

# Ancient Lighthouses - Part 8: An Overview

by Ken Trethewey

Gravesend Cottage, Torpoint, Cornwall, PL11 2LX, UK

**Abstract:** This paper is a summary of seven other papers in this series about Ancient Lighthouses. A complete presentation of the work is available in the A4 hard-back volume entitled "Ancient Lighthouses - and Other Lighted Aids to Navigation" by Ken Trethewey, ISBN 978-0-9926573-7-6, published by Jazz-fusion Books at the above address.

"There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns. There are things we don't know we don't know." (Donald Rumsfeld, 2002)

## Introduction

Donald Rumsfeld's comedic lines were given to the world in all seriousness, in the context of the USA going to war with Iraq. However, they are apt in many situations, not least of which is the subject of Ancient Lighthouses.

This study has embraced almost the entire span of humanity and it is a "known known" that we shall never be certain of the precise origins of lighthouses. However, this work has attempted to pencil in some of the details by consideration of current thinking amongst the community of scientists, historians, archaeologists and others, all of whom are contributing to pharology.

The rapid growth in understanding of human evolution has given us much better knowledge of the capabilities of the various species of *homo* and a more accurate time-line for their migration patterns. We are better equipped now to identify the epochs when humans first set out on water-borne journeys and their earliest use of fire. Social and cultural anthropologists have extensively studied the behaviours of different groups of peoples and we are much better able to correlate their activities with historical periods.

To make a precise statement about when and where the first lighthouse was built requires a clear agreement about the definition of a lighthouse. We have no such consensus today, a fact that introduces a layer of the "unknown" into our deliberations.

This work has presented a definition of a lighthouse and, in the fullness of time, it is up to other pharologists to decide upon its merits. In this final paper, I shall give an overview of what I believe to be the latest understanding of the origins of pharology. First, let us re-examine what we understand by the term, *lighthouse*.

## What is a Lighthouse?

At a superficial level, it seems a very easy question to answer. Pharologists are frequently asked the question, "So how many lighthouses are there?" My own very hesitant response of, "Er, well, it depends..." could be taken as an indication of, "Ah, he doesn't know!" Consider for a moment that we are trying to precisely define a motor car. It seems so easy to give an answer, but we quickly realise that there are many forms of transport that could be called a motor car. For example, we cannot simply say it is a 4-wheeled form of transport, for motor cars can have both fewer and more wheels than 4. We *might* also decide that, to be a car, it *must* have four wheels.

A lighthouse (or a motor car) has both form and function - i.e. "What does it look like?" and "What does it do? Figures N01 and N02 were presented at the start of this book in order to clarify some of the issues, and these charts, known as Venn diagrams, will form part of this discussion. I have also resorted to what are popularly known as mind maps and which I call topic taxonomies. These make good summaries of properties and because of their tree-like structures, they bring together aspects of a subject in a clearer, diagrammatic way. However, their main disadvantage is that they do not provide the overlap that is offered by Venn diagrams. All human-related activities are "fuzzy" in nature and have no clear lines of demarcation. Thus a property shown in one part of a topic taxonomy may also be applicable in another. To show a truly complete schematic diagram such as this is clumsy and impractical and probably not useful. The two methods I have selected are useful in different contexts and both have their issues. The answer to the question, "What is a lighthouse?" is not to be given lightly.

## A Top-Down Analysis

Fig. 8-1 presents seven aspects of the study of ancient lighthouses, although you will recognize that there is a close parallel with modern lighthouses too. A top-down analysis is a logical way of describing a complex subject. It begins with these topics and drills down into each one.

### Information

In Part 1, I attempted to summarize the information available to us from ancient sources. Fig. 8-2 summarizes the elements involved in the information about ancient lighthouses that is presently available to us. Knowing with certainty (a known known!) that our subject of study began before written records were made, we must rely on the protracted and determined studies of archaeologists. For much of the time through the 19th and early 20th centuries, archaeology was performed by enthusiastic amateurs or ill-disciplined professionals who, in the absence of precedent were defining their fields of study by trial and error. Modern practices have had to work with those past studies that were in some cases, performed with catastrophic and irreversible consequences

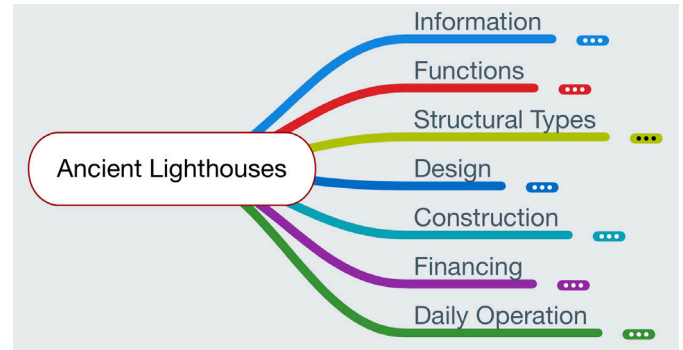


Fig. 8-1: Some considerations of the subject of ancient lighthouses

to some of our most precious sites, notably Troy. However, the field is now both mature and stable from an academic point of view, in the developed world, at least. Fortunately, with the help of the UN and other international organizations, the developed world has been able to provide both financial and logistical support to archaeological work in the under-developed countries, maximizing the outcomes there.

In terms of the global picture, archaeology is a discipline in which there is a great deal still to be discovered, especially underwater, close to the present shorelines because of significant sea level rises during the Holocene period. In this regard es-

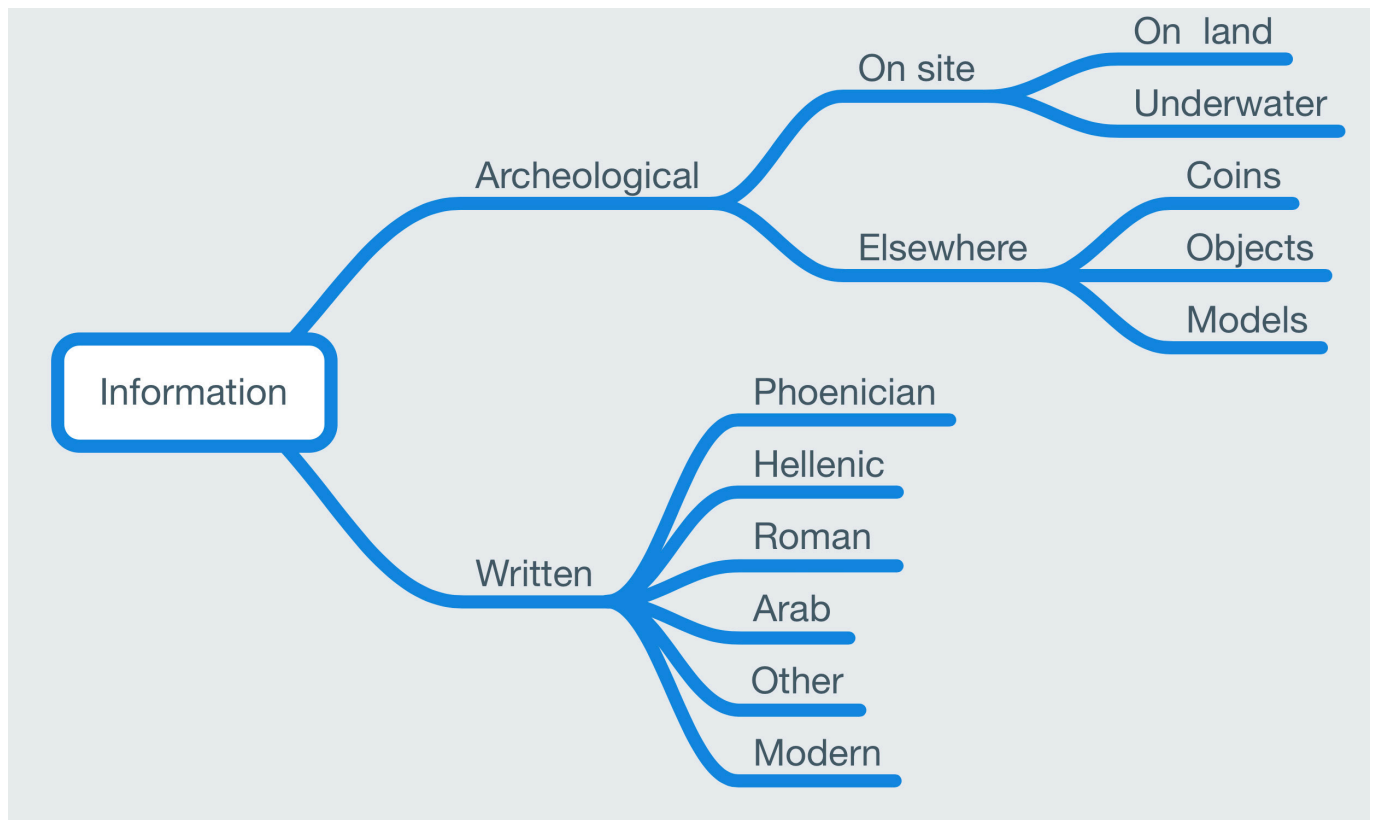


Fig. 8-2: Topics relevant to sources of information. For information before the time of writing, we must rely upon the work of archaeologists.

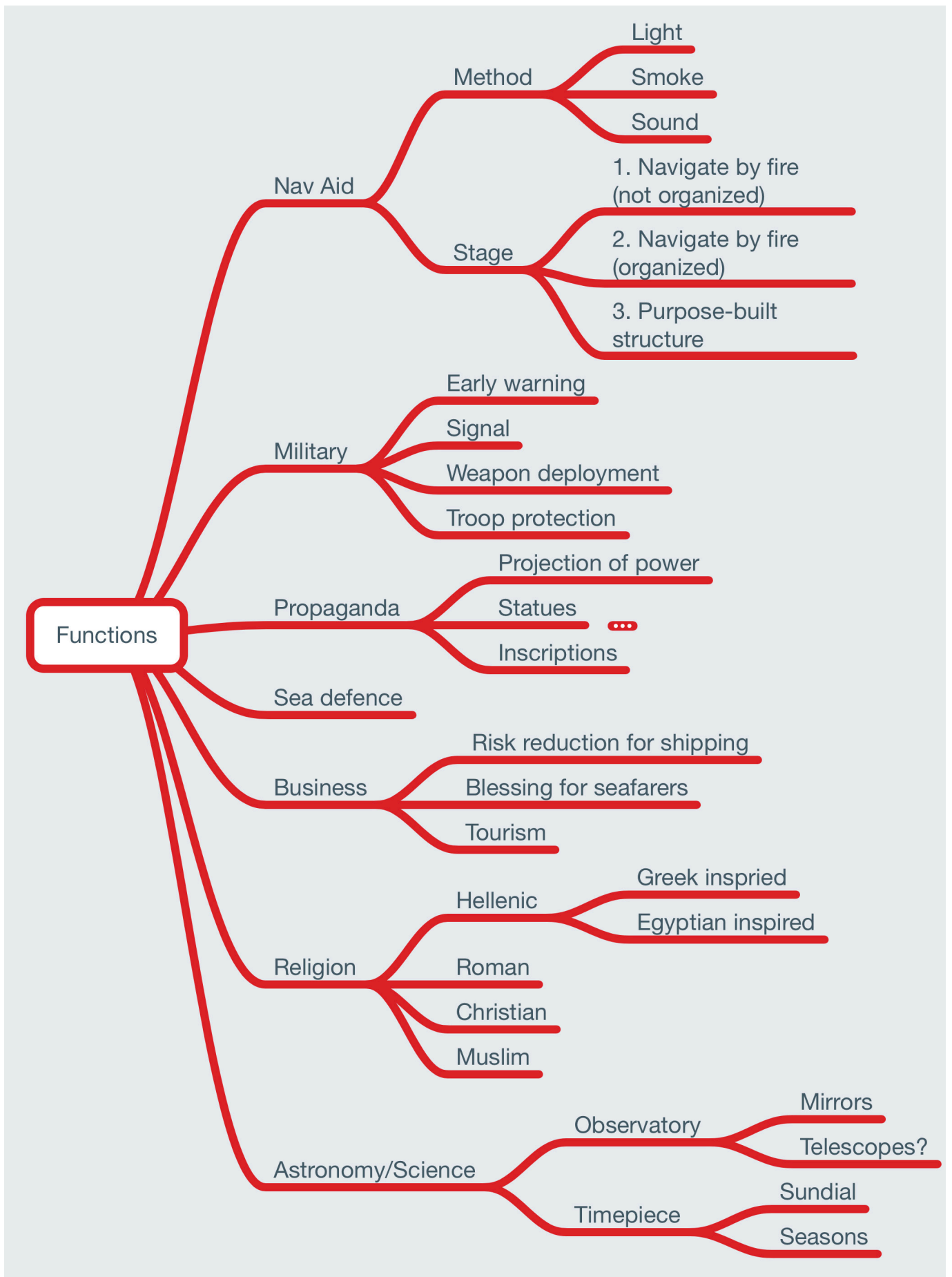


Fig. 8-3: Possible Functions of ancient lighthouses, with particular relevance to the Pharos of Alexandria.

pecially, pharology can expect to be rewarded with wonderful new finds in the foreseeable future, as long as there is not too much political interference in regions of instability, such as north Africa and the middle east.

Where written records are available, I have shown how much we can determine from them, albeit with serious limitations that affect the degree to which an unknown can be converted into a known. Phoenician written records are rare and those we do have irrelevant to our inquiries. Although Chinese written records date back to at least 1500 BCE, and early scripts from northwest India dating back even further are known but not yet deciphered, we have so far found no evidence that can add to the descriptions in this book.

## Functions

The elucidation of the history of ancient lighthouses is probably easier to establish by considering the answer to the question, “What does it do?” or, perhaps, “What *might* it do?” Fig. 8-3 summarizes the possibilities. Clearly the scope for advantages to be gained from a lighthouse are far wider than merely to assist navigation. Furthermore, there will be a great variability of factors with time, as each waxes and wanes in importance through history. With this in mind, the chart has been compiled with the Pharos very much to the foreground because, remarkably, all of the properties are applicable to it - even tourism, for we have seen how many Arab visitors made the effort to visit the famous Pharos on their travels through Alexandria. If we consider the only candidate that offers a precedent to the Pharos - the small cylindrical structure on Thasos, shown in Fig. 3-8, then we see that there are few factors that apply to it. This casts doubt as to whether such a simple structure could possibly be thought of as a precedent. The Pharos was so extraordinary that it would seem to be our duty to regard it as the first lighthouse, a conclusion that satisfies our modern idea of a lighthouse, but not our logical analysis.

An easily overlooked property is the development stage, which has been defined in three levels in the section describing Conventions and Terms at the start of this book. Stage 1 is unlikely to be considered as a lighthouse, for an essential ingredient is that some structure - however basic - must be assembled by a human *with the intent* to

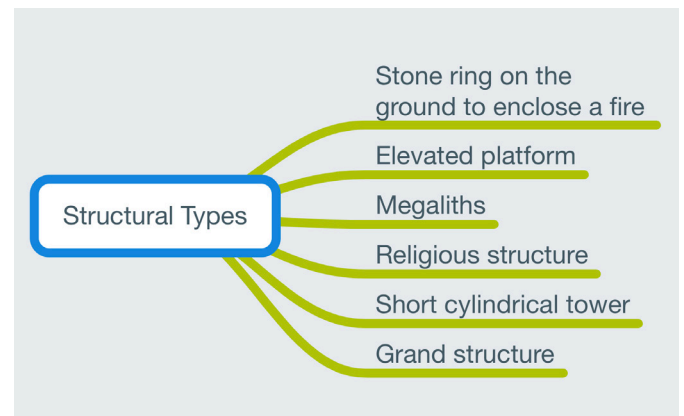


Fig. 8-4: Structural types that might have been used in ancient lighthouses.

assist navigation. This means that the undoubted (yet until now, unreported, making it an unknown known) use by mariners of lights shown for religious purposes at sanctuaries, temples and such like, should be assigned to Stage 2, whilst the Pharos - and the Thasos structure - should be allocated to Stage 3 and hence formally described as lighthouses. From the viewpoint of functional analysis, this is surely the essence of defining a lighthouse.

## Structural Types

Fig. 8-4 shows the various types of structure that might be considered for the role of an ancient lighthouse. In the very beginning, our empirical concept of a navigational aid is any material arrangement configured by a human that purposefully shows a light at night and is of use to a navigator. This could be something as simple as a group of stones - or even just a hole in the ground - in which a fire could be lit at night. According to my proposed definition, it would be the purpose of the fire that determined whether we might consider it a lighthouse or not, i.e. it would conform to a stage 3 function. Any advancement of this idea, whether by building an elevated wooden or stone platform is irrelevant, as long as the purpose is clear.

I have discussed the problems of identifying lighthouses in the context where structures have been built for military signalling rather than navigational purposes, as was the case with Roman signal towers. In such case, it may have been true that both functions were employed, but this is a known unknown.

The idea that prehistoric megaliths might have been used as a very early kind of primitive light-

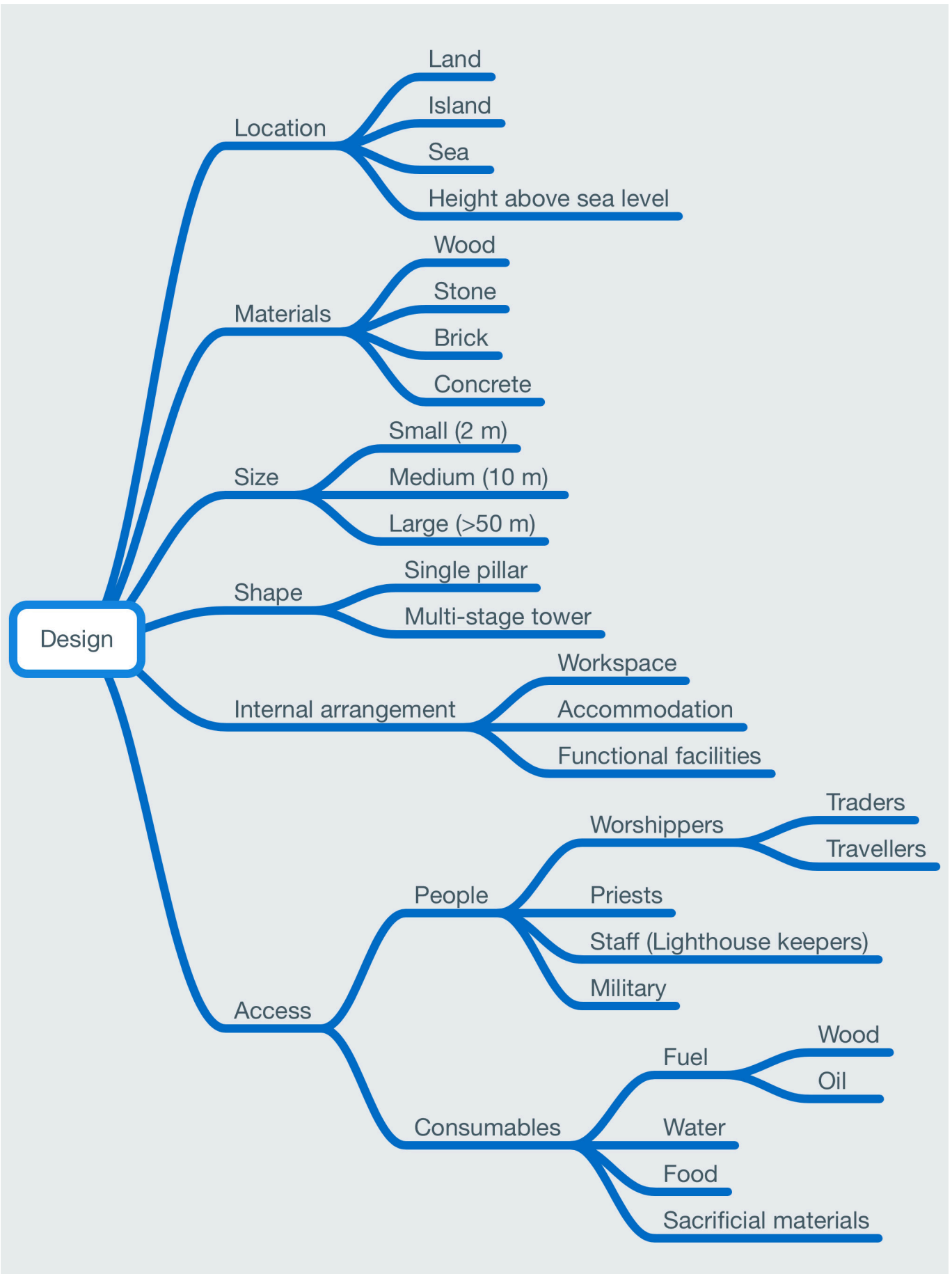


Fig. 8-5: A Topic Taxonomy of properties relevant to the design of ancient lighthouses.

houses is possible, sensible and tantalising. In my exposition on the Phoenician seafaring culture I reported the recent finding of megalithic structures in Sicily, used but not built by the Phoenicians, that could not only have acted as lighthouses by showing fires from specified places at night, but might even have performed the role of signposts pointing to distant destinations across the sea. Unfortunately the report is too new to attach more than a modicum of importance to it.

The opportunities for lights shown from religious installations are more than a possibility; indeed, they are most probable, as my studies of Greek and Phoenician seafaring cultures has shown in Parts 3 and 4. However, since their primary purpose was religious, it may be incorrect to describe them as lighthouses: the lights were not purposefully set to assist navigation.

In those cases where we can be confident of describing a structure as a lighthouse, we are on firmer ground. The difference between the short, cylindrical tower on Thasos and the grand structure of the Pharos is irrelevant in this context.

## Design

It is a most unfortunate known unknown that there is so little information about the architects who designed (and perhaps built) ancient lighthouses, for we should admire these people far more than many others who were able to attract the limelight of history. Roman engineering was, in many ways, about fifteen centuries ahead of its time, and the Greek minds who had already established the principles of mathematics and mechanics upon which it was based lived in even earlier times. Of course, it was the community leaders who decided upon the requirements, but that was usually the easy part. The employment of incompetent people to implement the instructions must have resulted in many failures that we could classify as unknown unknowns.

The requirement was always defined by the location for it was necessary to position navigational aids where they would offer effective assistance to mariners. On land, this was usually at the entrance to a port, but it might also be in a more remote (high) position if it were more effective - perhaps when the light was used as a waypoint or landfall light, for example.

At first, ports and harbours were selected on

the basis of their natural geographical features - the Phoenicians were masters of this from the earliest times. Later, as harbours were developed for improved access, shelter from bad weather, and capacity, engineers added artificial structures to their designs. Islands, islets and man-made moles were used to carry light structures. We have even found at Portus Claudius at Ostia how a man-made island was created to form the foundation of a wonderful lighthouse - the first of its kind.

The height of the light above sea level was very important for in every situation, it was vital to consider the distance from which the light was intended to be seen by the navigator. This was a part, but not the entire reason for the extreme height of the Pharos, which was intended to impress as much as it was to assist.

The choice of materials was mostly driven by a combination of technology and availability. Wooden structures are always less permanent than stone. Bricks were a fundamental part of Roman structures above ground; stone and concrete were vital for foundations as well as to give extra strength in bulk. Even the choice of stone was an important consideration for there are types of hard stone that are selected for maximum resistance to wave impacts, and other softer types best suited for interiors and ornamentation where more difficult shapes are necessary.

The Thasos tower is approximately the size of a man and would sensibly be placed in the category of 'small'. The Pharos is clearly the opposite - in the extreme! We place it in the 'large' category (with a smile?) Many later lighthouses were 'medium' in size, although Part 6 suggests that there were many that were 'large' because local chiefs wanted to impress foreign visitors arriving in their ports.

Complications arise when the balance of properties is considered. For example, wooden platforms are cheaper, easier to make, and therefore easier to replace in view of the low durability of wood. However, there is a height restriction. Where a tower needs to be high, a short wooden tower could be built in an elevated location. Different arguments apply to stone.

We have also noted in Part 6 how much the form of the Pharos was copied; the multi-stage tower was a frequently selected design. This is a design feature that is relevant to the proposed height of the tower for taller structures are like-

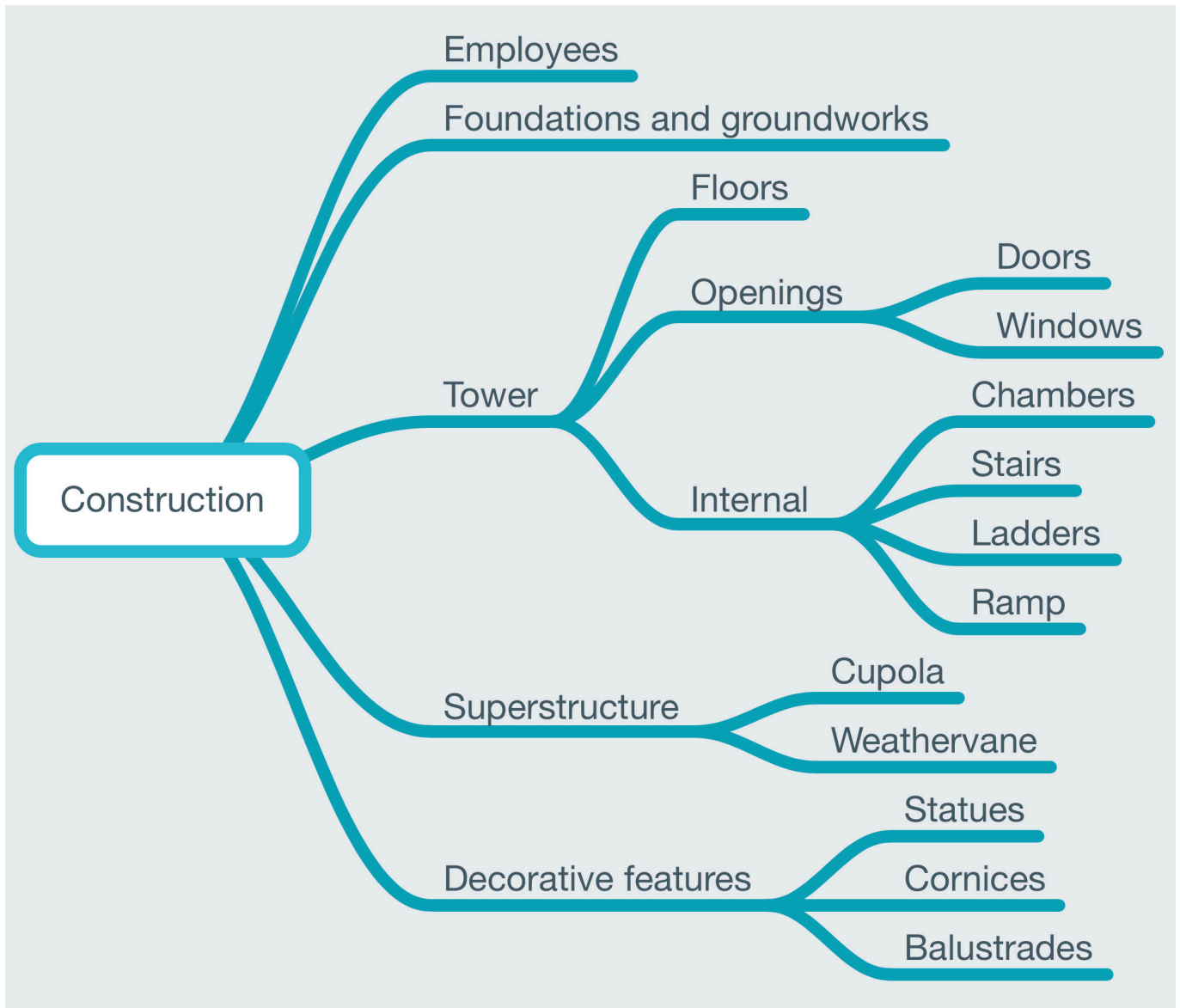


Fig. 8-6: Factors applicable to the construction of an ancient lighthouse.

ly to topple if they are of the same cross-section throughout their whole height. We noted how, for example, at Dubris and Gesoriacum, the tapering height was an important feature since greater stability is achieved.

Internal arrangements are important too for there were often many people to sustain in a large lighthouse, of whom keepers of the light were probably in the minority.

Finally, the access to the structure was a major decision to make. In general, the larger the tower and the more functions it was required to meet, the more access was required. At the Pharos site, we noted that what began as a small island ended with a land bridge created with huge infill of the sea. Clearly there were large demands to keep such a great structure working to its specification. Many different people were involved, not to men-

tion their matériel requirements to sustain their professional and personal activities. And as a lighthouse alone, the quantities of fuel needed for such a powerful light must have been extraordinary.

## Construction

The initiation of the process that results in the building of any lighthouse is an identification of the need. Whilst it is navigators who make their needs known, we are well aware that they do not necessarily get what they want. Political considerations generally outweigh all else, but given the agreement of the politicians, there are plenty of other reasons why a project might not go ahead. Financing is always a potential show-stopper, but so too is the availability of suitable labour, not just the manual kind, but also the necessary engineer-

ing skills to produce a structure that will fulfill the requirements.

There has been much discussion about the designer of the Pharos. It has been agreed, almost universally, that Sostratus of Cnidus was the architect, but, even so, there are those who doubt this and assign him other roles in the project. Simply put, we do not have sufficient written and unambiguous material to be certain of it. Of all the reports of possible lighthouse sites listed in the catalogue, there are no other names of lighthouse architects than Sostratus. Even in the Roman era, it is, sadly, only the names of the commissioning emperors that have emerged as responsible for the many fine Roman lighthouses.

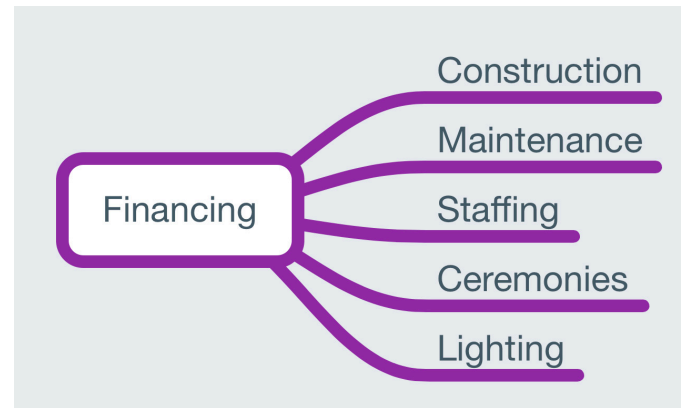
If we assume that the name of Sostratus is indeed a known known, then we must attribute a remarkable degree of engineering and scientific knowledge to this man, for we have seen how his brainchild was converted into one of the most remarkable engineering achievements in history. Not only was the lighthouse function completely fulfilled but so also were all of the other attributes listed in Fig. 8-3. Few engineers have the privilege of getting it right first time, and Sostratus was no exception. He clearly was unsuccessful in achieving the necessary degree of resistance to earthquake, but that is perhaps entirely forgivable in the circumstances. His design was so successful that it was copied many times, by Roman engineers in particular and the longevity of the basic structure was unparalleled throughout history.

The construction features were also completely successful and we are fortunate indeed to have a very clear picture of all aspects of the building processes, especially of the many modifications to the structure made during the long period when the Pharos came under Islamic control.

## Financing

The financing of lighthouse projects in ancient times has been discussed in a very cases above. The remarkably large amount of money reportedly spent on the Pharos has been the only occasion when we have been given a stated amount - 800 talents. In the case of the Roman development of Ostia, I mentioned the considerations given by Claudius to the cost of the ambitious project, but unfortunately we know little more than this.

It is clear that the cost of a project needs to



*Fig. 8-7: Factors applicable to the Financing of ancient lighthouses*

cover the topics shown in Fig. 8-7. Construction costs include materials, labour and architects fees, as well as the fittings, fixtures and, in the case of many towers, decorative features that were considered essential in those times. Installation of the lighting and other equipment was probably a small cost in comparison with the costs of running the lighthouse, where maintenance costs were also significant, especially after it had suffered damage from storms and earthquakes.

Probably the least expensive element was the wage bill, as we understand that most ordinary workers lived on subsistence money. Soldiers probably earned more, but were probably financed independently as part of the costs of keeping an army.

## Daily Operation

It is in the subject area of daily operation of ancient lighthouses that we have virtually no firm knowledge other than what has already been reported in Part 5, the story of the Pharos, which is the lighthouse we know most about. It is a sad reflection upon our subject that so little was written about the lives of ordinary people who, of course, were those primarily involved with all aspects of ancient lighthouses. It could be said that the lives of individual citizens were of no consequence when it came to the value of official records. It was only with respect to large groups of individuals that events and the actions of leaders were considered important enough for scribes to record. Emperors, kings and pharaohs were interested in the likes of us when their own position was threatened. Naturally, this is an aspect of the development of civilization that was perpetuated through many centuries and still exists today in



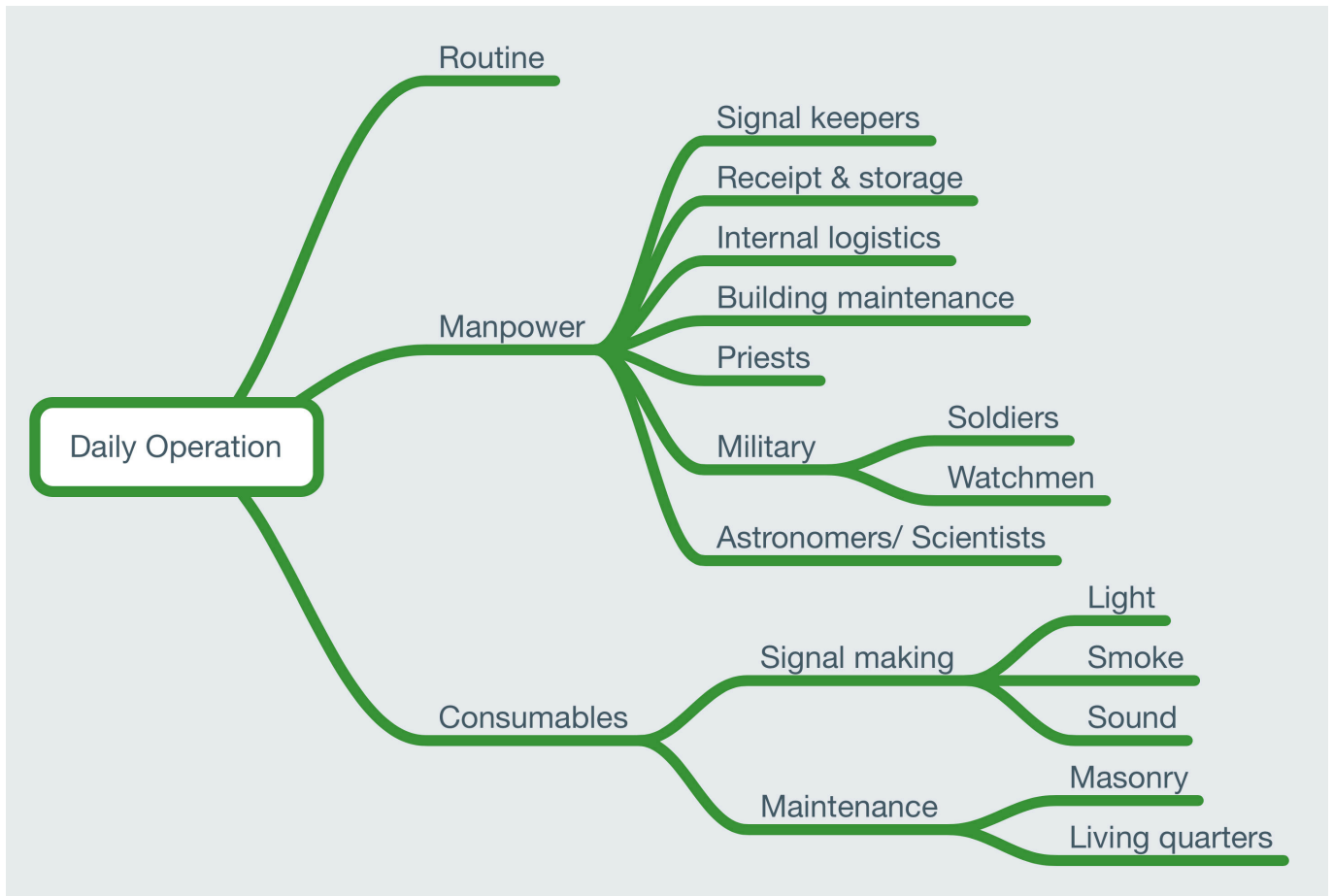


Fig. 8-8: Factors necessary for the day-to-day operation of an ancient lighthouse such as the Pharos.

many countries. Only since the days of mass media has it really become possible for the names and actions of ordinary citizens to be recorded for posterity, apart from such national recording systems as registers of births, marriages, deaths etc. which have purposes other than to massage the egos of 'unimportant' individuals. Unless an individual possessed sufficient education to be able to write, and enough resources to be able to make long-lasting records (such as stone tablets, papyrus, parchment, paper, writing tools etc.) the lives and activities of virtually all humans were eradicated with their deaths.

The Phoenician people have left us only a very tiny legacy of records, a sad fact that has reduced our knowledge of their culture more than almost all of the other major cultures. In contrast, Greek peoples are well known for their record-keeping and for individual authorship on a great variety of subjects including philosophy and science, as well as art, literature and poetry. Even here, there is a great paucity of literature in the areas of concern here. Despite the extensive knowledge we have

of ancient Greek history, some of which has been outlined in Part 3, we have nothing of substance on the actual activities necessary to provide navigational assistance to mariners. Only in our studies of the Pharos - constructed under the influence of the Hellenic culture - do we begin to find even the slightest attempts to describe what actually occurred inside the lighthouse walls. This deficiency continued under Roman leadership when it appears that any subject was fair game for a writer, except for the simple lives of lighthouse keepers and navigators. What we are left with is a frustratingly large number of known unknowns.

## Final Words

At the end of this study that I hope has been exhaustive, but not exhausting, I wish to conclude with my considered responses to various claims regarding the earliest lighthouses.

There is no definitive evidence for a lightstructure earlier than the Pharos of Alexandria. However, there is much indirect evidence. Whether the story of Hero and Leander is myth or historical fact is irrelevant. The mythology of the ancient culture of the Greeks and the Trojans clearly refers to the idea of constructing navigational aids for those who use the sea. It is surely inconceivable that, given the prevalence of these ideas, no structures were built. There is unambiguous evidence linking the stories with recognizable places in the 21st century landscape. Thus, it is possible that the first lightstructure was indeed at Abydos on the Hellespont, a crucial crossing point between Europe and Asia. There is every possibility that the idea, expressed in a story of Hero showing a navigation light for Leander, had some element of truth, but we have no other evidence than the texts written in Roman times and we have no indication of a date.

The evidence at Troy is more positive. Troy was the earliest major population with a clear dependence upon sea-borne traffic that might have constructed artificial aids to navigation. We might conclude that it was the construction of a lightstructure at Cape Sigeum on the southern side of the entrance to the Hellespont that began it all. Here was a most important and strategic waterway where the sheer amount of traffic justified the effort and expense of construction. Here also was the burial site of the greatest Greek warrior. We can place the time of this event as occurring somewhere during the long period of stability of Troy VI, i.e. from 1700 BCE to 1250 BCE.

We shall almost certainly never be able to verify the story of Hero and Leander. However, many of the ancient sites on Turkish soil remain unexcavated and there is every chance that archaeology will, in years to come, unearth a new structure that can be unambiguously interpreted as a lightstructure and dated to the same period, if not earlier.

The possibility that the Phoenicians built the first lightstructure at Cadiz cannot be ignored, but remains most unlikely, unless the Sigeum structure was never built. Although Cadiz was possibly

founded in 1110 BCE, it was argued above that a more likely date for the creation of a significant presence is some 300 years later. The extended discussion about the Phoenicians, their culture and their methods tends to render the argument unlikely. Even if it did exist, a lightstructure at Carthage would only qualify as the first lightstructure in the absence of others at Sigeum and Cadiz. If it can be shown that structures at Cadiz and Carthage were indeed built (although I am not convinced) it is far more likely that the Phoenicians, having seen the lightstructures on the Hellespont, adopted the idea for their own ports. There are no other sites where earlier lightstructures can be proposed, consistent with the ideas of their association with the development of civilization and culture.

Nothing lasts forever in history, and there were many times when lighted sites became dark. The structures became victims of frequent and violent battles and changing politics. Indeed, it is also possible that, because the great majority of sea journeys took place in summer months, ancient lightstructures were not lit in winter and thus only temporary. But the seed of the idea of a lighted aid to navigation, once sown, remained present in the roots of subsequent interacting cultures. Copied occasionally at first, the idea evolved in a number of forms around the Mediterranean between 1250 and 300 BCE, only to be celebrated in glorious style by the building of the great Pharos itself. The remaining and perhaps most curious question is why nothing relevant to previous structures seems to have been recorded.

As we look to the future there are two things that promise to reveal much about the past. The first is underwater archaeology. A very recent branch of study, the study of the coastal strips from earliest times that were used intensively by those peoples and which is now underwater, is a treasure trove of knowledge that we have only just opened, and which will take many decades – even centuries of detailed exploration to unravel.

The second is promised by the great and rapid strides being made in the understanding of genetics through DNA analysis. This promises to provide many new insights into the peoples of the earliest times, and we can only anticipate that there is great deal that is new and surprising still to be discovered using these techniques. Taken together

er, these two methodologies could offer clearer answers to the questions posed in this book. Until then, I shall reiterate the original question of questions, “Who built the first lighthouse?” To which I reply:

The First Lighthouse Was Built By...

...Romans.

No, it was not. The Romans were responsible for the spread of lighthouse technology, but not its creation. All Roman structures were built post-Pharos.

...Greeks.

Probably. If we care to believe that the first lighthouse was the Pharos of Alexandria then it was Greek culture that built the Pharos. The Greeks who achieved it lived in Egypt at the time, so they may have considered themselves Egyptian, but they were certainly living in the Greek culture brought there by Alexander. If we settle on the use of temples and other sacred sites as being the providers of lights for navigational purposes, then it is also true that Greeks were responsible from around 700 BCE. If we choose to believe the first lighthouse was in the Troad or the Hellespont then it was again implemented within Greek culture around 1200 BCE.

...Phoenicians.

Possibly. Phoenician sailing practices seemed much less dependent upon these kinds of navigational aids, and more upon those provided by nature. However, there are clear instances, such as at Cadiz, where Phoenician temples provided navigational assistance to incoming ships. We might speculate that in Phoenicia this happened well before the Greeks adopted the practice, but it seems to me that the evidence is largely missing.

...Neolithic Peoples

Unlikely, but possible. Recent evidence suggests that Neolithic people set up megalithic signposts. These would have given assistance to navigators in daylight. If fires were lit on top of these (flat) stones then they may have been useful at night too. The use of fire might have been when ships were expected to arrive or depart. Unfortunately, this remains a new theory and much more research is necessary to enhance our understanding.

When we balance the known knowns against the known unknowns, the comparison is heavily weighted in favour of the latter. This is surely the reason for the lack of serious studies of the subject for so many years. Examples of the known unknowns include:

**No firm knowledge of the fuels used, whether types or quantities. How efficient were they? How reliable? When they were used?**

**No knowledge of lighthouse architects, lighthouse engineers or lighthouse keepers. Who were they? What were their terms of reference? Were they supervised?**

**Few structures are left today, only meagre remains. Why is there so little to study, especially during the Roman period when much use was made of lighthouses? Where foundations can be seen, it is a matter of speculation whether or not they supported lighthouses.**

**We must rely upon the few relevant observations of ancient authors, many of whom were not actually present.**

We know that the earliest Mariners used whatever they could find to help with their navigation. If they saw a light at night and they could recognize its source, then they used it as a beacon to find their direction. Besides the natural sources of light such as the moon, stars and perhaps volcanoes, there were the lights from human activity. Many were shown at random and with irregularity and were therefore useless. However those lights from permanent locations of human activity such as religious locations, temples, villages, and perhaps other fixed locations, could be used on a regular basis to identify the position of a ship at sea relative to the land. All of these light sources were secondary in nature and therefore we cannot truly record these as lighthouses. Having scoured the literature and Google maps for as-yet unidentified lighthouse sites, we must conclude that, before the Pharos was built, there were none. Yet we have just argued that this cannot be true. As far as the wider world is concerned, we must continue to present the case that the Pharos was indeed the first Lighthouse. The counter argument is just too hard to swallow in a journalistic world.

# Conventions and Terms

## Navigational Aids

For consistency, this series of papers will generally refer to navigational aids using the modern definitions given below and described in Figs. N01 and N02. However, so little is known about many of the structures discussed herein that any distinction between them is often very difficult. We note the following definitions:

**Beacon:** *Any artifact, built or floating, visible or recognizable from a distance, whether by land or sea, that is specifically intended to provide a signal or warning for any purpose not exclusive to navigation.*

**Navigational aid:** *Any artifact set up, either in the sea or on land, whether built or floating, with the specific purpose, whether primary or otherwise, of assisting seamen in safe navigation. A navigational aid can be lit or unlit and may or may not have an audible signal. When floating, it is always moored in a fixed position.*

**Lighthouse:** *A fully or partially enclosed built structure bearing a light that is used as a navigational aid and that is capable of admitting at least one person who can operate or maintain the light entirely from within.*

**Lightstructure:** *A built structure bearing a light that is used as a navigational aid. All lighthouses are lightstructures.*

## Functional Analysis

Whilst accepting that the use of lighted aids to navigation may have developed incrementally, it is possible to identify three stages of development:

A waterborne craft steers at night towards a fire or other light that:

- **IS NOT intended to act as an aid to navigation**

(Stage 1);

- **IS intended to act as an aid to navigation**

(Stage 2);

- **IS intended to act as an aid to navigation AND is set on a purposefully-built, elevated platform**

(Stage 3).

### **Stage 1:**

Would have been possible from the times when fire was first used by hominins (today suggested as around 400 ka ago), together with the first use of waterborne craft. It was opportunistic on the part of the navigators and unplanned by those who lit the fires. This could have been available to any species of homo having fire and the capability of using water-borne transport.

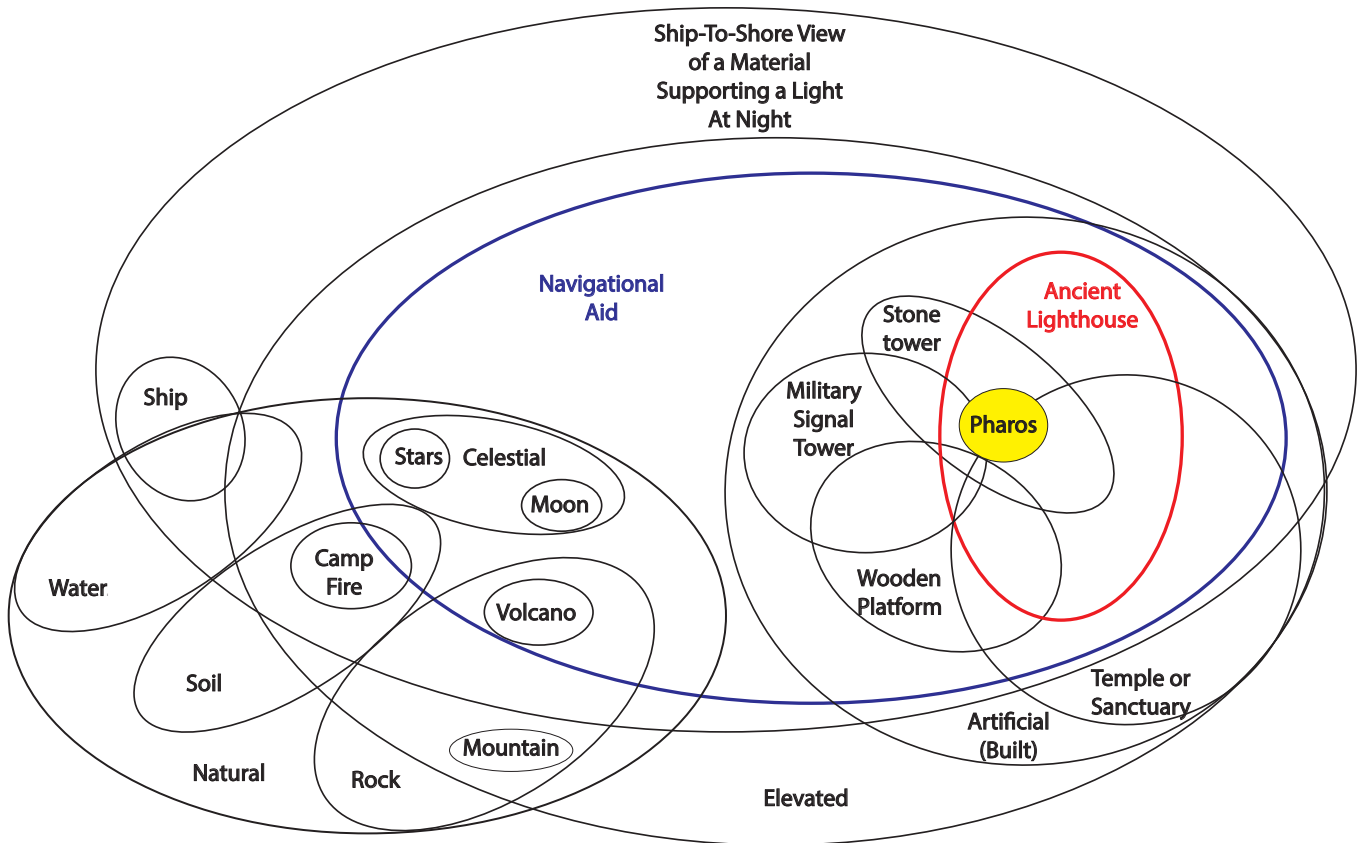
### **Stage 2:**

Could have occurred over a long period of transition after Stage 1. The deliberate maintenance of fires provided a guide to homecoming craft. There is a clear distinction between Stages 1 and 2, for Stage 2 requires a purposeful intent that may have been impossible for species of *homo* other than *homo sapiens*, although we cannot rule out its use by Neanderthals. It is therefore likely that Stage 2 was implemented at about the same time or soon after *homo sapiens* began to travel by water. In the English language, this would commonly be referred to as a beacon.

### **Stage 3:**

Is the point at which the idea of a lighthouse finally emerged as a discrete, built, purposeful structure. It seems to have not occurred until a long time after Stage 2, probably in the second millennium BCE.

All of these significant events in human history remain vague and subject to change as new evidence comes to light. In particular, the placement of Stage 3 into the time-line of Fig. 2-1 is challenging, given the time gap that clearly exists since Stage 2. However, this analysis concludes that the Pharos of Alexandria was the first true lighthouse, rather than simply a Stage 2 lightstructure.



*Fig. N01: Ship-To-Shore View at Night. This Venn Diagram illustrates the relevant visual and functional properties of lights viewed at night by mariners as aids to navigation. In particular, the diagram defines the world's first accepted ancient lighthouse.*

**The diagram applies to night; varying degrees of reflected moonlight have not been included.**

**Elevated is above ground level on the shore.**

**Sizes of ellipses and sectors have no significance. Overlap is a visual allusion to shared visual and functional properties.**

**A volcano is a navigational aid if it is visible at night.**

**A ship may carry a light but because it moves is not a navigational aid.**

**A camp or domestic fire can be a navigational aid if it helps a mariner to return to a place from where he departed.**

**A temple or sanctuary or other altar is by definition elevated and can be considered to be an ancient lighthouse as a secondary function.**

**The Pharos of Alexandria is the first artificial (built) stone tower that was used as a lighthouse for its primary function. It may also have been used for religious and military purposes, but these were secondary functions.**

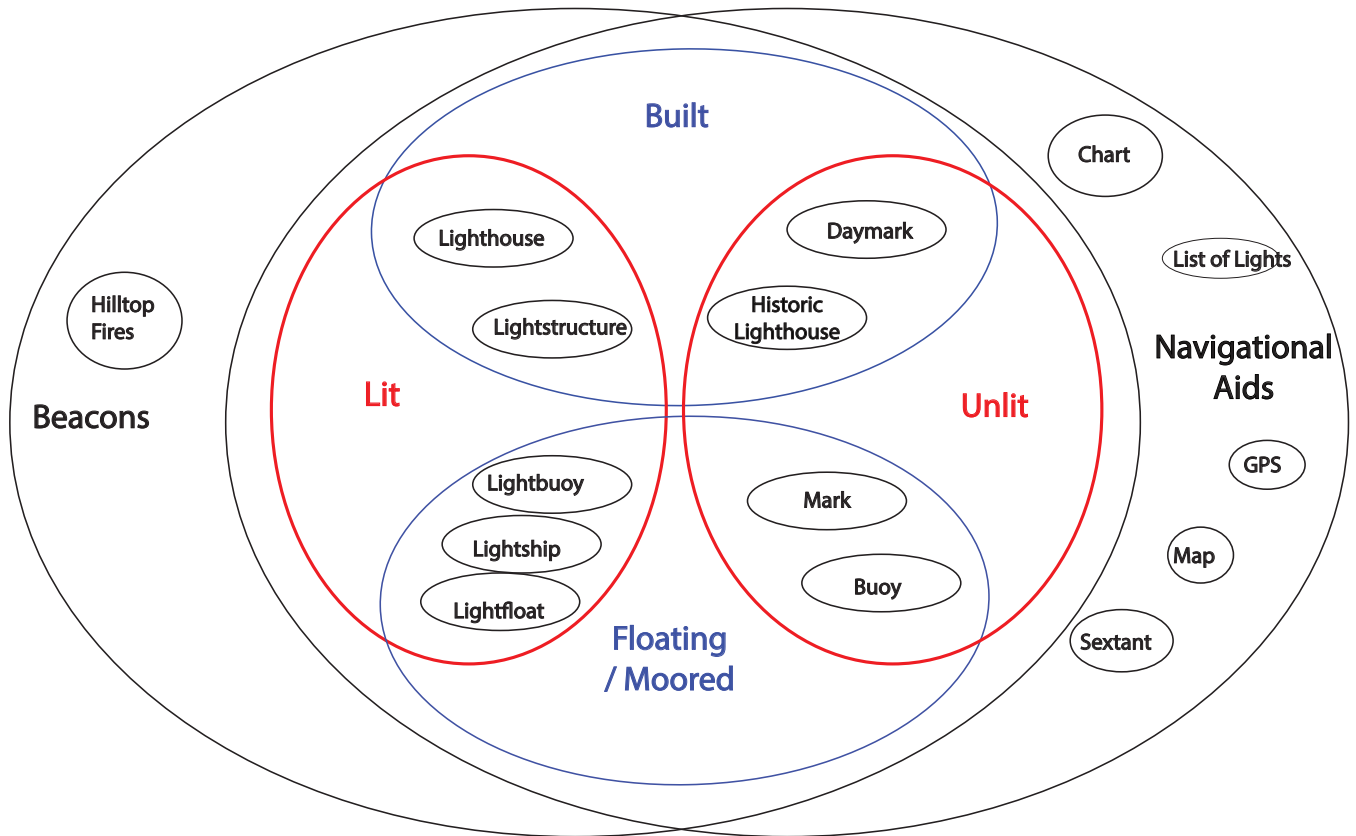


Fig. N02: A Venn Diagram that considers modern navigational aids in terms of their visual properties.

Those structures that are both lit and built are lighthouses and lightstructures.

A historic lighthouse is unlit.

## Time / Years

In these papers, we shall consider events that occurred a very long time ago. The use of BC has in recent years been replaced by the abbreviation BCE, meaning Before the Current Era, where the Current Era is defined as 0. However, if we measure time on a scale that goes backwards from today, the relevant symbol is BP (Before the Present). Whilst it may be more convenient for some readers, the present is undefined and, in print, loses its sense with the passage of time. I intend to use the more natural CE - Current Era - to denote dates that were once referred to as AD. I intend not to use a comma to denote thousands up to ten. Thus, I shall use 3000 BCE, not 3,000 BCE. However, beyond ten thousand I shall use the comma, thus 12,000 BCE.

I may attach BCE to dates that fall into this category, except where the number of years is so large as to make it simpler to use a second system. This method of defining dates complies with the unit of 'thousands of years before the present, where 'thousands of years' is represented by ka. The symbol kya stands for 'thousands of years ago'. Thus 6000 BCE is 8 kya. Dates having no indication of BCE or kya are assumed to be in the Current Era from 0 to 2018. All dates are necessarily approximate, but are in general agreement with current literature.

## The Islamic Calendar

Part 5 is about the Pharos of Alexandria, which stood in various forms for some 1600 years. This series of papers covers the period up to around 400 CE, therefore much of the history of the Pharos extends beyond the period covered by this series, and during a period when Egypt was under Muslim government. Dates in the Islamic, Muslim or Hijri Calendar begin in 622 CE.

To Convert Hijri years (H) to Gregorian years (G) we use the formula:

$$G = H + 622 - (H/33)$$

This is still not a perfect formula, but is good enough for our purposes. We note also that when years in the Muslim Calendar are given in Gregorian by other authors, they can sometimes be subject to +/- 1. Without precise knowledge of the exact date of an event in history, this error margin must be accepted as inevitable.

## Names of People and Places

A number of civilizations and cultures are covered by the contents of this series of papers and so the names of people and places can vary with context. Perfect precision requires a level of detail that becomes cumbersome and renders the text clumsy and difficult to read. I have tried to use a common-sense approach that, on the whole, uses the commonest form and gives alternatives where it seems sensible to do so. Since this is history, I use the ancient name in preference and give the modern name in parentheses. The catalogue of lighthouse and lightstructure sites gives all of the alternatives that I am aware of.

I have used italics for the names of ancient places or terms in non-English languages. Any inconsistency is unintended.

# 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 Millennium: 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](http://www.temehu.com)
- Anon: *The Adventures of Leucippe and Clitophon, V.6* (online). [http://penelope.uchicago.edu/~grout/encyclopaedia\\_romana/greece/paganism/pharos.html](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).
- Bartocchini, Renato: Il Porto Romano di Leptis Magna, In *Bollettino del Centro Studi sull' Architettura*, 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 Romaine*, 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 Shiphsheds; *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 Julius: 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/arab-conquestofeg029678mbp>. 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 Punique 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 llamada 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](http://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/terrachineessaidh34labl\\_0](https://archive.org/details/terrachineessaidh34labl_0)
- De Montfaucon, Dom Bernard: *L'Antiquité Expliquée et Représentée 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; G<sup>3</sup>ngerich [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, Due-mila 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 Hâmîd al-Ghar-nâtî (1080-1168)*, *L'Harmattan* (2006), 210pp. ISBN 9782296005594. <http://www.muslimheritage.com/article/lighthouse-of-alexandria>
- Duggan, T.M.P.; Aykan Akpaya: *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-medi-evaies>

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, Muhammad: *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](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 Harbours - Applying 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 Cotes 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 Necesses 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 Ariminense*. In: *Analisi Di Rimini Antic, Storia Ed Archeologica per un Museo*, Rimini (1980).

Goiran, J-P.; Salomon, F.; TronchPre, H.; Carbonel, P.; Djerbi, H.; Ognard, C.: *Caractéristiques du Bassin Portuaire de Claude - Nouvelles 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](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](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 Çobanoğlu (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 für 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 *Moscatti* (1988).
- Kassab, Maroun (online). [www.phoenicia.org/originphoenicians.html](http://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](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 Rhein (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](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, pp135-6.
- 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*. Copenhagen (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.
- McCrinkle, 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: *De 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/Mikalsen\\_sample%20chapter\\_ancient%20greek%20religion.pdf](http://www.blackwell-publishing.com/content/BPL_Images/Content_store/Sample_chapter/0631232222/Mikalsen_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, Margaret: *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.
- Moscato, Sabatino (ed): *Phoenicians*. Bompiani, Palazzo Grassi, Venezia (1988a).
- Moscato, Sabatino: *The Carthaginian Empire* (1988b), pp54-61. In: Moscati (1988a).
- Moscato, Sabatino; Alastair Hamilton (trans): *The World of the Phoenicians*, Weidenfield and Nicholson (1968), Also Sphere Books (1973). ISBN: 0351174044.
- Moscato: *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 Congreso 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 Escogidas*, 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 Antigüedad 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*. Weidenfeld 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'après un auteur arabe du XIe siècle*. *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.
- Tripathi, 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 *Moscatti* (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 Inscriptio-num 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 Erythraean 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 Peiraeus. *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](http://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: Cushite (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  
Wikipedia: Lighthouse of Alexandria 20160618  
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.