

Fig. 3-12: Satellite image of Greater Istanbul showing the locations of important sites on the Bosphorus. Two modern lighthouses function at Türkelifeneri (Fig. 3-13) and Anadolufeneri.[68] Markers as for Fig. 3-11.

early lights of the medieval period with places of Christian worship. Indeed, this tradition continues to this day throughout Greece where thousands of small sanctuaries and Christian religious artifacts have been set up either on hill tops or other places close by the sea, as if to perpetuate the desire to provide the seaman with recognizable navigational aids (Fig. 3-10). The possibility that we have stumbled upon the answer to the question of missing ancient lighthouses before the Pharos is beguiling, for although we have by no means excluded the possibility of using bespoke stone towers to bear lights at night, the single step from simple religious sacrifice to magnificent Pharos still seems unac-

ceptably great. Nevertheless, we are left with a conclusion that fits the observations. Perhaps we should look for more supporting evidence.

In my opinion, it is a strong possibility that at least throughout the Greek Archaic (750 to 500 BCE) and Classical (500 to 31 BCE) Periods, probably earlier, the function of lighted aids to navigation was provided in this way. Across the coasts of the inhabited lands of the Mediterranean and Black Seas, the locations of settlements were marked by *temene* – religious sites for sea travellers to make offerings to appropriate gods. These ceremonies took place at frequent intervals and were places where the exhibition of lights at night was necessary for each ritual. *Temene* containing anything from a hole in the ground to a large stone altar or a grand temple were recognizable by navigators and fulfilled the role of lighthouses. The idea of these sites acting as lighted aids to navigation became embedded in the culture and there was no need to invent a new word to describe these features.

Lightstructures in the Dardanelles and the Bosphorus

The early history of the Greek, or Hellenic, culture is dominated by the history of two centres of population based in Mycenae and Troy – a history that was frequently described by violent conflict. We must always bear in mind that the national boundaries of today bear no relation to the lands that were occupied by the cultures of 3000 years ago. Much of what will be discussed in this section took place in present day Turkey, and more specifically in that part of Turkey that was known as Anatolia.

The geography of the Dardanelles and the Bosphorus (or Bosporus) is of great interest to this study because of its vital importance as a link between northern and southern Europe via routes from the Black Sea to the Aegean Sea, Fig. 3-11. A satellite image of the Bosphorus is shown in Fig. 3-12. Its narrow width and its twists and turns have posed a danger to safe navigation since the earliest times.

A strategic waterway known as the Hellespont runs from the northeastern corner of the Aegean Sea, through the Dardanelles into the Sea of Marmara, then north through the Bosphorus and into

Fig. 3-13 The modern lighthouse in the Black Sea, on the west side of the mouth of the Bosphorus known as Rumelifeneri or Türkelifeneri (E4956). The lighthouse at Anadolufeneri (E4958) is in the far distance at the left of the photograph.[69]

the Black Sea, Fig. 3-11. It is of obvious importance in providing access by sea to vast areas of land in Europe, Asia and Africa. Through this narrow doorway lay the route to the Black Sea and the great landmasses to the north, themselves accessed by means of many large rivers such as the Danube, Dnieper, Rioni, Southern Bug, and Dniester. Crossings to other rivers in Europe (the Rhine) and Asia (the Volga) were possible. The southern entrance from the Sea of Marmara (known in ancient times as the Propontis) was marked on eastern (Asian) side by settlements at Chalcedon and Chrysopolis (Fig. 3-15).

All these areas were subject to early settlement as people - many of them belonging to the proto-Greek culture - migrated north and east from the Mediterranean. The Anatolian (Asian) side of the Bosphorus is known to have been an important site for human settlement since the earliest Neolithic times from 10,000 to 5000 BCE. Not only was it a place where it was possible to cross the relatively narrow gap between the two continents but there were deposits of copper in

the ground - a metal that bridged the gap between the age of stone and the age of bronze. Gold was also found in this region, a fact that perhaps led to the application of the name Golden Horn to the site that later became Byzantium. The first settlement that dates from this age of copper (known as the chalcolithic period - 5000 to 3500 BCE, and archaeologically agreed to be an early part of the bronze age but distinct from the stone age) was on a small peninsula at the southeast entrance to the Bosphorus.

In 685 BCE Greek colonists from Megara settled at Chalcedon (part of the present day Kadiköy district of Istanbul), before Byzantium had been founded. It seems that the location was considered to be inferior to that on the opposite (European) bank of the seaway, a factor that caused the Megaran Greek settlers to work on a better city that in 667 BCE became known as Byzantion (Latin: Byzantium), named after their King Byzas. Nevertheless, for some time it was Chalcedon that flourished, presumably because of its better trading facilities. Soon it was joined by another small
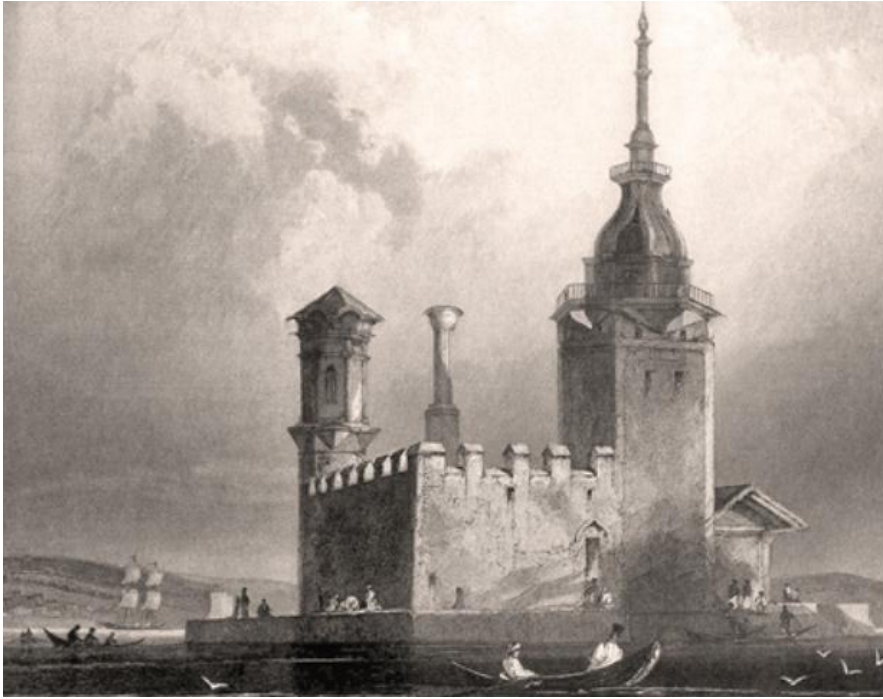
Fig 3-14 Both images on the left show the Maiden's Tower, otherwise known as the Tower of Leander or Kiz Kulezi. It is located in the Bosphorus Strait just offshore from Üsküdar in Istanbul. Tradition states that a light has been shown on the small island since very early times, and this continues today as an official aid to navigation - not on the building but on the white square conical structure on the right of the lower photograph. (E4903.8)[70]

community named Chrysopolis just to the north on the eastern bank and at the closest point of crossing, directly opposite Byzantium. Like Chalcedon, Chrysopolis was used as a harbor and shipyard and was an important staging post in the wars between the Greeks and Persians. In 410 BCE Chrysopolis was taken by the Athenian general Alcibiades, and the Athenians used it thenceforth to charge a toll on ships coming from and going to the Black Sea. In the 12th century, the name was changed to Scutari (Skoutarion) and later to its modern form, Üsküdar. As a focus of maritime activity over many centuries, there is a strong tradition of a lighthouse being present, probably from a point on the shore.

However, there is a well-known island (Chrysopolis Insula) close to the shore of Üsküdar called Kiz Kulezi where a lighthouse has been in existence since at least 1110. Today, the Maiden's Tower (or Leander's Tower, to give it but two more aliases) provides a popular model for an ancient lighthouse. It is unlit itself, although the small island still carries a navigational light, Fig. 3-14.

Perhaps a better, but lesser known structure is the old lighthouse at the northern entrance to the Bosphorus, on the European side, known as Rumelifeneri (alias Türkelifeneri), Fig. 3-13, an octagonal stone tower in two discrete sections with echoes of the ancient pharos shape, Fig. 3-13.
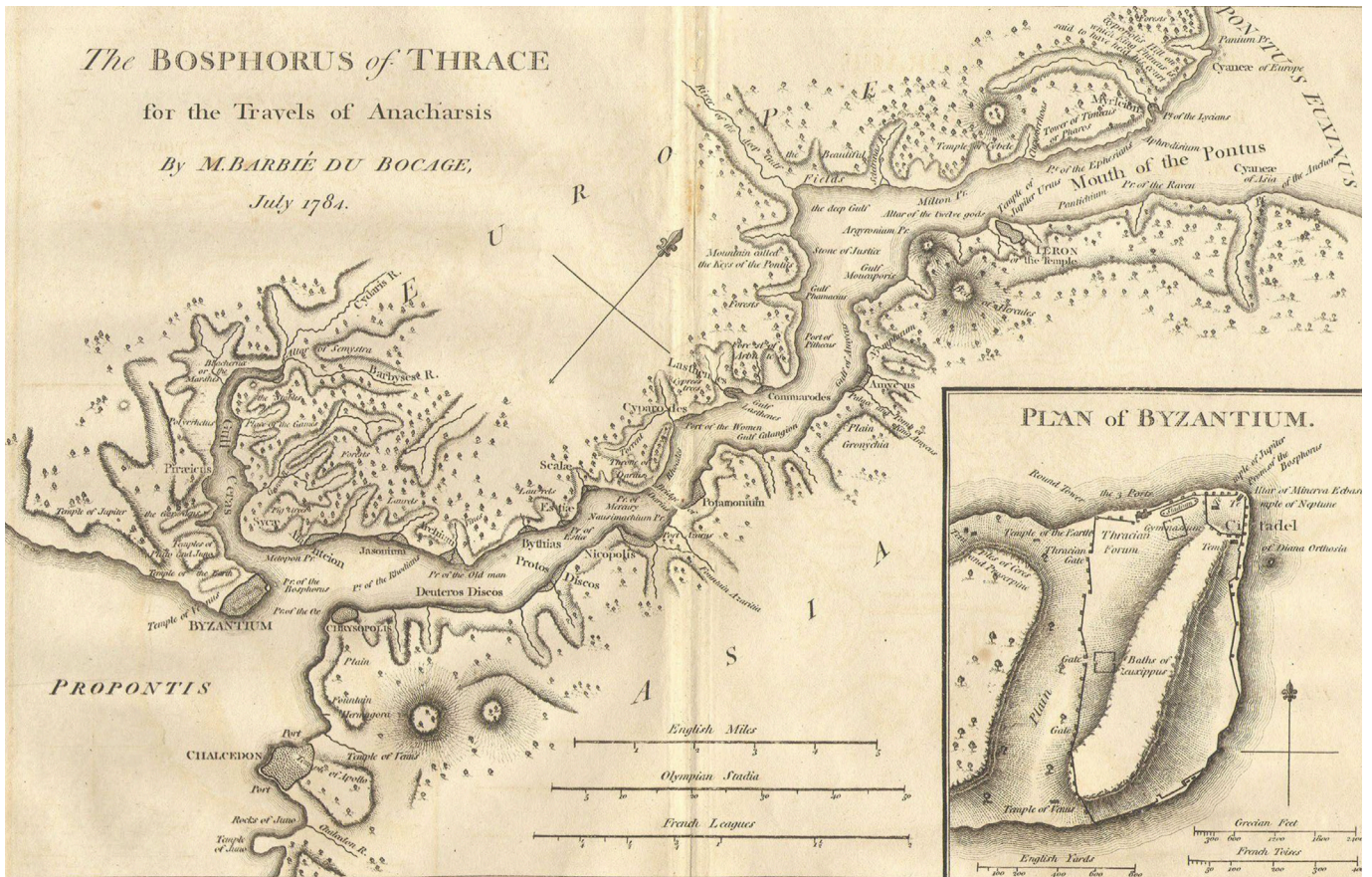
Fig. 3-15 An old map of the Bosphorus of Thrace by M. Barbie du Bocage (1784) showing the import-
ant sites of Byzantium, Chalcedon, Chrysopolis and Hieron. The Propontis is the old name for the Sea of
Marmara; the Pontus is the name for the entry to the Black Sea. A cluster of temples dedicated to Jupiter,
Minerva and Neptune on the northeast point of Byzantium indicates a strong possibility that at least one
aid to navigation was present here.[71]

Troy

One of the earliest ideas of a lighthouse was
discussed and dismissed by Stevenson[34] and
focuses on a tower called the Sigeum Pillar. It
concerns the death of the Greek hero Achilles who
was supposedly killed on the battlefields of Troy.

Troy (ancient name: Ilium) is one of the most
famous ancient cities. It is situated in a region of
western Turkey known as Anatolia, at the southern
entrance to the sea channel known as the Darda-
nelles. Troy was the focus of a larger area known
as the Troad in which many ancient settlements
have been discovered.[35] On the northwestern side
of the Hellespont channel lies the sparsely popu-
lated Gelibolu (Gallipolis) peninsula. The modern
name for the channel is Çanakkale Bogazi named
after Çanakkale, the main town in the region, and
which lies northeast of the site of Troy where the
waterway is narrow. Çimenlik Castle was construct-
ed on the Anatolian side by Sultan Mehmet the

Second, Conqueror of Istanbul, in 1462 and occu-
pies an important strategic position, in conjunction
with Kilitbahir Castle opposite. Together with Nara
Castle on Nara Point, they have watched over the
Dardanelles right up to the present day. Kumkale
Castle on the Anatolian shore at the mouth of the
Çanakkale Bogazi was built to protect the Straits.
Today, two lighthouses mark the entrance at
Kumkale Burnu (E4848) on the southern side and
Mehmetcik Burnu (E4850) on the northern side.

Today, the priceless World Heritage Site of Troy
is called Hisarlik where archaeologists have worked
since the 1870s and identified up to nine settle-
ments called Troy I - IX, mostly built on top of one
another. The earliest of these is thought to date
from around 3000 BCE, whilst the city that is so
well-known from the story of the wooden horse
that brought about the end of the war between
Trojans and Greeks is equated to Troy VII and is
thought to have existed from around 1250 BCE.

The cities Troy I to V occupied the years from

Fig. 3-16: The locations of Sigeum and Troy. The area enclosed by the black line is clearly darker than the surrounding land and illustrates the area of low-lying land that was once under water.[72]

3000 BCE to 1700 BCE. Troy VI lasted from 1700 to 1250 BCE, a very long period of 550 years. It represented a significant cultural development from Troy V, being much more military and fortified. The city was contemporary with the Hittite culture. The city walls are almost completely intact permitting entry into the city through a number of gates. They represent advanced engineering skills for the time in which they were built. Several towers, once 30 metres high, can also be seen. It was laid waste in 1250 BCE by a devastating earthquake and rebuilt soon after so as to continue the cultural development that had been established to that point.

Troy was built on Hisarlik Hill, a site of only modest elevation, but which could be defended from attackers and provide a good view over surrounding countryside. As we saw earlier, coastlines have changed over the many years of our study. During the time of Troy I, the sea came south from the Hellespont and much closer to the city, making Cape Sigeum a distinct promontory that projected into the southern entrance of the Hellespont and made a perfect strategic location, Fig. 3-16. Observations of the materials from which many of the buildings of Troy are constructed quickly reveal

that they contain many seashells. This is because they were made from mud bricks composed of soil from the alluvial plains below Hisarlik Hill after the sea had retreated.

The land surrounding Hisarlik Hill made a fertile plain, watered by two rivers, the Scamander and the Simois, that ran into the nearby Beşik Bay, the waters of which extended much farther inland than they do today. For example, around 2,000 BCE, the sea level was about 1 m higher than it is today. Ships passing north through the Dardanelles struggled to overcome the fast currents that flowed against them. This was made worse by the prevailing wind that was frequently from the northeast. It was thus important for ships to have safe harbour before commencing the transit through the Hellespont and there were ports on either side of the entrance. On the eastern side, Abydos was the port of Troy, whilst on the European side was Sestos.

Following the original Anatolian settlements, and the destruction of Troy, the Greeks began colonizing the province from about the 9th century BCE. The Persians took control in the 7th century but in 334 BCE Alexander the Great crossed the

Straits and onto Asian soil for the first time. He joined with the Persians in a fierce battle at Granikos on the banks of the river Kocabaş. The area changed hands several times, coming under Lydian rule in the 2nd century BCE before the Romans took over in 191 BCE.

Fabulously rich in treasure of all kinds, the remains of the city have been ravaged over many years by indiscriminate and ill-disciplined excavation, making a full understanding of the history impossible. Today, the Turkish government carefully controls archaeological excavation and we must hope that there is still plenty to learn from as yet undiscovered artifacts.

A Lighthouse at Sigeum?

There is a strong possibility that the first light-structure - perhaps even a lighthouse - was at a place known by its Roman name as Sigeum (Greek: Sigeon or Sigieon).[36] Historians have referred to it as the Sigeum Pillar, but its existence has aroused much debate. Since there was no written record of these times, we have only the stories passed down by word of mouth and solidified in the words of later scribes, as in Homer's *Iliad*. The source of the idea arose out of the death of Achilles and historians have argued about the truth of the story for centuries. It is known that Alexander the Great, an admirer of Achilles, made a pilgrimage to the tomb of his hero, which he thought to be on Cape Sigeum. So let us explore the idea more fully.

A small settlement of Greek origins arose here as the adjacent bay was used by the Greek shipping entering the Hellespont. It is situated about 34 km from Çanakkale and is in the region of Yeniköy. At the time, the sea was covering the low-lying land next to this point some 6 km northwest of Troy and on the southern side of the Hellespont. Sigeum would have been a promontory and a natural place for a daymark or lightstructure. This is the supposed location for the tomb of Achilles. After his death, a mound was created over his burial place, a site that has been (unsuccessfully) searched for by archaeologists. In accordance with typical Greek tradition, an eternal flame was likely to have marked the grave of one of the greatest Greek heroes. Whether there was actually a built tower there or not is irrelevant because we have now discovered that navigational assistance was provided by the lights displayed by temene.

Our problem lies with the existence of Achilles. Contrary to the fashion of late 19th and early 20th century historians to instantly dismiss everything that was not forensically provable, there is no reason to disbelieve his existence in a time before the writing of history books. Many scholars believe his death corresponded with Troy VII around 1250 BCE and marked by the end of the Trojan Wars.[37] Even were Achilles to be mythical, the religious rites of sacrifice at the start and end of voyages to this strategic focus of sea routes would surely have taken place at a prominent location somewhere along the coast adjacent to Troy. In consequence, this could constitute the earliest example of a Stage 3 lighted aid to navigation that we have found so far, and indicate a triumph for the Greek team in our competition for who built the first lighthouse.

It should be appreciated that the inhabitants of Troy were not Greek and did not speak that language; it is inaccurate to refer to Trojans as Greek.

> *"Hector, I urge you above all to do as I say. In his great city, Priam has many allies. But these foreigners all talk different languages. Let their own captains in each case take charge of them, draw up their countrymen, and lead them into battle."[38]*

> *"...Such was the babel that went up from the great Trojan army, which hailed from many parts, and being without a common language used many different cries and calls."[39]*

Current opinion is that the Trojans should be considered to be a people native to Anatolia, i.e. those people who had lived in the surrounding lands for as far back as archaeology is presently able to discern.

The tantalising suggestion that there was an early lit navigational aid at Sigeum seems to derive from the interpretation of an ancient stone tablet concerning Virgil's writings on the Trojan War, but evidence is very rare.

It is said that the Greek poet, Lesches, wrote in 660 BCE that there was a guiding light for mariners at Sigeum in the Troad. (It appears that Lesches' writings are now lost.) Beaver wrote:

> *"Lesches, a minor poet who flourished around 660 BCE, tells of a lighthouse on the promontory of Sigaeum in the Troad and this seems to be the first lighthouse that was regularly operated."[40]*

Fig. 3-17 A late 18th c. map showing the Plain of Troy (Troad) by M. Chevalier. The location of Troy relative to the Sigeum promontory is indicated. The tumulus of Achilles is assumed to be located at the latter position, but is not indicated. However, just above it, the tumulus of Patroclus is indicated.[73]

A highly respected lighthouse engineer, Kenneth Sutton-Jones wrote:

> *"To assist their [seamen] arrival, fixed points ashore were made conspicuous by day and night. The first of those was almost certainly on the promontory of Sigeum, on the Hellespont, and thus slightly predated the more famous tower [Pharos]..."[41]*

However, despite his vast experience, Sutton-Jones was not privy to any new data or sources of certainty. Sutton-Jones does not reference his source for this last statement, which we must question, of necessity. Both Beaver and Sutton-Jones seem to have been using the book by McCormick who wrote these 'facts' in similar terms.[42] Talbot too is confident that there was a lighthouse at Sigeum, and describes it as "the first authentic lighthouse".[43]

Other writers merely report a lighthouse at Hel-

lespont, but this is a vague description.

David Alan Stevenson, is adamant that this is not true. He wrote:

> *"The Sigeum story is based on an account by Montfaucon in 1721 of a tablet dating from about 50 B.C. which was discovered in Rome in the 17th century. It depicted a pillar, with a squat conical top, which he illustrated. An inscription on the tablet explained that the outline accorded with a description by Lesches, a poet of about 1200 B.C. whose writings have long been lost. Montfaucon, who wrote in French, called the pillar a phare but as he used the word phare to indicate not only a lighthouse or beacon carrying fire but also the unlighted stone-and-timber beacon shown in his representation of an early port, it is clear that he did not intend to give the impression that the Sigeum tower carried a*

light: he concluded from its proximity to the coast that it served as a navigation beacon. More recently the pillar has been explained as a symbol for the tomb of Achilles, certainly not as supporting the idea of an early lighthouse having been established at Sigeum."[44]

Perhaps siding with Stevenson, Hague wrote nothing about this location. Stevenson's argument appears superficially valid, but is based on the idea of a misinterpretation by Montfaucon. However, there is other evidence that Montfaucon's interpretation is the correct one, even if the illustration he used is a poor representation of the lightstructure that was actually built here. Indeed, if this were the site of the tomb of Achilles, it is very likely that the spot would have been marked with a continuously burning flame, which would have constituted a lightstructure. Thus, the last sentence of Stevenson's argument seems illogical.

The author believes there is a strong argument for the presence of a lightstructure or lighthouse at this strategic position, even if it were only for a secondary function.

In pharology, the considered opinions of David Alan Stevenson, published in his influential work of 1959, should not be questioned without due consideration. As a descendant of the Stevenson family of lighthouse engineers he is unquestionably qualified to pass judgment on matters relevant to his family's works. However, as a historian he does not possess better tools for analysis of pre-historical events than any serious researcher today. Therefore conclusions about the history of early lighthouses in the millennia before the birth of Christ will always be open to argument.

Stevenson discusses the works of Homer who, in book XIX of the Iliad, apparently referred to the light from Achilles polished shield acting as a lighthouse for seamen. We have dealt in detail with this quotation in Part 1. Of course, the interpretation is from an ancient Greek text that need not be directly translated as a reference to a lighthouse and it is on this basis that Stevenson denies claims that homer referred to lighthouses. Nevertheless, there can be no doubt that Homer is referring to the idea that on dark nights, sailors could extract navigational assistance from seeing a light on the shore. Such a capacity does not imply the existence *per se* of an edifice built specifically to behave like a lighthouse today, but is an unquestionable expression of the idea of lights to aid navigation.

Most experts agree that Achilles was a real Greek warrior who died in a Trojan War and was buried somewhere in the land that is called the Troad. The reports of his death describe a large mound of soil or tumulus being created over the burial place and the precise of Achilles' body has become as The Tumulus of Achilles. Unfortunately, there is no agreement on where this site is precisely located.[45]

Troy is, I believe, of great significance in the history of ancient lighthouses because of its extremely ancient age and its strategic location. All sea traffic passing through this sea route had to pass Troy. Furthermore, Troy was close to one of the main land crossing points between Asia and Europe at Sestos and Abydos in the narrows of the Dardanelles.

As Figs. 3-16 and 3-17 show, Troy was located inland from the main channel so, for navigators, it was the point of the Sigeum promontory that was the key to navigating the entrance to the Dardanelles. I believe that Cape Sigeum was so important for mariners that from a very early time - in the second or even the third millennium - there was a lighted aid to navigation here. As the amount of human activity grew, so a settlement was formed with an unconfirmed name. Eventually it was founded as Sigeum around 750 BCE. The geography has now changed substantially since the time of the Trojan war because the area inside the black line was once below sea level.

Supplied by at least five major rivers, the Black Sea has a positive water balance that creates a net outflow of 300 km^3 per year through the narrow straits of the Bosphorus and the Dardanelles, via the Sea of Marmara, into the Aegean Sea and thence to the Mediterranean. However, the formation of the link between the Mediterranean and the Black Seas remains controversial.

Whilst the Dardanelles Strait is a maximum of 55 m in depth, the Bosphorus is just 36 m deep, and at the height of the last Ice Age, with so much water in the form of solid ice across the northern hemisphere, the water levels were as much as 100 m lower than today. Clearly, there were many thousands of years when the freshwater Black Sea was isolated from the rest of the world's seas.

Then, as the great northern ice sheets melted, there was a general rise in sea level in the Med-

iterranean Sea that over-topped the level of the land at the northern entrance to the Bosphorus, an event currently estimated to have occurred ca. 5600 BCE.[46] The event caused great volumes of water to pass through to the Black Sea. The rise in sea level caused flooding inside the black line of Fig. 3-16 and created a long promontory of higher ground on the western edge of the land. Meanwhile contours of the land released from the great pressure of the ice sheets changed its height in relation to sea level. Although deposition of sediment from the River Scamander (the modern Karamenderes River) visible in the centre of the zone may also have contributed, it was the effects of these changes in the levels of land and sea that ultimately produced the present shape of the land in the image. (The rise in level of the Black Sea flooded much of the surrounding land and is cited as the reason why there are so few Neolithic sites in northern Turkey.[47])

Thus, we have seen how the combination of geology, geography, archaeology and history have brought about a scenario in which Greek culture may have led to the earliest known instance of a lighted aid to navigation in the sense of a landfall or waypoint light. It is still possible that archaeological evidence could add further support. Troy has attracted immense archaeological investigations since the nineteenth century, at the expense of the peninsula area. There is almost no data available for the Sigeum peninsula, and it is to be hoped that in coming decades this site will receive a long overdue, careful investigation.

Sestos and Abydos

Of the period prior to 750 BCE – the year generally associated with the works of Homer who wrote the first 'histories' of the Trojan Wars in *The Iliad* and *The Odyssey* - far less is known. However, many of the features relevant to our discussion of Greek culture can be found in those pages, as well as useful indicators disguised as mythology but that, like the Old Testament of the Bible, contain significant elements of truth. The story involving a youth called Leander swimming across the Hellespont to be with his lover, Hero, involves 'lighthouses' at Sestos and Abydos and may be more than just aids to story-telling.

In 480 BCE, the Persian King Xerxes moved to attack Greece with one of the greatest armies that had so far been assembled. He ordered the construction of a bridge across the Hellespont between Abydos and Sestos where the crossing distance was least. He must have had a large navy too, for he was able to spare enough of it to form two parallel rows of ships called penteconters and triremes - 360 in one and 314 in the other. These were lashed together and anchored across the Channel. A roadway was then constructed on top, made from planking covered with soil, and with side panels added so that the animals would not take fright as they crossed.

The story of Hero and Leander is an essential part of our study. In the style of Romeo and Juliet, the waters of the Hellespont separated these two famous lovers. At the narrowest point of the Hellespont, Leander lived on the European side (Sestos) and had to swim to his lover each night, on the Asiatic side at Abydos. Leander was guided in his swim by a light Hero held out in her hand (Fig. 3-18). Tragically, one night the light was extinguished by a gust of wind, Leander lost his way and was drowned. Stricken with grief, Hero committed suicide.

The earliest appearances of the story that we know of were by Virgil and Ovid, although the story seems to have been clearly established in the folklore of the time. In Virgil:

"What of the youth, when love's relentless might
Stirs the fierce fire within his veins? Behold!
In blindest midnight how he swims the gulf
Convulsed with bursting storm-clouds! Over him
Heaven's huge gate thunders; the rock-shattered main
Utters a warning cry; nor parents' tears
Can backward call him, nor the maid he loves,
Too soon to die on his untimely pyre."[48]

The use of a tower for the purpose of displaying a light is more plainly described by Ovid with his imagined words from the two lovers:

Hero:
"So when day's done, and night's more friendly hour
shows its bright stars, driving away the daylight,
straight away I set out the unsleeping lights in the tower's top"
Leander:

Fig. 3-18: The painting by JMW Turner entitled, "The Parting of Hero and Leander" (before 1837).[74]

"Seeing a distant light, I said: 'My fire is in that fire: that is the shore that holds my light.'"[49]

This story has been inspirational in Western culture for over two thousand years, appearing, for example, in the 6th century work of Musaeus, another by the famous classical author Christopher Marlowe, and reported in the standard text known as Bullfinch's Mythology. Numerous works of art depict the event, most notably in paintings by the British master J M W Turner, as well as earlier works by Regnier and Feti. A particularly fine example of earthenware is the plate in the Getty Museum of California. The famous romantic poet, Lord Byron, was so taken with the story that he successfully repeated the swim on a visit to the region in 1810, albeit during daylight and without the aid of a light for guidance.

Abydos is located close to Nara Point and is about 2 km away from Çanakkale and more than 30 km away from Cape Sigeum. The site of Abydos was excavated in 1675, but was performed badly and much valuable information was lost. We are left with a clear indication that lightstructures were built on either side of the narrowest part of the Hellespont. The probability is that the structure at Abydos on the southern shore, being more closely associated with the focus of activity in Troy, was constructed first.

If we accept the presence of lightstructures at the entrance to the Hellespont in the south, there is every reason to suppose the existence of similar structures on the Bosphorus at the entrance from the Black Sea in the north. Ancient texts do report more recent lightstructures on the European side of the narrows at Byzantium, and on the Asian side at Chrysopolis. Early towers may have existed during the period from 1250 to 1100 BCE, say. However, as centres of population, they did not compete with Troy until centuries later, so we conclude that the southern entrance was almost certainly lit first. The towers built on the Bosphorus were probably later restored or rebuilt by the Romans, but there is very little evidence for lightstructures here to compete with those at the southern entrance. There is no evidence yet discovered to suggest that the peoples of Troy built lightstructures in other locations.

Hieron

In ancient times, there was just one site that served as a haven and place of worship for any mariner entering or leaving the Black Sea. It was well-known as a way-point that separated the Aegean Sea from the Black Sea, and in particular the region of the southern Black Sea known as the Pontus. Navigators used it as the start and end of all their calculations concerning routes in the Black Sea, as well as being the place of safety from the treacherous currents and storms in the twisting course of the Bosphorus. Its name was Hieron, Fig. 3-19.

The site has been much neglected by historians and archaeologists until recently, yet it has been described quite frequently in the classical literature, albeit often obliquely. [50] Dionysius wrote:

"After the Breakwater is the place called Hieron (meaning Shrine), which was built by Phrixus, son of Nephele and Athamas, when he sailed to Colchis, and which at any rate is controlled by the Byzantines, but is a common haven to all who sail."[51]

This ancient temple site was considered to be at the mouth of the Bosphorus, even though it looks to be more inland on today's maps.[52]

Herodotus describes how Darius:

"... seated in the temple, which stands by

Fig. 3-19: Yoros Castle and the ancient site of Hieron in the Bosphorus. The modern location is Anadolu Kavağı, Beykoz-İstanbul.[75]

the straits ... looked out over the Black Sea - a sight indeed worth seeing.”[53]

This led to the impression that the temple was located at the very widest part of the Bosphorus mouth with Rumelifeneri on the western flank and Anadolufeneri on the east. Today, there are beautiful modern lighthouses at each site, but in the times of Herodotus these treacherous locations were called by at least four different names: kyaneai (dark blue), planktai (treacherous crags with white froth from crashing waves)[54], symplegades (clashing rocks)by Euripides, and synormades (by Simonides).[55] The poet Pindar described them as “moving rocks” to amplify the point that there is extreme danger for sailors passing too close. Not surprisingly, it was not until a ship's arrival in the calmer waters at Hieron that they felt safe enough to land and give thanks for their safe journey. Pindar says that the Argonauts prayed:

“...that they might escape the irresistible movements of the rocks that run together. For both were alive and used to roll more swiftly than the ranks of the load-roaring winds.”[56]

Later, as the Argo set sail through the pass between the rocks and into the Black Sea, Apollonius describes how Athena intervenes to assist the Argo. He wrote:

“With her left hand she supposedly pushed back one of the rocks, and with her right hand she guided the ship through the pass.”[57]

The scientific method demanded that authors shun any desire to attach truth to such stories, and in the twentieth century, truths disguised within these stories were frequently ignored. Many modern writers are inclined to look deeper for improved understanding buried within these mythological tales. There can be no doubt that, within the tale of Jason and the Argonauts, when they set out in a quest for the Golden Fleece, and in a time well before the Trojan War, implicit details were told of the common travails of seamen: the proximity to death from shipwreck in angry waters and around razor-sharp rocks, and the need for safe haven to rest, recuperate, and to plan the next leg of the journey. Such statements were as valid then as they are today. Overlaid are the sentiments and

habits of those contemporary citizens of ancient cultures, embellished, perhaps, with stories of the supernatural. We know today that prayers of thanks for safe journeys just made, or prayers for safe assistance during journeys to come, were fundamental to sea travel, and so shrines and temples were to be found at all sites where mariners commonly landed. If there was none already in existence, it was necessary to build one.

The most strategic points on journeys were obvious to all who made them and were marked with larger temples with permanent flames in reverence to the god to whom the site was dedicated. These temples and shrines could be seen from afar and guided the sailors towards them in the same way as a lighthouse.

We note that at this stage, it was not common practice to show lights at specific sites where there were dangerous rocks; the showing of lights was an invitation to a place of safety and not a warning to keep away.

This is a rare occasion in classical literature when we have a direct reference to a temple acting as a lighthouse, and it was at Hieron. A writer called Philostratus wrote:

> *"... until we come to Hieron. You see the temple yonder, I am sure, the columns that surround it, and the beacon light at the entrance that is hung up to warn from danger the ships that sail out from the Pontus."*[58]

Athenian ships entering the Black Sea would have done so usually in early spring at the start of the sailing season, stopping at Hieron before doing so. On their return, they would equally have stopped there, but in late autumn and laden with goods for their countrymen at home. Payment of tolls on the merchandise was due in each direction, more on the return journey because of the extra goods being carried, generally grain.

Ashore in Hieron, the crews carried out their religious duties. A temple high up on the promontory was dedicated at first to the Twelve Gods, plus Poseidon and Artemis. There, in the lofty position described by Herodotus, a great temple had been built since the simple altar erected by the first Greek pilgrims. There is reason to believe that it could have been as early as 1,400 BCE (i.e. during the height of Troy's power and influence), but scholars can only be confident of its existence since the Dark Age period of the seventh or eighth

c. BCE. Much later, during Hellenistic times from 323 to 31 BCE Hieron is known to have thrived. A smaller temple of Artemis had been built in the harbour, and the high temple now dedicated solely to Zeus.

The voyages were fraught with danger, not just from the natural elements of wind and waves, land and sea, but also from those intent on stealing their cargoes. The peoples of Byzantium and Chalcedon were frequently known to indulge in piracy, and it was therefore necessary for ships to call into Hieron where they await an escort of Athenian ships that would see them safely through the narrows to the home seas of the Aegean.

Even so, safety of the shrine was not always guaranteed. It was normal for any one who stopped in a sanctuary to be awarded inviolability[59], but records show that Philip II of Macedonia attacked ships for their cargoes of grain even whilst sheltering in Hieron. The attack carried out in late summer 340 BCE, resulted in war between Philip and Athens.

For perhaps as much as five centuries, the name of Hieron disappeared from the literature, but by the sixth century it is well established as a toll and customs point. After that, there were a series of conflicts that resulted in its Byzantine owners establishing Hieron as a point of militarize control. A continuing series of defensive installations modified the site right through to the 18th c. so that the visitor today sees nothing but the remains of a "castle" called Yoros. Details of many of those changes are carefully described by Moreno.[47] However, a skilled eye can still perceive occasional remnants from its ancient past incorporated into the stonework.

Conclusions

1. Before 3000 BCE we can disregard the possibility of a culture creating lightstructures because there was insufficient human activity on the open sea.

2. Between 3000 BCE and 300 BCE (before the construction of the Pharos at Alexandria) there is no firm evidence in proto-Greek culture of any built edifice specifically intended to act as a Stage 3 lighthouse or lightstructure.

3. The extensive and well-connected network of proto-Greek colonies involved the establishment of sanctuaries at the points of arrival and departure by sea.

4. Religious practices carried out in proto-Greek culture resulted in smoke and fire, by day and night, that would have been visible to ship navigators.

5. Navigational advantage was obtained by informed ship-to-shore observation of sites of religious practice.

6. Of the many simple structures that were used as Stage 2 and Stage 3 aids to navigation, many have been destroyed during the centuries of warfare between developing civilizations.

Notes

1 Wikipedia, History of the Cyclades 20171010.

2 Wikipedia, Milos, 20170828.

3 Heyerdahl (1972).

4 Morkot (1996).

5 Morkot (1996), pp30-33.

6 Wikipedia: Bronze Age Collapse, 20171010.

7 Alley (2004).

8 Bond (1997).

9 Broodbank (2015), p14.

10 Malkin (2011), p51.

11 Malkin (2011), p90; Also: Wikipedia: Naukratis 20171011.

12 Morkot (1996), pp46-51.

13 Archegetes was an epithet of the Greek god Apollo, under which he was worshiped in several places, as at Naxos in Sicily, where Archegetes was the most popular cult of Apollo; also at Megara. The name refers to Apollo as the leader and protector of colonies or the founder of towns.

14 Thucydides: History of the Peloponnesian War, Book 6; Cited in Malkin (2011), p101.

https://www.loebclassics.com/view/thucydides-history_peloponnesian_war/1919/pb_LCL110.187.xml?rskey=VSNQqf&result=1&mainRsKey=Qqps5E

15 Morton (2001), p185ff.

16 Casson (1994), p65.

17 Casson (1994), p72.

18 Some older documents mistakenly place Phaleron at the site of Munichia and identify Zea as Munichia.

19 Thucydides; Thomas Hobbes (trans): The History of the Peloponnesian War 1, 138, www.perseus.tufts.edu

20 Pausanias: Guide to Greece 1, 11 note 15:

> *"Tourkolimani. You can see the Parthenon from the east mole, which has a lot of classical stones in it and the ruins of a lighthouse. There are some last remains of some ancient slipways."*

Sadly, there is no source for this statement. A third site has been proposed by Wallace (1972), but I have not been able to locate its position.

21 de Graauw (2016), p163, entry 976.

22 Malkin (2011).

23 Malkin (2011), p32.

24 Malkin (2011), pp48-50.

25 Malkin (2011), p55.

26 Malkin (2011), p56.

27 Malkin (2011), p49.

28 Malkin (2011), p38.

29 Malkin (2011), p205-6.

30 Malkin (2011), p198.

31 Mikelson (2004).

32 Silius Italicus; Duff (1959), 3, 15-38.

33 Jonatan Christiansen, private communication; also Giardina (2010), p264-5.

34 Stevenson (1959), p6.

35 Cook (1973.)

36 Allard (1895). Allard (1818-1892) was head of the French Lighthouse Service.

37 Wood (2005).

38 Homer: Iliad 2, 800-805.

39 Homer: Iliad 4, 437-439.

40 Beaver (1971), p10.

41 Sutton-Jones (1985), p3.

42 McCormick (1936), p9.

43 Talbot (1913), p2.

44 Stevenson (1959) p6

45 Burgess (online).

46 Wikipedia, Black Sea 20171012.

47 Wilford (1996). Also, Wikipedia, Black Sea Deluge Hypothesis 20171012.

48 Virgil: Georgics 2, 258 and Statius: The Thebaid (Thebaidos) 6, 535.

49 Ovid: Heroides xviii and xix.

50 Moreno (2008). The Fanum Asiaticum light at the entrance to the Bosphorus, facing the Fanum Europaeum, Philostratos (Maior), de Imag. I. 12.1-5 (IInd-IIIrd century A.D.) cited in, Moreno (2008), 655-709, 697. Also translated as:

"...till we come to a shrine. You see the temple yonder, I am sure, the columns that surround it, and the beacon light at the entrance which is hung up to warn from danger the ships that sail out from the Euxine Sea".

51 Dionysius: Güngerich (1958). Given in Moreno (2008).

52 Moreno (2008), pp661-2.

53 Herodotus: The Histories 4, 85 (The Bosphorus.)

54 Homer: Odyssey 12, 69-72.

55 Spence (2011).

56 Pindar: The Pythian Odes, 4, 207-11. Given in Spence (2011).

57 Apollonius: Argonautica 2, 317-340.

58 Philostratos The Elder: Images 1, 12, 1-5. (2nd-3rd century A.D.) cited in, Moreno 2008, 655-709, 697. Also translated as:

"...till we come to a shrine. You see the temple yonder, I am sure, the columns that surround it, and the beacon light at the entrance which is hung up to warn from danger the ships that sail out from the Euxine Sea".

59 Rigsby (1996).

60 Google Earth (2017).

61 Greek trireme. Reproduced under the CC License. Credit: Templar52 (2006)

62 Google Earth (2017).

63 Athens tower photo.

64 Photo Thasos tower.

65 Sounion Photo by Χρήστης Templar52. Reproduced under Wikimedia Commons licence.

66 Unattributed Images.

67 Google Earth (2017).

68 Google Earth (2017).

69 Photo reproduced under the CC license. Credit: VikiPicture (2014).

70 Photo credits.

71 Old map: The Bosphorus of Thrace by M. Barbie du Bocage (1784).

72 Google Earth (2017).

73 Old map: Plain of Troy (Troad) by M. Chevalier. (Late 18th century.)

74 Painting reproduced under the Creative Commons License, National Gallery, London, UK.

75 Photo: Moonik. Used under CC Licence.

Bibliography

Conventions used

1. References are given in the usual format: Smith (2002), p123. Multiple citations having the same author and year are given the suffix a, b, c etc.

2. A reference given as Smith (online) has no date if it is continuously updated. Specific information downloaded from the Internet is given a date of download.

3. Entries in the Bibliography are considered relevant to the content of this book, but are not necessarily to be found in the references.

4. Entries are in alphabetical order of the first author's last name. Unnamed authors are assigned the usual 'Anon'.

Bibliography

Abu Hamid Al-Gharnati: Tuhfat Al-Albab, p99-100. In: Okasha el-Daly: Egyptology: The Missing Millenium: Ancient Egypt in Medieval Arabic Writings. (2008). ISBN 9781598742800.

Abulafia, David (ed): The Mediterranean in History, Thames and Hudson (2003). ISBN: 9780500251201.

Adams, William Henry Davenport: Lighthouses and Lightships, T. Nelson & Sons, London, (1871).

Akurgal, Ekrem: Ancient Civilizations and Ruins of Turkey. Haset Kitabevi, Istanbul (1985), 6th edition.

Allard, Emile: Les Phares. Histoire, construction, éclairage, Paris (1889).

Al-Edrisi; R. Dozy; M. J. de Goeje; E. J. Leyde (trans): Description de L'Afrique et de L'Espagne. Troisième climat, quatrième section. Brill (1866).

Al-Gharnati, Abu Hamid; Jean-Charles Ducène (trans.): De Grenade à Baghdad - La Relation de Voyage d'Abu Hamid al-Gharnati (1080-1161). L'Harmattan, Paris (2006). ISBN: 9782296005594.

Allen, Jim; O'Connell, James F.: Getting from Sunda to Sahul, pp31-46. In: Clark (2008).

Alley, R.B.: GISP2 Ice Core Temperature and Accumulation Data. IGBP PAGES / World Data Center for Paleoclimatology Data Contribution Series #2004-013. NOAA/NGDC Paleoclimatology Program, Boulder CO, USA (2004).

Al-Masudi (translated by Lunde and Stone, (2007), p46.

Al-Masudi: Les Prairies D'Or. Translated in French by C. Barbier de Meynard et Pavet de Courteille. Volume 2, Paris, (1863) p433.

Al-Murtadi: The Egyptian History. Vattier, Pierre (French): 1623-1667, Davies, John (English): 1625-1693. London, (1672), 8 vols.

Al-Qazwini, Zakariya Ibn Muhammad: Br. Mus., Or. MS 3623, fol. 41b. http://www.iranicaonline.org/articles/atar-al-belad-geographical-work

Ambraseys, Nicholas N.; Melville, C. P.; Adams, R. D.: The Seismicity of Egypt, Arabia and the Red Sea - A Historical Review, Cambridge University Press (1994). ISBN: 9780521391207.

Ambraseys, Nicholas: Earthquakes in the Mediterranean and Middle East - A Multidisciplinary Study, Cambridge University Press (2009), 968pp. ISBN: 9780521872928.

Anderson, Atholl; James H. Barrett; Katherine V. Boyle (eds.): The Global Origins and Development of Seafaring. McDonald Institute Monographs, McDonald Institute for Archaeological Research, Cambridge UK (2010). http://www.mcdonald.cam.ac.uk/publications/publication-images/table%20of%20contents/global-seafaring-toc

Anon: A Brief History and Description of Nea Paphos. Antiquities Department, Republic of Cyprus (1978).

Anon: Brief History and Pre-History of Libya. www.temehu.com

Anon: The Adventures of Leucippe and Clitophon, V.6 (online). http://penelope.uchicago.edu/~grout/encyclopaedia_romana/greece/paganism/pharos.html

Anon: The Pharos Site, Alexandria, Egypt International Journal of Nautical Archaeology, March (1975) 4(1), pp126–130.

Arculf; Stewart, Aubrey (trans.): Burchard of Mount Sion. Palestine Pilgrims Text Society, Vol. iii. (1896). https://archive.org/details/libraryofpalesti12pale

Arnold, John H.: History: A Very Short Introduction. Oxford University Press (2000), p17. ISBN 019285352X.

Arunachalam, B.: Navigation Environment of Ancient and Mediaeval Ports of Tamilaham, KW Publishers, New Delhi, India (2008). ISBN: 9788187966784.

Aubet, Maria Eugenia: The Phoenicians and the West - Politics, Colonies and Trade. Cambridge University Press (1996). ISBN: 9780521795432. Also 2nd edition (2001). ISBN: 9780521795432.

Aubet: Spain (1988) p228. In: Moscati (1988).

Aucler, M. Paul. In: Sladen (1906).

Bailey, Geoff: Earliest Coastal Settlement, Marine Paleoeconomies and Human Dispersal - the Africa-Arabia Connection (2010). In: Anderson (2010).

Barthelemy, P.:History of Boulogne-sur-Mer, from Julius Caesar to the year 1825; embellished with plans by M. Barthelemy. Griset, Paris (1825).

Bartoccini, Renato: Il Porto Romano di Leptis Magna, In Bollettino del Centro Studi sull' Architetturo, Supplemento 13, Roma (1958).

Bartoloni, Piero: L'Antico Porto di Nora. In: Antiqua 13 (1979), pp57-61.

Bartoloni, Piero: Ships and Navigation (1988), pp72-7. In: Moscati (1988).

Beaver, Patrick: A History of Lighthouses, Peter Davies Ltd (1971).

Beckby, H. (ed.); Higgins, R. (trans.): Anthologia Graeca. Munich (1957) 4, 171.

Bedon, R.: Les Phares Antiques. In: Archeologia. Prehistoire et Archaeologie, Paris (1988b), pp54-66.

Bedon, R.; R. Chevallier, P. Pinon: Architecture et Urbanisme en Gaule Romain, Paris (1988a).

Behrens-Abouseif, Doris: The Islamic History of the Lighthouse of Alexandria. In: Muqarnas, Vol. 23 (2006), pp1-14. http://www.jstor.org/stable/25482435

Benett, Léon. In: Verne, Jules: Les Grands voyages et les grands voyageurs. Découverte de la Terre. Paris: J. Hetzel (1878). http://www.artfinder.com/work/ibn-battuta-in-egypt-hippolyte-leon-benett/

Bernard, E.: Alexandrie la Grande, Paris (1956).

Blackman, David: Roman Shipsheds; Memoirs of the American Academy in Rome, Supplementary Volumes, Vol. 6, The Maritime World of Ancient Rome (2008), pp. 23-36; University of Michigan Press for the American Academy in Rome. http://www.jstor.org/stable/40379295

Bloom, Jonathan; M. Cresswell: The Origins of the Minaret, Muqarnas 8 (1991) p56. http://archnet.org/system/publications/contents/4179/original/DPC0329.pdf?1384781505

Boin, Douglas: Ostia in Late Antiquity. Cambridge University Press (2016). ISBN: 978-1316601532.

Boivin, Nicole; Roger Blench; Dorian Q Fuller: Archaeological, Linguistic and Historical Sources on Ancient Seafaring (2009). In: Petraglia (2009) Chapter 18, p260.

Bond, G. et al.: A Pervasive Millennial-Scale Cycle in North Atlantic Holocene and Glacial Climates. Science 278, No 5431 (1997), pp1257-1266.

Boston Public Library: Ships and the Sea - A Catalog of an Exhibition of Books and Manuscripts, Boston Public Library, Boston, MA (1966).

Bouras, Catherine: On the Urbanism of Roman Harbours- The Evolution of Space Organization in Harbours of the Aegean Sea. In: Ladstätter (2014), pp669–682. http://www.ancientportsantiques.com/wp-content/uploads/Documents/PLACES/GreeceIslands/Rhodes&Kos-Bouras2014.pdf

Bouriant, Urbain: Description topographique et historique de l'Egypte. Paris (1895-1900), Chapter IX: Du Phare d'Alexandrie, pp444-50.

Brandon, C. J.: Roman Formwork Used for Underwater Concrete Construction. In Oleson (2014) Chapter 8, pp189-235.

Brandon, C. J.; R. L. Hohlfelder; J. P. Oleson: The Concrete Construction of the Roman Harbours of Baiae and Portus Iulius: The ROMACONS 2006 Field Season; submitted to International Journal of Nautical Archaeology 20 April

Breeze, David J.: The Northern Frontiers of Roman Britain. Batsford Academic and Educational Ltd., London (1982) 188pp. ISBN: 0713403454.

Broadhurst, Roland (trans.): The Travels of Ibn Jubayr. Goodword Books, India (2001). ISBN: 9788187570554. First published: London (1952).

Brogan, Olwen: Roman Gaul, G Bell & Sons Ltd, London (1953), 250pp.

Bromwich, James Stephen: The Roman Remains of Northern and Eastern France, Routledge (2013) p51-2. ISBN-13: 9780415143585.

Bronson, R.G., G Uggeri: Isola del Giglio, Isola di Giannutri, Monte Argentario, Laguna di Ortebello - Notizia Preliminare dei Rinvenimenti del 1968. In: Studi Etruschi, 38, II,(1970), pp201-14.

Broodbank, Cyprian: The Making of the Middle Sea. Thames and Hudson (2015). ISBN: 9780500292082.

Buceti, Giuseppe: Gialo. I Misteri Del Peloro, Messina, EDAS (2012), 176pp. ISBN: 9788878203747.

Burgess, Jonathan S: Tumuli of Achilles, Center for Hellenic Studies, Harvard University. https://chs.harvard.edu/CHS/article/display/1312

Butler, Alfred J.: The Arab Conquest of Egypt and the Last Thirty Years of the Roman Dominion. Clarendon Press, Oxford (1902). https://archive.org/details/arabconquestofeg029678mbp. Retrieved 20170330.

Butler, Alfred. J.: The Ancient Pharos at Alexandria. The Athenaeum, November 20 (1880), p681.

Casson, Lionel: The Ancient Mariners - Seafarers and

Sea Fighters of the Mediterranean in Ancient Times. Princeton University Press, 2nd edition (1991). ISBN: 9780691014777.

Casson, Lionel: Travel in the Ancient World, The Johns Hopkins University Press (1994). ISBN: 9780801848083.

Cintas P.: Fouilles Puniques a Tipasa. Revue Africaine, 92 (1949), pp1-68.

Clark, Geoffrey; Foss Leach; Sue O'Connor (eds.): Islands of Inquiry (Terra Australis 29) Colonisation, seafaring and the archaeology of maritime landscapes. ANU Press (2008). ISBN: 9781921313899. http://press.anu.edu.au?p=26551

Clayton, Peter A.: The Pharos At Alexandria (1988b), pp138-57. In: Clayton (1988).

Clayton, Peter A.; Price M. (eds.), The Seven Wonders of the Ancient World. Routledge, London (1988a). ISBN: 0415002796.

Cobb, Paul (ed): The Lineaments of Islam: Studies in Honor of Fred McGraw Donner, Leiden: Brill, (2012), 488pp. ISBN: 9789004218857.

Constable, Anthony R.; William Facey (eds): The Principles of Arab Navigation. Arabian Publishing (2013), 146pp. ISBN: 9780957106017.

Cook, J. M.: The Greeks in Ionia and the East. Thames and Hudson, London (1962), 268pp.

Cook, J. M.: The Troad - An Archaeological and Topographical Study. The Clarendon Press, Oxford (1973), 444pp.

Cooper-Marsdin, Arthur Cooper: The History of the Islands of the Lerins - The Monastery, Saints and Theologians of S. Honorat. Cambridge University Press (1661). Republished (1913), (2013). ISBN: 9781107615465.

Cornide de Folgueira, José: Investigacion Sobre Origen, Progresos y Fabrica de la Torre Ilamada de Hércules Situada a la Entrada del Puerto de la Coruña. Madrid (1792).

D'Ascenzo, Annalisa: Civitavecchia Penuriava D'acqua Dolce da Bere da Molto Tempo Già Persa... ASITA2014. http://atti.asita.it/ASITA2014/Pdf/044.pdf

Dallas, M. F.; Yorke R. A.: Underwater Surveys of North Africa, Jugoslavia and Italy, Underwater Association Report (1968).

Daux, A.: Origines et l'emplacement des emporia Phéniciens. Paris, Imprimerie Impériale, (1869) p302.

De Asin, Don Miguel: Ibn Al-Sayj, the Duke of Alba, Proceedings of the British Academy, 19 (1933), pp277-292.

De Graauw, Arthur: Ancient Ports and Harbours. Volume I: The Catalogue, 5th edition (March 2016). Volume II: Citations of Ancient Authors. Volume III: Ancient Port Structures. Volume IV: Stories of Ancient Sailors. www.ancientportsantiques.com.

De La Blanchere, R.: Terracina, Saggio di Storia Locale, Terracina (1983); Reprinted from Terracine, Essai D'Histoire Locale, Paris (1884). https://archive.org/details/terracineessaidh34labl_0

De Montfaucon, Dom Bernard: L'Antiquité Expliquée et Representée en Figures, vols. 1-15, Paris (1719-1724).

De Rose Evans, Jane (ed): A Companion to the Archaeology of the Roman Republic, Wiley-Blackwell (2013), 746pp. ISBN: 9781405199667.

De Rossi, G.M.: Ventotene e Santo Stefano, Roma (1993).

Della Croce, I.: Nistoria Antica e Moderna Sacra e Profana Della Citta di Trieste, Venetia (1698).

Denny, Mark: The Science of Navigation, From Dead Reckoning to GPS; The Johns Hopkins University Press, Baltimore (2012), 262pp. ISBN: 9781421405124.

Di Vita, A.: Sabratha. In: Libya, the Lost Cities of the Roman Empire, Cologne (1999), pp146-175.

Diels, H.: Antike Technik, Osnabrück (1965).

Dionysius Byzantius; G³ngerich [1927] (trans.): Per Bosporum navigatio. (1958), pp92-94.

Donaldson, G.H.: Signalling Communications and the Roman Imperial Army. Britannia, Vol. 19 (1988), pp349-356, Society for the Promotion of Roman Studies, DOI: 10.2307/526204. http://www.jstor.org/stable/526204

Dorigo, W.:Venezie Sepolte Nella Terra Del Piave, Duemila Anni Fra Il Dolce E Il Salso, Rome (1994).

Dubois, Charles: Pouzzoles Antique (Histoire et Topographie). Paris, A. Fontemoing (1907).

Ducène, Jean-Charles (trans.): De Grenade À Bagdad: La relation de voyage d'Abû Hâmid al-Gharnâtî (1080-1168), L'Harmattan (2006), 210pp. ISBN 9782296005594. http://www.muslimheritage.com/article/lighthouse-of-alexandria

Duggan, T.M.P.; Aykan Akþay: On the Missing Navigational Markers, Beacon Towers; Pharos Of Antiquity, And Notice Of Two Extant Small Marker Beacon Towers of Roman Late 1st c. BC - Early 1st c. AD Anemorium. Akdeniz.Edu.Tr; Cedrus

Dunn, Ross E.: The Adventures of Ibn Battuta - A Muslim Traveller of the 14th. Century. University of California Press, Los Angeles (1986). ISBN: 0520243854.

El-Fakharani, Fawzi: The Lighthouse of Abousir in Egypt. Harvard Studies in Classical Philology, Department of Classics, Harvard University Press, Vol. 78 (1974),

pp257-272.

Elnashai, A.S.; L. Di Sarno; M.D. Carter: New Light on an Ancient Illumination - The Pharos of Alexandria. International Journal of Nonlinear Sciences and Numerical Simulation, Freund Publishing House Ltd, 7:2 (2006), pp137-48. https://scribium.com/sebastien-polet/a/laspect-du-phare-dalexandrie-dapres-les-sources-medievales

Empereur, Jean-Yves: Le Phare d' Alexandrie, La Merveille Retrouvée, Découvertes Gallimard (1998) 112pp. (In French). ISBN: 9782070303793.

Engels, Donald W.: Roman Corinth: An Alternative Model for the Classical City. University of Chicago Press (1990), 264pp.

Esposito, E.; E. Filici, P.A. Gianfrotta, E. Scognamiglio: Il Porto di Kyme. In: Archaeologia Subacquea, Studi, Ricerche, Documenti, III, Roma (2002), pp1-37.

Euzennat Maurice: Ancient Marseille in the Light of Recent Excavations. American Journal of Archaeology, Vol. 84, No. 2, Apr (1980), pp133-140; DOI: 10.2307/504261. http://www.jstor.org/stable/504261

Fantar, Muhammud: North Africa (1988), pp166-185. In Moscati (1988).

Fatta Francesca: Luci del Mediterraneo. I fari di Calabria e Sicilia. Disegni, rilievi e carte storiche. Rubbettino (2002), 198pp. ISBN: 9788849803501.

Feissel, D.: Gouverneurs et Edifices Dans Epigrammes de Smyrne au Bas Empire. REG, 111 (1998), pp125-44.

Ferentinos, George; Maria Gkioni; Maria Geraga; George Papatheodorou: Early Seafaring Activity in the Southern Ionian Islands, Mediterranean Sea. Journal of Archaeological Science 39(7), July (2012), pp2167-2176.

Fernandez Ochoa, C.; A. Morillo: Roman Lighthouses on the Atlantic Coast, BAR International Series 2162 (2010). https://www.academia.edu/9887581/_2010_Roman_lighthouses_on_the_Atlantic_coast. Retrieved 20180312.

Ferreol Salomon; Simon Keay; Nicolas Carayon; Jean-Philippe Goiran: The Development and Characteristics of Ancient HarboursùApplying the PADM Chart to the Case Studies of Ostia and Portus, September 15 (2016). https://doi.org/10.1371/journal.pone.0162587

Fichou, Jean-Christophe; Noel Le Hénaff; Xavier Mével: Phares - Histoire Du Balisage Et De Léclairage des C¶tes de France (1999), Editions Le Chasse-Marée / Armen, Abri Du Marin, 29177, Douarnenez Cedex, 452pp. ISBN: 2903708924.

Finocchi, S.: La Laguna e L'Antico Porta di Nora; In: Rivista di Studi Fenici 27 (1999), pp167-92.

Fischer, Steven Roger: A History of Writing. Reaktion Books (2001). ISBN: 9781861891679.

Fisher, M. B.; M. R. Griffin: Pliny's Letters, Cambridge University Press (1973), 74pp.

Florus, Lucius Annaeus; E. S. Forster (trans): The Epitome of Roman History (1929).

Forbes, Robert James: Studies in Ancient Technology, Vol. 4., E. J. Brill (1964) 311pp.

Forster, E. M.: Pharos and Pharillon, London (1923).

Foucher, L; Hadrumetum, Paris (1964).

Fox, Robin Lane: The Classical World - An Epic History of Greece and Rome. Penguin Books (2006).

Fraser, P. M.: Ptolemaic Alexandria, The Clarendon Press, Oxford, Volumes 1-3 (1972).

Garbini, Giovanni: The Question of the Alphabet (1988), pp86-103. In: Moscati (1988).

Gardiner R.: Earliest Ships - The Evolution of Boats and Ships. Conway Maritime Press Ltd (1996). ISBN: 9780851776408.

Gébara, Chérine; Christophe Morhange: Fréjus (Forum Julii); Le Port Antique; The Ancient Harbour. Portsmouth, R.I., Journal of Roman Archaeology (2010), 152pp. (2010)

Giardina, Baldassarre; Navigare Necesse Est - Lighthouses from Antiquity to the Middle Ages; History, Architecture, Iconography and Archaeological Remains. BAR International Series 2096; BAR Publishing; Oxford (2010) 348pp. ISBN:

Giorgetti, G.: Geografia Storica Ariminese. In: Analisi Di Rimini Antic, Storia Ed Archeoligica per un Museo, Rimini (1980).

Goiran, J-P.; Salomon, F.; TronchÞre, H.; Carbonel, P.; Djerbi, H.; Ognard, C.: Caractéristiques du Basin Portuaire de Claude - Nounelles Données pour la Localisation des Ouvertures, pp31-45. In: Keay (2011)

Goren-Inbar, Naama; Nira Alperson, Mordechai E. Kislev; Orit Simchoni; Yoel Melamed; Adi Ben-Nun; Ella Werker: Evidence of Hominin Control of Fire at Gesher Benot Ya`aqov, Israel. Science, 30 Apr (2004) Vol. 304, Issue 5671,

Grant Michael (ed): The Birth of Western Civilization, Thames and Hudson (1964).

Graves, Robert: The Greek Myths - The Complete and Definitive Edition, Penguin Books (1992), reissued (2011). First published (1955) by Pelican Books, London.

Grimal, Pierre; G. Michael Woloch (trans): Roman Cities. University of Wisconsin Press (1983).

Guzzo, Maria: Painting, pp448-455. In: Moscati (1988)

Hague, Douglas B; Rosemary Christie: Lighthouses, Their Architecture, History and Archaeology. Gomer Press (1975). ISBN: 850883245.

Hamarneh, S: The Ancient Monuments of Alexandria According to Accounts by Medieval Arab Authors (IV-XV century). Folia Orientalia 13 (1971), pp77-110

Hancock, Graham; Santha Faiia: Heaven's Mirror - Quest for the Lost Civilization. Michael Joseph and Channel 4 (1998). ISBN: 0718143329.

Hapgood, Charles H.: Maps Of The Ancient Sea Kings - Evidence Of Advanced Civilization In The Ice Age. Adventures Unlimited (1996). ISBN: 9780932813428.

Harari, Yuval Noah: Sapiens, A Brief History of Humankind. Vintage (2011). ISBN: 9780099590088.

Hardy, W. J.: Lighthouses - Their History and Romance. The Religious Tract Society (1895).

Harris, Eleanor: Ancient Egyptian Magic, Weiser Books, (2016), 240pp. ISBN: 9781578635917.

Harris, Jonathan: A Statue for America - The First 100 Years of the Statue of Liberty. New York City. Four Winds Press (1985). ISBN 9780027427301.

Harris, W. V.; Giovanni Ruffini: Ancient Alexandria between Egypt and Greece. Brill, Leiden, Netherlands (2004), 318pp.

Heeren, Arnold Hermann Ludwig: Historical Researches Into the Politics, Intercourse, and Trade of the Principal Nations of Antiquity, Henry Bohn (1854).

Heilbrunn: Timeline of Art History. New York: The Metropolitan Museum of Art, 2000. http://www.metmuseum.org/toah/hd/grlg/hd_grlg.htm

Hemingway, Colette; Sean Hemingway: Greek Gods and Religious Practices (2003). In: Heilbrunn (2000). http://www.metmuseum.org/toah/hd/grlg/hd_grlg.htm

Herm, Gerhard (trans. from German by Caroline Hillier): The Phoenicians. First Futura Publications, London (1975).

Herodotus; Aubrey de Sélincourt (1954): The Histories. Revised by John Marincola (1996), Penguin edition (2003.

Heyerdahl, Thor; P. Crampton (trans): The Ra Expeditions, Penguin (1972). ISBN: 9780140034622.

Higgins, Reynold: The Colossus of Rhodes. In: Clayton (1988), pp124-37. ISBN: 0415002796.

Hill, Donald: A History of Engineering in Classical and Medieval Times. Routledge (1996). ISBN: 0415152917.

Hodges, Henry: Technology in the Ancient World.

Michael O'Mara Books, London (1996). ISBN: 9781854796042.

Hohlfelder, Robert L.; Christopher Brandon: Narrative of the ROMACONS Fieldwork. Ch. 4, pp73-81. In Oleson (2014).

Hohlfelder, Robert L.; Christopher Brandon; John P. Oleson: Constructing the Harbour of Caesarea on the Sea - New Evidence from the ROMACONS Field Campaign of October 2005. https://web.uvic.ca/~jpoleson/ROMACONS/Caesarea2005.htm

Holmes, George C. V.: Ancient and Modern Ships. Createspace (2015).

Homer; Butler, Samuel (trans): Iliad.

Homer; Murray, A. T. (trans): Iliad. Loeb Classical Library Volumes, Cambridge, MA, Harvard University Press; London, William Heinemann, Ltd (1924).

Homer; Murray, A. T. (trans): Odyssey. Loeb Classical Library Volumes, Cambridge, MA, Harvard University Press; London, William Heinemann Ltd (1919).

Homer; Pope, Alexander (trans): Iliad (1796); notes by Gilbert Wakefield.

Homer; Rieu, E. V. (trans): Iliad (1950); notes by Peter Jones, Penguin Classics (2003).

Homer; Rieu, E. V. (trans): Odyssey (1946). Penguin Classics (2003).

Hourani, George F.; Arab Seafaring - In the Indian Ocean In Ancient and Early Medieval Times. Princeton University Press (1951, reprinted 1995), 190pp. ISBN: 0691000328.

Hughes, A. J.: The Book of the Sextant with Ancient and Modern Instruments of Navigation. Brown, Son & Ferguson, Glasgow (1949).

Hutter, Siegfried: Der Romische Leuchtturm von La Coruna, Verlag Philipp Von Zabern, Mainz am Rhein (1973). (In German).

Hutton, Edward: Ravenna - A Study (1913).

Huxley, George: The History which Inspired Homer (1964). In: Grant (1964).

Irby, Georgia L. (ed): A Companion to Science, Technology, and Medicine in Ancient Greece and Rome, Volume 1 (2016a). ISBN: 9781118372678.

Irby, Georgia L.: Navigation and the Art of Sailing (Chapter 51) (2016b). In: Irby (2016a).

Irwin, G.: The Prehistoric Exploration and Colonization of the Pacific. Cambridge University Press (1992). Online publication date: January (2010). ISBN: 9780511518225. https://doi.org/10.1017/CBO9780511518225

Işık, Fahri; Merih Çobanoglu (trans.): Patara - The History and Ruins of The Capital City of Lycian League. Orkun & Ozan Medya Yayinlari, Antalya (2000), 173pp. ISBN 9789757094043.

Iskan-Isik, H.; W. Eck; H. Engelmann: Der Leuchtturm von Patara und Sex. Marcius Priscus als Statthalter der Provinz Lycia von Nero bis Vespasian. Zeitschrift fur Papyrologie und Epigraphik, 164 (2008), pp91-121.

James Stephen Bromwich: The Roman Remains of Northern and Eastern France, Routledge (2013) pp51-2. ISBN: 9780415143585.

Josephus; William Whiston (trans.): The Jewish War. Book IV Chapter 10.5, Cambridge (1737). http://penelope.uchicago.edu/josephus/index.html

K Muckelroy: Archaeology Under Water - An Atlas of the World`s Submerged Sites, London, (1981).

Karageorghis, Vasos: Cyprus (1988), pp152-165. In Moscati (1988).

Kassab, Maroun (online). www.phoenicia.org/originphoenicians.html

Keay, S. J. (ed): Rome, Portus and the Mediterranean. Archaeological Monographs of the British School at Rome, The British School at Rome, London (2012), 38pp. ISBN 9780904152654. http://www.bsr.ac.uk/site2014/wp-content/uploads/Rome-Portus-and-the-Mediterranean-Chapter-2.pdf

Keay, S. J.: Roman Spain, London (1988).

Keay, S. J.; Millett, M.; Paroli, L.; Strutt, K: Portus - An Archaeological Survey of the Port of Imperial Rome. Archaeological Monographs of the British School at Rome, 15. London: The British School at Rome (2005).

Keay, S. J.; Paroli, L.: Portus and its Hinterland. Archaeological Monographs of the British School at Rome, The British School at Rome, London (2011), 18pp.

Kozelj, T.; Wurch-Kozelj, M.: Phares de Thasos. Bulletin de Correspondance Hellenique, CXIII (1989) 1:161-181, Ecole Francaise d'Athènes. (In French). http://www.persee.fr/doc/bch_0007-4217_1989_num_113_1_4716

Krause, Clemens: Villa Jovis. Die Residenz des Tiberius auf Capri, Verlag Philipp von Zabern, Mainz am Rheim (2003), (In German). ISBN: 9783805330916.

Krischen, F., Die Grieschische Stadt, Berlin (1938).

Ladstätter, S.; Pirson, F.; Schmidts, T.: Harbors and Harbor Cities in the Eastern Mediterranean. BYZAS 19 (2014).

Lagan, Jack: Barefoot Navigator. Navigating with the Skills of the Ancients. A & C Black (2006). ISBN: 9780713674293.

Lakin, David; Fiona Seeley; Joanna Bird; Kevin Rielly; Charlotte Ainsley: The Roman Tower at Shadwell, London - A Reappraisal. Museum of London Archaeology Service, English Heritage, Archaeology Studies Series 8, (2002) 72pp.

Lamboglia, N.: I Monumenti Medioevali Della Liguria del Ponente, Torino (1970)

Lamboglia, N.: Liguria Romana. Alassio (1939).

Landels, J. G.: Engineering in the Ancient World. Chatto and Windus, London(1978), 224pp. ISBN: 0701122218.

Laronde, André: Apollonia de Cyrénaïque. Archéologie et Histoire, Journal des savants, no 1 (1996), pp3-49.

Lehmann-Hartleben, K; Die Antiken Hafenanlagen des Mittelmeeres. In Klio: 14 Aalen (1963) pp178-180.

Lewis, David: The Voyaging Stars. Secrets of the Pacific Island Navigators. Collins, Sydney (1978).

Lewis, David: We, the Navigators - The Ancient Art of Landfinding in the Pacific. University of Hawai'i Press, United States (1994). ISBN: 9780824815820.

Lianos, Nikolas A.: The Ancient Port of Marea-Philoxenite at Lake Mareotis in Alexandria. The Alexandria International Conference on Maritime and Underwater Archaeology (2016). https://www.researchgate.net/publication/322235868_The_ancient_port_of_Marea-Philoxenite_at_Lake_Mareotis_in_Alexandria

Lindsay, William S. (1816-1877): History of Merchant Shipping and Ancient Commerce. ReInk Books (2015).

Lipinsky, Edward: Itineraria Phoenicia (Orientalia Lovaniensia Analecta); Peeters Publishers (2005). ISBN: 9789042913448.

Litchfield West, Martin: Greek Epic Fragments from the Seventh to the Fifth Centuries BC. Harvard University Press, 2003 - Literary Criticism - 316pp.

Liversidge, Joan: Everyday Life in the Roman Empire. B. T. Batsford Ltd (London), G. P. Putnam's & Sons (New York) (1976). ISBN: 071343239X.

Long, Neville: Lights of East Anglia, Lavenham Press (1983) p2.

Lowe, Dunstan: Twisting in the Wind - Monumental Weathervanes in Classical Antiquity. Cambridge Classical Journal, 62, (2016), pp147-169. ISSN 17502705.

Lucian; H. W. Fowler; F. G. Fowler (trans.): The Works of Lucian of Samosata. The Clarendon Press Oxford, 1905, p135-6.

Lucian; William Tooke (trans.): Lucian of Samosata. Vol 2, London (1820). http://www.sacred-texts.com/cla/luc/wl2/index.htm

Mackintosh-Smith, Tim (ed): The Travels of Ibn Battut-

ah. Picador (2002) 325pp. ISBN 9780330418799.

MacPherson, James Rose: The Pilgrimage of Arculfus in the Holy Land About the Year A.D. 670, Palestine Pilgrims Text Society, London, (1895). https://archive.org/details/libraryofpalesti03paleuoft

Mahmoud-Bey, Memoire sur L'Atlantique Alexandrie. Copenhague (1872). https://archive.org/stream/mmoiresurlantiq00falagoog#page/n5/mode/2up

Maiuri, Amedeo: La Specola Misenate. In: Itinerario Flegreo, Bibliopolis, Napoli (1983), pp177-194. ISBN: 9788870880847.

Malkin, Irad: A Small Greek World. Oxford University Press (2011) 284pp. ISBN: 9780199315727.

Manfredini, C.: Il Libro Dei Fari Italiani. Mursia editore, Via Tadino 29, Milano, Italy, (1985), pp 196.

Mansel, A.M.: Die Ruinen von Side, Berlin (1963).

Marimpietri, K.: Fra le dune della Cirenaica/ Archeo (2008), XXIV 4 (278), pp12-13.

Maryon, H.: The Colossus of Rhodes. The Journal of Hellenic Studies, 76 (1956), pp68-86. doi:10.2307/629554.

Matter, M.: (1840-44).

McCann, A.M.; Bourgeois, J.; Gazda, E.K.; Oleson, J.P; Will, E.L.: The Roman Port and Fishery of Cosa - A Centre of Ancient Trade, Princeton University Press (1987).

McCormick, W. H.: The Modern Book of Lighthouses, Lightships and Life-Boats. A&C Black, London (1936), 142pp.

McCrindle, John Watson: The Commerce and Navigation of the Erythraean Sea. Forgotten Books, United States (2015). ISBN: 9781330880883.

McKenzie, Judith: The Architecture of Alexandria and Egypt 300 BCE - AD 700. Yale University Press, New Haven and London (2007) 460pp. ISBN: 9780300170948.

McMahon, Donald J.: A Seafarers Decoding of the Irish Symbols - The Oldest Testament - 3200 BCE to 2500 BCE. Createspace, United States (2014), 9781497395206.

Medas, Stefano:áDe Rebus Nauticis: L'Arte Della Navigazione nel Mondo Antico. Rome: L'Erma di Bretschneider (2004), 234pp. ISBN: 8882652785.

Meiggs, Russell: Roman Ostia, Clarendon Press, Oxford, UK (1997), p279.

Merriam, Augustus Chapman: Telegraphing Among the Ancients. Papers of the Archaeological Institute of America, Classical Series, 3, 1 (1890), 32pp.

Mikelson, Jon: An Overview - Greek Sanctuaries and Worship. AGRC01 (2004), 31pp. http://www.blackwell-publishing.com/content/BPL_Images/Content_store/Sample_chapter/0631232222/Mikalson_sample%20chapter_ancient%20greek%20religion.pdf

Milne, Gustav: The Port of Roman London. B. A. Batsford Ltd., London (1985), 160pp. ISBN: 0713443642.

Mingazzini, P.; F. Pfister: Forma Italiae: Regio I - Latium et Campania, Volumen Secundum, Surrentum, Firenze (1946).

Mirley, Margarett: Closing the Helix - The Journey and Experiences of Pytheas, the Greek Merchant Adventurer Who Explored the Northern Seas. Troubador Publishing, UK (2007). ISBN: 9781906221133.

Moreno, Alfonso: Hieron - The Ancient Sanctuary at the Mouth of the Black Sea. Hesperia, 77 (2008), pp655-709. Quotation on p697.

Morkot, Robert: The Penguin Historical Atlas of Ancient Greece. Penguin Books (1996). ISBN: 0140513353.

Morton, Jamie: The Role Of The Physical Environment In Ancient Greek Seafaring. Brill (2001), 363pp. ISBN: 9789004351073.

Moscati, Sabatino (ed): Phoenicians. Bompiani, Palazzo Grassi, Venezia (1988a).

Moscati, Sabatino: The Carthaginian Empire (1988b), pp54-61. In: Moscati (1988a).

Moscati, Sabatino; Alastair Hamilton (trans): The World of the Phoenicians, Weidenfield and Nicholson (1968), Also Sphere Books (1973). ISBN: 0351174044.

Moscati: Sardinia. (1973b), pp257-282. In Moscati (1973a).

Most, Glenn W.; Schreyer, Alice (Eds.): Homer In Print: A Catalogue Of The Bibliotheca Homerica Langiana At The University Of Chicago Library, University of Chicago (2013) 352pp. ISBN: 9780943056418. https://www.lib.uchicago.edu/e/webexhibits/homerinprint/BHL.html

Mothersole, Jessie: The Saxon Shore. The Bodley Head (1924).

Muckelroy, K.: Archaeology Under Water - An Atlas of the World`s Submerged Sites, London, (1981).

Naish, John M: Seamarks - Their History and Development. Stanford Maritime Limited, 12-14 Long Acre, London WC2E 9LP, (1985), 192pp. ISBN: 0540073091.

Newhouse, Daniel (Capt.): The Whole Art of Navigation in Five Books (1685).

Noble, Joseph V.; Derek J. de Solla Price: The Water Clock in the Tower of the Winds, American Journal of Archaeology, Vol. 72, No. 4. Oct (1968), pp. 345-355.

O'Connell, James; Jim Allen; Kristen Hawkes: Pleistocene Sahul and the Origins of Seafaring Ch5 (2010),

pp 57-68. https://www.researchgate.net/publication/251888687

Oates, Whitney J.: The Population of Rome. Classical Philology, Vol. 29, No. 2 Apr (1934), pp101-116.

Obregon, Mauricio: Beyond the Edge of the Sea. Modern Library Paperback Edition (2002). ISBN: 9780679783442.

Oleson, J. P. and M. D. Jackson: The Technology of Roman Maritime Concrete (2014b), pp1-10.

Oleson, John P., C. J. Brandon, M. D. Jackson, R. L. Hohlfelder: Building for Eternity: The History and Technology of Roman Concrete Engineering in the Sea, Oxbow Books, United Kingdom (2014). ISBN: 9781782974208

Oleson, John P., M. D. Jackson and G. Vola: Appendix 3: Catalogue and Descriptions of Concretes Drilled from Harbour Structures by ROMACONS, (2014a), pp260-263. In: Oleson (2014).

Ordonez Agulla, Salvador: El Faro de Gades y Las Fuentes Medievales. In: II Congresso Peninsular de Historia Antiga, Actas Coimbra (1993), pp247-277.

Ormerod, Henry A.: Piracy in the Ancient World. Johns Hopkins University Press, United States (1996). ISBN: 9780801855054.

Paget, R. F.; From Baiae to Misenum. Vergilius, The Vergilian Society, No 17 (1971), p22-38. http://www.jstor.org.stable/41591669

Paglia, Alessandro: La Lanterna - Trieste Sono Io, Trieste, Assicurazioni Generali, (1997) p116.

Palacios, Miguel Asin: Una Description nueva del faro Alejandria, al-Andalous 1 (1933), pp241-92. Reproduced in Obras Escogigas, II-II, 389-460.

Pasquinucci, Marinella; G. Rossetti: Porto Pisano - The Harbour Infrastructure at Pisa and Porto Pisano from Ancient Times to the Middle Ages. (1988), pp137-55. In Raban (1988)

Pasquinucci, Marinella; Simonetta Menchelli: The Landscape and Economy of the Territories of Pisae and Volaterrae (Coastal North Etruria). The Journal of Roman Studies, 69, November (1979).

Patai, Raphael: The Children Of Noah - Jewish Seafaring In Ancient Times. Princeton University Press (1998), ISBN: 9780691015804.

Pausanius; Peter Levi (trans.): Guide to Greece - Vol. 1, Penguin Books (1971), 586pp. ISBN: 9780140442250.

Peman, Cesar: Las Fuentes Literarias de la Antiguedad y Fundacion de Cadiz, Madrid (1954).

Petraglia, M. D.; Rose, J. I. (eds.): The Evolution of Human Populations in Arabia - Vertebrate Paleobiology and Paleoanthropology. Springer Science and Business Media B. V. (2009)

Petry, Carl: The Cambridge History of Egypt, Volume 1 & Volume 2. Cambridge University Press (2008).

Phillips-Birt, Douglas: A History of Seamanship. Allen & Unwin (1971). ISBN: 9780046230098.

Philp, Brian: The Excavation of the Roman Forts of the Classis Britannica at Dover 1970-1977. Kent Archaeological Rescue Unit, CIB Headquarters, Dover Castle, Kent (1981).

Pliny the Elder; John Bostock, H.T. Riley (trans): Natural History. Taylor and Francis, Red Lion Court, Fleet Street, London (1855).

Pliny the Elder; John Healy (trans.): Natural History - A Selection; Penguin Classics (1991).

Poochigian, Aaron: Phaenomena. Johns Hopkins University Press (2010). ISBN: 9780801894664.

Raban, A. (ed.): Archaeology of Coastal Changes. Proceedings of the First International Symposium: Cities on the Sea, Past and Present; Oxford, B.A.R. (1988).

Raban, Avner; Kenneth G. Holum: Caesarea Maritima - A Retrospective After Two Millennia. (Documenta et Monumenta Orientis Antiqui), Brill, Netherlands (1996). ISBN: 9789004103788.

Rapisarda, Massimo; M. Ranieri: A Phoenician Lighthouse at Capo Gallo Palermo. Mediterranean Archaeology and Archaeometry, Vol. 16, No 4 (2016), pp225-231.

Reich, David: Who We Are And How We Got Here, Oxford University Press (2018), 335pp. ISBN: 9780198821250

Renard, Leon: Les Phares, Editions L'Ancre de Marine, St. Malo (1990).

Ricci, R.: Bergeggi - Un Isola Davanti ad Un Isola, Torino (1998).

Rigsby, K. J: Asylia - Territorial Inviolability in the Hellenistic World. University of California Press, Berkeley (1996).

Robinson, Damian; Goddio, Franck (eds): Thonis-Heracleion in Context, Oxford Centre for Maritime Archaeology, University of Oxford (2015). ISBN: 9781905905331. http://www.franckgoddio.org/projects/sunken-civilizations/heracleion.html

Rowlett, Russ: The Lighthouse Directory (online). https://www.unc.edu/~rowlett/lighthouse

Rugua, Zhao; Hirth, Friedrich, W.W. Rockhill (trans.): Zhu fan zhi (1225), (1911). http://ebook.lib.hku.hk/CADAL/B31403797

Rutherford, Adam: A Brief History of Everyone Who Ever Lived. Weidenfield and Nicolson (2016), 420pp. ISBN: 9781780229072.

Sachs, Abraham: A Classification of the Babylonian Astronomical Tablets of the Seleucid Period. Journal of Cuneiform Studies, Vol. 2, No. 4 (1948), pp271-290.

Scarre, Chris (ed.): Antiquity, A Review of World Archaeology, Vol. 90, 350, April (2016).

Schoff, Wilfred Harvey: The Periplus of the Erythraean Sea - Travel and Trade in the Indian Ocean by a Merchant of the First Century. London, Bombay & Calcutta (1912).

Sharp, Andrew: Ancient Voyagers in the Pacific. Penguin (1957).

Silius Italicus; J. D. Duff (trans): Punica. William Heinemann Ltd, London (1959).

Sladen, Douglas Brooke Wheelton: Carthage and Tunis, The Old and New Gates of the Orient. Hutchinson, London (1906).

Smith, James: The Voyage and Shipwreck of St. Paul - With Dissertations on the Life and Writings of St. Luke, and the Ships and Navigation of the Ancients. Forgotten Books, United States (2016). ISBN: 9781332037926.

Somner, William: A Treatise of the Roman Ports and Forts in Kent. James Brome, Oxford (1693). http://name.umdl.umich.edu/A60898.0001.001

Spence, Simon: The Image of Jason in Early Greek Myth. Lulu.com, (2011), pp292. ISBN: 9781446115817.

Stevenson, Alan: On the Theory and Construction of Lighthouses (1857).

Stevenson, David A.: The World's Lighthouses Before 1820. Oxford University Press (1959).

Stewart, Charles: Magic Circles - An Approach to Greek Ritual. Journal of the Anthropological Society of Oxford 25:1 (1994), p91-101.

Strabo; Jones, Horace L. (trans.): The Geography of Strabo. William Heinemann, London & New York (1917). Books 1 to 17 in 8 Volumes with index in Volume 8.

Strong, Anthony: The Phoenicians in History and Legend. 1st Books Library (2002). ISBN: 140336690X.

Stuart, James; Nicholas Revett: The Antiquities of Athens. London (1762).

Suetonius Tranquillus, C.; Alexander Thomson (ed): The Twelve Caesars. Penguin Classics (2007)

Sutton-Jones, Kenneth: Pharos - The Lighthouse Yesterday, Today and Tomorrow. Michael Russell Publishing Ltd, Salisbury UK (1985).

Talbot, Frederick A.: Lightships and Lighthouses. William Heinemann, London (1913), 325pp.

Taylor, E.G.R.: The Haven-Finding Art; A History of Navigation from Odysseus to Captain Cook. Hollis & Carter, London (1956).

The New English Bible, Cambridge University Press (1970), Acts 27:20.

Thiersch, Hermann: Pharos, Antike, Islam Und Occident. B. G. Teubner, Leipzig und Berlin (1909). Reprinted under license. ISBN: 9781248365946.

Thomas, Stephen D.: The Last Navigator - A Young Man, an Ancient Mariner, the Secrets of the Sea. Booksurge Publishing, United States (2009). ISBN: 9781439233498.

Thompson, D.J.: Ptolemaios and The Lighthouse - Greek Culture in the Memphite Serapeum. Proceedings of the Cambridge Philological Society 33 (1987), p105-21.

Thouvenot, Raymond: Essai sur la Province de Bétique, Paris (1940).

Torrin, Ken: Maritime History Part 1 - Ancient Times Age of Navigation; Medieval Times; and More. Webster`s Digital Services (2016). ISBN: 9781276188869.

Toussoun, Prince Omar: Description du Phare d'Alexandrie d'aprÞs un auteur arabe du Xlle siÞcle. Bulletin de la Société Royale d'Archéologie d'Alexandrie 30 (1936) 49-53.

Trethewey, K. R.: What is a Lighthouse? A Modern Definition. World Lighthouse Society Quarterly Magazine, 1st. Quarter (2013), Volume 11, Issue 1, 5-14.

Tripati, Sila: Maritime Archaeology- Historical Descriptions of the Seafarings of the Kalingas. Kaveri Books, New Delhi (2000). ISBN: 9788174790385.

Tuck, Steven L.: Ports, Chapter 21. In: A Companion to the Archaeology of the Roman Republic, Jane DeRose Evans (ed) Wiley-Blackwell (2013), 746pp. ISBN: 9781405199667.

Tusa, Vincenzo: Sicily (1988) p186-205; In Moscati (1988).

Uggeri, Giovanni: Baro Zavelea near Comacchio, Aemilia Ferrara (1973); Torre Romana: In Fasti Archaeologica, XXX-XXXI, pp821-822.

Usai, D.; S. Salvatori: The Oldest Representation of a Nile Boat. Antiquity Vol 81 issue 314 December (2007).

van Berkem, Dennis: Sanctuaires a Hercules-Melqart, Syria, 44 (1967).

van Berkem, Max: Materieux pour un Corpus Inscriptionum Arabicarum (Egypte). Paris (1900), pp473-89.

van de Noort, Robert: North Sea Archaeologies - A Maritime Biography, 10,000 BC - AD 1500. Oxford University

Press (2011), pp282. ISBN: 9780199657087.

Vann, Robert L.: The Drusion - A Candidate for Herod`s Lighthouse at Caesarea Maritima. International Journal of Nautical Archaeology, Vol. 20 No.2 (1991), pp123-139.

Villa, Paola; Wil Roebroeks: Proceedings of the National Academy of Sciences, 14 March (2011). http://www.colorado.edu/today/2011/03/14/neanderthals-were-nifty-controlling-fire-according-cu-boulder-researcher

Vincent, William: The Commerce and Navigation of the Ancients in the Indian Ocean (1807). British Library, Historical Print Editions (2011). ISBN: 9781241411022; Also Nabu Press (2014), USA. ISBN: 9781294892038.

Vincent, William: The Periplus of the Erythrean Sea (1739-1815). Pre-1801 Imprint Collection (Library of Congress) DLC,Thomas Leiper Kane Collection (Library of Congress, Hebraic Section) DLC, ReInk Books (2015).

Vitruvius; Morris Hicky Morgan (trans.): The Ten Books on Architecture. Harvard University Press Cambridge Mass. USA / Oxford University Press, Oxford, UK (1914).

Vorderstrasse, Tasha: Descriptions of the Pharos of Alexandria in Islamic and Chinese Sources: Collective Memory and Textual Transmission (2012), pp457-81. In: Cobb (2012).

Wachsmann, Shelley: Seagoing Ships and Seamanship in the Bronze Age Levant. Texas A&M University Press (2009). ISBN: 9781603440806.

Wallace, Paul W.: The Tomb of Themistocles in the Peiraieus. Hesperia, Oct. - Dec. (1972), The American School of Classical Studies at Athens, pp. 451-462. http://www.ascsa.edu.gr/pdf/uploads/hesperia/147386.pdf

Wheeler, R. E. M.: The Roman Lighthouses at Dover. Archaeological Journal Vol. 86 (1929) 1:, pp29-46. https://doi.org/10.5284/1018054; www.archaeologydataservice.ac.uk

White, Tim D.; Asfaw, B.; DeGusta, D.; Gilbert, H.; Richards, G. D.; Suwa, G.; Howell, F. C.: Pleistocene Homo sapiens from Middle Awash, Ethiopia. Nature, 423 (6491) (2003), pp742-747.

Whitney, Marie: A Look At The History Of Sailing Including Ancient Maritime History, History Of Navigation, Maritime History Of The United States, Plus Historic Ship Types... Webster's Digital Services (2016). ISBN:

Wikipedia: Australia (continent) 20160727

Wikipedia: Beta Ursae Minoris 20160831

Wikipedia: Black Sea 20171012

Wikipedia: Black Sea Deluge Hypothesis 20171012

Wikipedia: Brittenberg 20180110

Wikipedia: Bronze Age Collapse 20171010

Wikipedia: Carthage (2016)

Wikipedia: Compass 20170828

Wikipedia: Cushi (2016)

Wikipedia: Denisova 20160727

Wikipedia: Dido (2016)

Wikipedia: Hellenistic Period 20171015

Wikipedia: History of the Cyclades 20171010

Wikipedia: Homo 20160723

Wikipedia: Inland Sea (Geology) 20180110

Wikipedia: Land of Punt 20160728

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Wikipedia: Milos 20170828

Wikipedia: Mirrors, Telescopes, Speculum metal 20180228

Wikipedia: Neanderthal 20160727

Wikipedia: Nuraghe (2017)

Wikipedia: Odyssey, 20160822

Wikipedia: Panormus (2017)

Wikipedia: Periplus of the Erythraean Sea 20180129

Wikipedia: Phoenicia (2016)

Wikipedia: Pleistocene (2017)

Wikipedia: Pythea, 20180129

Wikipedia: Reed boats 20160723

Wikipedia: Sardinia (2017)

Wikipedia: Venerius the Hermit 20170417

Wilde, W. R.: On the Pharos of Coruña. Proceedings of the Royal Irish Academy (1836-1869), Vol. 2 (1840 - 1844), pp. 583-594, Published by: Royal Irish Academy, pp12. http://www.jstor.org/stable/20520203

Wilford, John Noble: Geologists Link Black Sea Deluge To Farming's Rise. The New York Times (17 December 1996). Retrieved 17 June 2013.

Witney, Dudley: The Lighthouse. Arch Cape Press (1989) 256pp. ISBN: 0517669536.

Wood, Michael: In Search of The Trojan War. BBC Books (2005). ISBN: 0563522658. Also ISBN: 0520215990.

Woodburn Hyde, Walter: Ancient Greek Mariners with Maps, Oxford University Press (1947).

Woodman, R.; Jane Wilson: The Lighthouses of Trinity House, Thomas Reed Publications (2002). ISBN:

190405000X.

Wright, George R.H.: Ancient Building in Cyprus. Brill, Netherlands (1992). ISBN: 9789004095472.

Wroth, L.C.: The Way of a Ship - An Essay on the Literature of Navigation Science. Martino Publishing, Mansfield Centre (2001). Reprint of 1937. ISBN: 9781578983254.

Yorke, Robert A.; David P. Davidson: The Harbour at Ptolemais - Hellenistic City of the Libyan Pentapolis. The International Journal of Nautical Archaeology (2017). https://doi.org/10.1111/1095-9270.12212.

Zemke, Friedrich-Karl: Leuchttürme Der Welt. (Volume 1), Koehler (1992). ISBN: 3782205375.