Ancient Lighthouses - Part 6: Lighthouses After The Pharos

by Ken Trethewey

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

***Abstract**: This paper describes the development of lighthouses from 300 BCE to 400 CE*

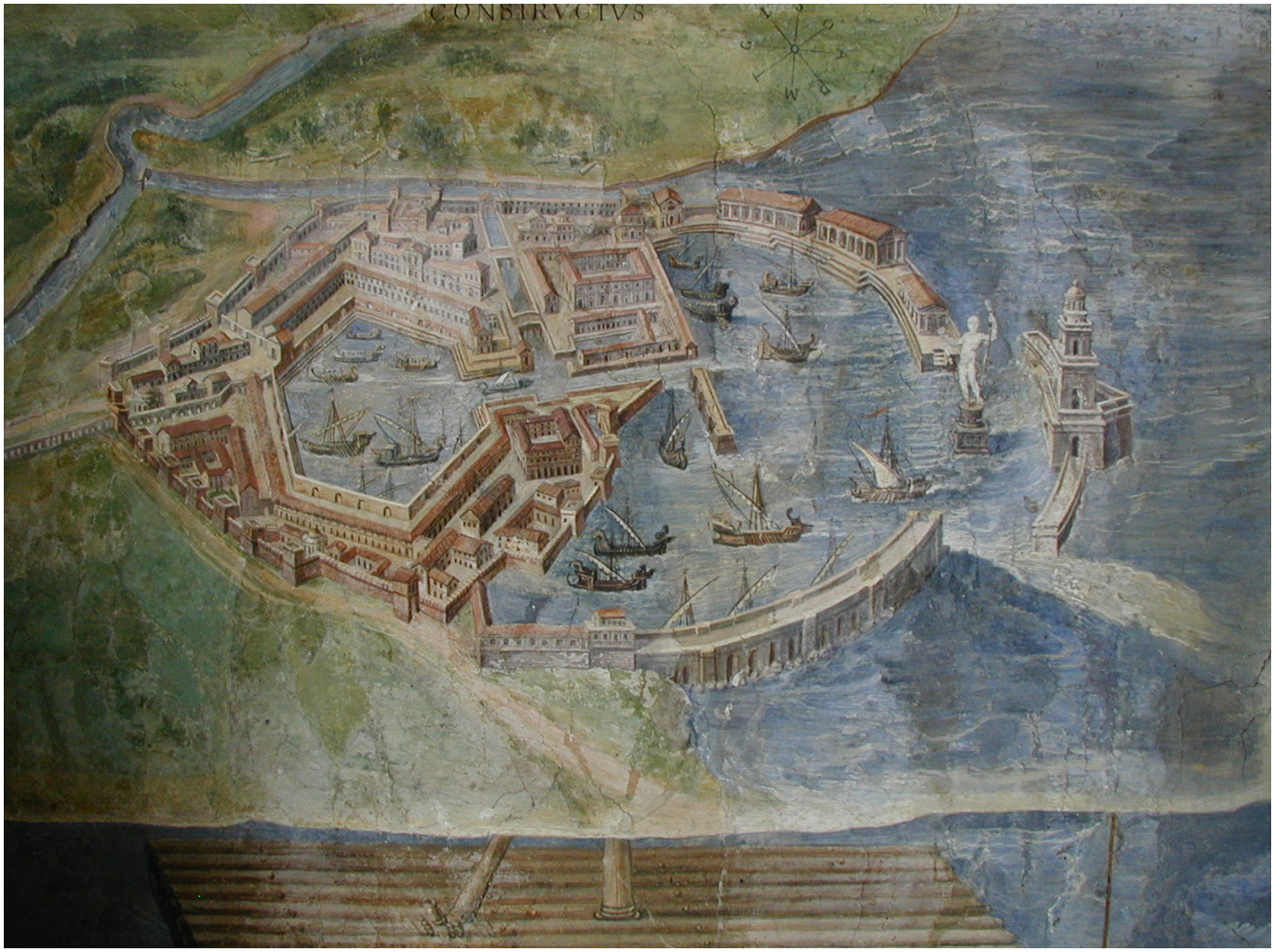


Fig. 6-1: The beautiful and complex Roman port at Ostia, viewed from the north, as shown in a 17th c. painting in the Gallery of Maps in the Vatican, Rome.[1]

Introduction

The practice of agriculture began to expand significantly from about ten thousand years ago, delayed in northerly latitudes as the Earth emerged from the last Ice Age. Pointed and bent digging sticks were used at first, in the absence of metal implements, but were replaced with a range of new tools as metal became more widely available. The most important of these tools was the plough. The benefits of agriculture to humankind were obvious: the more seeds that could be sown, the greater was the supply of food and the more humans and animals could be sustained on any given piece of land. But as with many things, there were downsides to the upsides. The greater the extent of land that was turned over (and the more frequently), the more rain washed soil off the land and into rivers where it was carried towards the sea. As particles of suspended soil travelled at a range of speeds along the rivers, solids were deposited in transit, and this process resulted in alterations to the flow patterns that had until the arrival of agriculture changed at far slower rates. When the soil-laden river water reached the sea, new effects became predominant, but in most cases the result was a rapid build-up of sediments in river mouths. First mud flats, then small islands appeared. Then entire coastlines were sculpted, and all accelerated because of farming at a distance.

Many sites of habitation that were situated at river mouths had already been selected as favourable for human settlement because they were focal points for travel. Thus, as the amount of human activity compounded the effects of sediment deposition, the geography of these locations changed significantly. The passage of large ships became more difficult and soon it was impossible to berth the bigger ships in the docks that had been constructed for them. The final stage of this unstoppable force of nature was the emergence of new land and alteration of the entire coastline such that the busiest ports that served the largest populations and had the greatest amounts of arable lands had to be abandoned and re-established elsewhere.

Studies of ports and harbours are made complex because of the extensive changes to the relative distributions of land and water, a problem that will arise frequently during this study. Often, the distribution of land that we see today is very different to what it was at the time of interest. Sometimes, land has appeared apparently from nowhere; in other cases, it has disappeared beneath the waves and taken priceless archaeological records out of reach.

Clearly, there are other factors that make these studies even more difficult. Some ports and harbours have been subject to much greater use than others. Changes in ownership of the ports often caused short periods of rapid alterations to the layout of the buildings and facilities. In the Mediterranean, of course, the expansion of the Roman Empire caused significant changes to the ports as the new masters imposed their progressive ideas upon the physical nature of their new acquisitions. Many sites that were settled by neolithic cultures and would have been of great interest to us have been modified and built upon by the expansive and hardworking Roman enterprises. There may well have been other changes to the ports in earlier centuries and land changed ownership during the long struggles for power of the ancient nascent civilizations.

This paper will not necessarily be presented as a time-lapse study of developments, but will select evidence of the building and use of ancient ports so as to decide on the likelihood that they had lighthouses during the period following the construction of the Alexandrian Pharos. The most important of these was the port of Ostia that was literally the heart that pumped lifeblood between the capital and its dependencies (Fig. 6-1). But Ostia too had natural problems that proved difficult to overcome, mainly the problem of silting, and this imposed a size limit upon ships seeking to enter the port. So, while Roman authorities struggled to establish effective port facilities at Ostia, other sites were of increasing value. The Bay of Naples, for example, offered much in the way of shelter to offload the large ships bringing grain from Egypt. From 194 BCE Puteoli became the Roman port favoured for the transfer of cargoes from large ships to smaller ones, suitable for the journey through Ostia. As we shall see, it also became one of the most remarkable emporia in the world.

Objectives

The objectives of this paper are:

1. To describe the best-known lighthouses built after the Pharos of Alexandria until approximately 400 CE.

2. To review the latest evidence for other lighthouses or similar aids to navigation that were (or might have been) constructed in this time window.

Roman lightstructures

Most of us are aware of the great extent of the Roman empire, a map of which is given in Fig. 6-2. Romans were not natural seafarers in the same way as Greeks and Phoenicians, but they were master tacticians in the art of warfare, whether on land or at sea. Much of their empire was established by means of land armies rather than naval invasion, and having grown their territories, their civil engineers took charge to construct all the necessary infrastructure to support them. Romans were pre-eminent in taking existing ideas and developing them to suit their own needs. Their use of sea travel was vital in maintaining what they had created and for feeding the millions of citizens.

I shall, of course, concentrate on their port facilities, an essential part of which was the improvements to navigation and safety by the provision of lights.[2] In this book, by now, you should appreciate that the lighthouse was not a Roman invention. However, it was Roman acuity that took the basic

Fig. 6-2: The Roman Empire in 117 CE.[43]

principle of the lighthouse from the Hellenistic culture, overlaid it with the template provided by the Alexandrian Pharos, and included the emerging design as a part of the layout and content of port facilities. We can therefore, without doubt, attribute the modern use of lighthouses to the Romans.

Romans used ships in a business-like fashion because it was the best way to get the job done, but they were always fearful of the consequences of failure or bad luck. Casson's description of Mediterranean sea travel at the time of the birth of Christ reads like a timetable for a ferry company.[3] Ships were usually commanded and steered by non-Roman sailors. They were powered by a combination of sails and oarsmen, who were usually freemen - slaves could not be relied upon in moments of hardship or difficulty. Cargo ships were large and more dependent upon sail, with fewer oarsmen and a small number of troops for self-defence. Military ships had many more oarsmen to give them extra speed and maneuverability and troops for attack capability. Merchant ships carried passengers and cargo at frequent intervals between the major ports of the Mediterranean, as long as the calendar showed a month between May and October. The other months of the year were left to the vagaries of the bad weather demons whom it was dangerous to upset. Voyages taking place between October and May were only made in case of necessity. But in those summer months it was possible to make open sea voyages that criss-crossed the Mediterranean with journey times taking typically four to seven days. With a good tailwind, ships averaged six knots. Typical travel times were as follows: Gibraltar to Rome or Carthage: seven days; Narbonne was three days from Rome, Corinth was five days, Rhodes was

seven days and Alexandria ten. It took five days to reach Rhodes from Byzantium and nine days to get to Alexandria. The statistics make the travel look easy. The equivalent journeys by road were incomparably long.[4] However, sailing was plagued by superstition. Besides a huge dependence upon good weather (in days before the science of forecasting was possible), the need to comply with a thousand mariners' superstitions was often too difficult to overcome. On top of that it was necessary to make animal sacrifices on the decks of ships arriving and departing, and this was another thing that needed to be favourable.

Ships grew larger with the passage of time. One record survives of a Roman ship that was 180 feet (60 m) long, 45 feet (15 m) wide, and the same in depth of the hold. It is thought that such a ship could carry a thousand tons of cargo, and, although at the time it carried 276 people, there was room for many more.[5]

Once in a major port it was straightforward to make short hops to neighbouring small ports. It is said that the favourable winds blowing from the north-northeast were responsible for the lack of development in north Africa where, besides Carthage and Alexandria, there was little of interest. The Romans destroyed Carthage in 190 BCE, which left only Alexandria on the southern shore and even more isolated the coast of Africa.

The Romans built many lighthouses and lightstructures, and greatly relied upon them in the expansion of their empire, but they were just a small part of massive undertakings to upgrade as many harbours as they could. All that work occurred after the Pharos of Alexandria had been constructed, and, unfortunately, we shall find that the remaining evidence of their lighthouses is very scarce. Indeed, as we survey the contents of the following pages, you may be surprised at just how few lighthouse sites give detailed information. The number of confirmed sites does not match the number of Roman ports in which we would expect to find a lighthouse.

The Roman Empire was very much in the early stages of its ascendancy in 300 BCE, and it seems that the first Roman lighthouse may not have been constructed until the time of Augustus or Caligula, around the time of the birth of Christ at such locations as Ostia, the port of Rome, *Puteoli*, or *Capreae*, today known as the island of Capri.

Lightstructures feature prolifically throughout the artifacts of Roman civilization. They can be found on a great many coins, mosaics and bas reliefs, as well as in all other forms of painted art and decoration. We conclude therefore that the concept of a lighthouse was deeply embedded in the Roman psyche. But the Roman culture was very much derived from the principles and practice of the ancient Greeks, and as we shall see below, it is entirely natural to accept that the earliest authors of Greek and Roman literature based their writings on events that have at least a small element of fact contained within them.

There are so many sites of archaeological interest to those specializing in Roman remains that many have been under-investigated - especially those that may have borne lighthouses, which after all have generally been considered to be of comparatively minor interest! However, it is one of the main results of this study that the use of lighthouses in the primary sense of the word - i.e. structures built specifically to show lights as aids to navigation - was an integral part of the design of virtually all those Roman ports and harbours where the benefits obtained were compatible with the available funds. In this paper, we can only cover those sites where there is reasonable evidence for lighthouses to have been built. However, in the catalogue at the back of this book you will find many other references to sites where there is far less direct evidence of the presence of lighthouses. However, knowing what we do about the Romans and their ways of conducting business, some observers (including me) now argue that we should actually *expect* to find a lighthouse in almost every port or harbour where ships berthed on Roman business.

It is one thing to have an archaeological site for which there has not yet been the time or money to conduct a detailed survey; quite another to have a site where evidence for whatever reason and despite best efforts has not yet been found. Where neolithic or early classical period harbours were already in existence, it was because they had already been found useful. Roman engineers, who had acquired significantly more skills and technical knowledge than those who had gone before, created new works on top of the older ones, with deeper foundations and more extensive, more massive walls that largely obscured the earlier

works. Once again, however, our understanding of the way Greeks and Phoenician seamen plied the seas of the Mediterranean and beyond must give us a sense of expectation that, ignoring ports and harbours, night lights would have been exhibited from those headlands that were most useful to navigation. Even today, our lighthouse heritage is based upon the simple fact that a geographical location that is of fundamental use to a navigator should carry a lighted mark, even if the latest lighthouse was built over the site of its earlier ancestors. We shall see that this principle was not taken advantage of by Roman commanders. Despite an extensive recognition of the use of lighthouses, it was almost always for guidance into port that they were constructed, and almost always at low level rather than elevated sites.

Portus Romanus (Ostia)

The story of Ostia and *Portus Romanus* is complex and riven with confusion. This is only to be expected for such an important and long-lived site. The problems begin with names of locations. These are frequently confused in the ordinary literature and even, occasionally, in the academic literature.

It is fortunate that parts of a very early tower have survived, as can be seen in the foundations of the *Tor Boacciana* at the mouth of the Tiber, Fig. 6-3. In view of the history related here, this must surely have been the first at this site.

Fig. 6-4 illustrates the detail of the site according to the latest archaeological studies of 2012.[37] I have tried to overcome any possible confusion with three labels:

Portus 1: the site of ancient Ostia (Ostia-Antica), c. 400 BCE;

Portus 2: the site of the port begun by Claudius, c. 42 CE;

Portus 3: the site of the port modified by Trajan, c. 103 CE.

The geography of the area is shown in an overlay to a Google Earth image of the same area, reproduced in Fig. 6-5. In this work I shall use the name Ostia to refer to the ancient site known as Ostia-Antica (to differentiate it from modern Ostia.) Ostia-Antica is clearly identifiable today as a designated archaeological site and is a popular tourist attraction. Frequent use of the name Portus in the literature is a shorthand for the

Fig. 6-3 Tor Boacciana, an ancient tower located at the site of the mouth of the River Tiber (Portus 1) in ancient times. The earliest part is visible at the base, thought to have been built around 100 CE. The tower was rebuilt in the 12th c. and again in the 15th c.[44]

Port of Rome - *Portus Romanus*. Inspection of the catalogue elsewhere in this volume shows that there are other ports in the Roman empire that were named Portus, and simply to refer to a site as Portus can be confusing. Furthermore, there was a clear evolution in the size and facilities of *Portus Romanus*, delineated by the developments under Claudius, Nero and Trajan. Hence my names Portus 2 and 3.

The earliest settlement on the coast nearest to Rome was at a site at the mouth of the River Tiber. It was an attractive location, not just because of its position, but because the land was perfectly suited for the manufacture of salt. The nature of the land was marshy with associated plants (known as sedges) and pools of water, a combination that made it suitable for creation of salt pans. This was the first

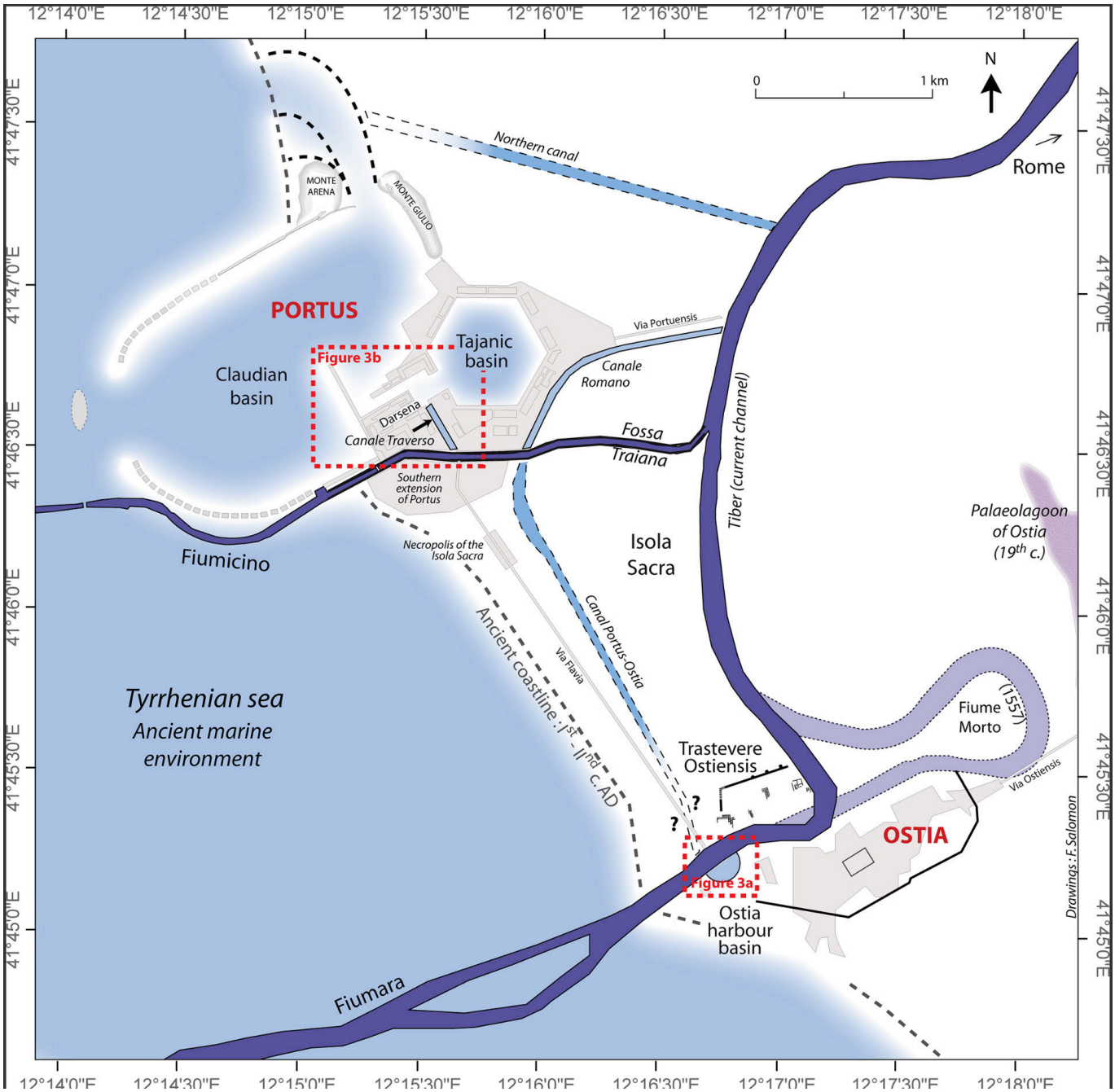


Fig. 6-4: The charted positions of ancient Ostia and Portus and the varying course of the River Tiber have become more secure as a result of much recent archaeological investigation, sources for which are contained in the notes.[45] In prehistoric times, the Tiber outlet (labelled Fiumicino) was in the north, from where it migrated to the South probably around the 7-8th century BCE, before Ostia developed along it in the 5th century BCE. All of the area coloured blue on the left of the map is now land. The old river course became a ditch called the Fossa Traiana, but was restored as a waterway in the development of Portus 2. The mauve section of the Tiber, right, shows the course of the river from around the 5th c. BCE, and how Ostia grew up on the banks of the eastern loop, offering around 1 km of wharves - perhaps even 2 km when the north bank came into use. Unfortunately, this loop disappeared during the periods of silting around the 1st c. CE and the river depth became much shallower, prohibiting large vessels from sailing up-river. The first port at Ostia is shown as a small inlet close to the southern river mouth, now the Fiumara. The Tor Boacciana, proposed as an early Roman lighthouse, remains today just west of the basin on the river's south bank, Fig. 6-3. The location of the Claudian lighthouse was finally established in 2011 by Keay and Goiran. It was located on the island, just outside the Claudian basin, far left. For comparison with present landscape see Fig. 6-5.

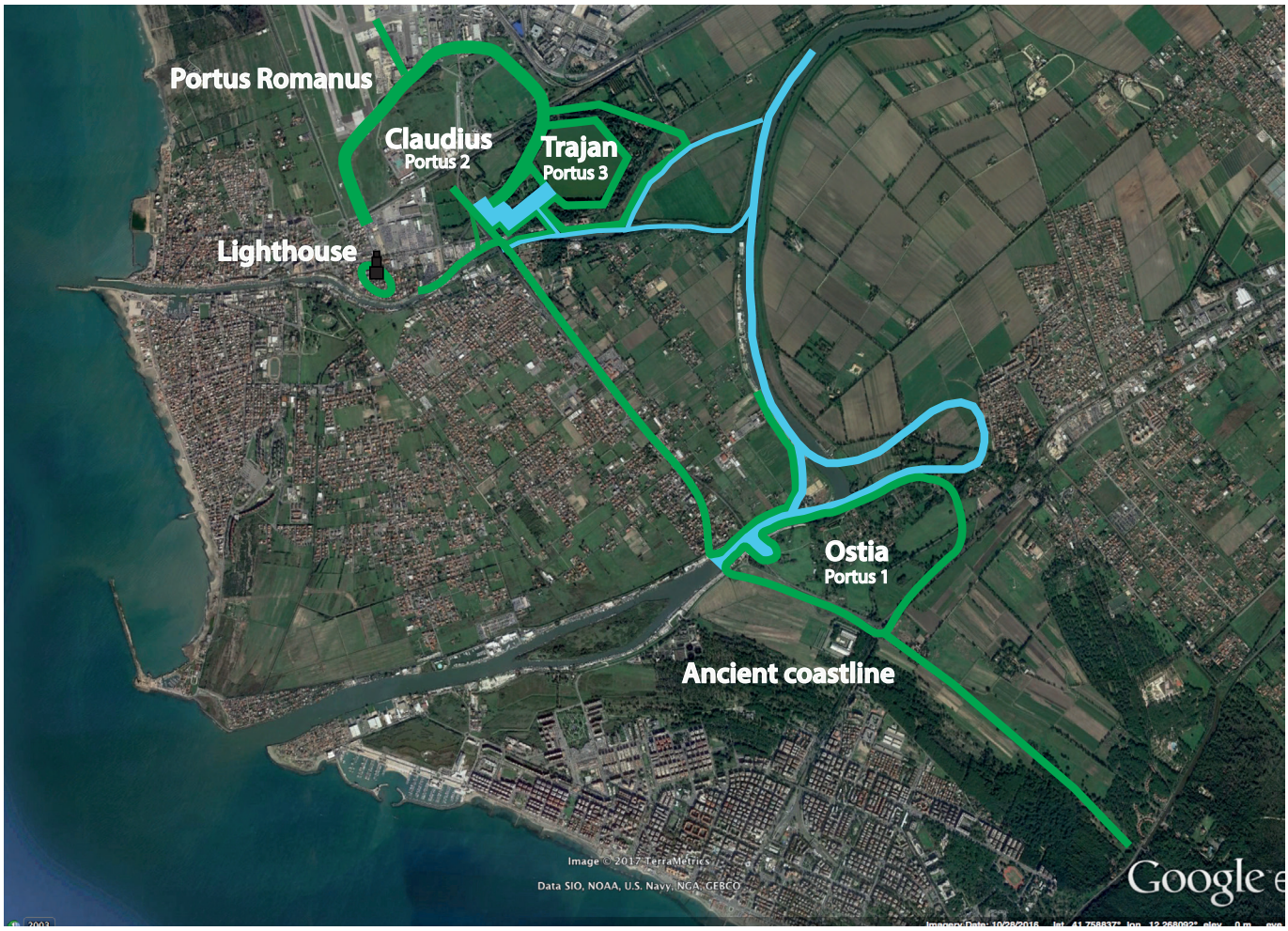


Fig. 6-5: Overlay of the archaeological sites of Ostia and Portus Romanus onto the present-day landscape. The old course of the Tiber is shown in blue. Note the position of the famous Ostia lighthouse.[46]

stimulus for growth from at least 700 BCE, according to Bellotti.[6] Salt was probably extracted from salt pans situated to the east of the town we now call Ostia, in the Middle and late Bronze Age (1400-1000 BCE), and there was a small village nearby in the early Iron Age (1000-700 BCE) called *Portus Tiberinus* that traded in salt.[7] (Later, in Trajanic times, the salt production was focused on an area called *Campus Salinarum Romanarum* to the north of the northern canal and the Trajanic harbour - see Portus 3.)

Portus 1

According to ancient tradition, Ostia was founded in the late seventh century BCE by the fourth king of Rome, Ancus Marcius. So far, however, no archaeological remains have been found in or near Ostia dating from this period. Current archaeological evidence places the foundation year in the 4th c.[8] From the beginning, shipping could enter the Tiber and sail all the way to Rome, but as ships grew larger, some needed to dock at Ostia. Cargoes were transferred to smaller boats in Ostia, which had a small port (Portus 1) off the River, south of the Tiber. Significant activities corresponding to the establishment of what we today call Ostia began around 400 BCE with the building of a rectangular fort called the *Castrum* around 305 BCE to guard the precious resources and overcome raids by pirates. During the third century BCE Ostia was primarily used as a naval base, but the commercial activities began to take precedence from the second century BCE as expansion took place along the southern river bank to the east. The harbour of about 2 ha (200 m x 100 m) in size lay at the western end of the town but there were port facilities on both banks too. Buildings thought to have been the *navalia* (shipsheds) that were open to the water have been identified in both the eastern and southern sides of the basin and there is strong evidence that the shipsheds were extensively repaired in the 2nd c. CE, which indicates how Portus 1 continued its activities, for a limited time, at

Fig. 6-6 A Roman mosaic at Ostia representing the port and its lighthouse. The design of the structure shows it tiered, a superposition of three rectangular floors with a fourth structure to contain the fire. (Whether the uppermost motif represents a statue of the flames of a fire is a matter for debate.)The resemblance to the Pharos at Alexandria is strong and the iconography is quite accurately reproduced across a wide range of contemporary artifacts.[47]

least, after Portus 3 had been completed.[9]

It has been calculated that, by the time of Augustus, the population of Rome had reached 1.25 million, a calculation largely based upon the amounts of grain being produced and concentrated at Ostia.[10] This is a very clear indication of the importance of the Ostia complex (Portus 1, 2 and 3) and the need for substantial infrastructure to support the shipping activity. It is therefore not at all surprising that we find many extraordinary descriptions of marine construction here.

The extensive port facilities of Portus 1 have never been properly excavated and so there remains uncertainty about the details. However, a tower exists today called *Tor Boacciana*, Fig. 6-3, that was built over an earlier tower that is in exactly the right place for a lighthouse.[11] A mariner needed only to enter the River Tiber with the tower on his starboard side and then turn right into the harbour.

In 1190, Richard the Lionheart visited Ostia, and as he entered the Tiber he was impressed by a beautiful, lonely-looking lighthouse. Some believe this was the Claudian lighthouse (see Portus 2 below) and this interpretation is not assisted by the ambiguities mentioned earlier. However, there is also good reason to think that it was the *Tor Boacciana* that King Richard observed.[12]

The confused situation regarding the possible lighthouse at Portus 1 makes conclusions difficult. Nevertheless, the present day geometry of the *Tor Boacciana* indicates that the original tower that must surely have stood on this site did not bear the form of the Alexandrian Pharos. This possibility raises the issue of the date of building. It is logical to suggest that the Portus 1 lighthouse was constructed between about 280 BCE and 42 CE, at a time when the function of lighthouses was still being clarified and before the Claudian lighthouse was accepted as a pattern for others throughout the Empire. This raises the realistic possibility that it was the first Roman lighthouse.

Portus 2

By 42 CE, Rome had outgrown the capacity of Portus 1 to supply it. An Alexandrian grain fleet was running regular supplies across the Mediterranean, but needed proper port facilities to maximize the efficiency of this large operation. Ships of some 500 tonnes and 3.7 m draught had become common by 50 BCE (dimensions that had increased to 1200 tonnes and 4.7 m by the start of the second century CE).[37] Emperor Claudius began the construction of a new harbour, Portus 2, at a

distance of 3 to 4 km northwest of Ostia (Figs. 6-4 and 6-5).

The Roman historian Suetonius recorded that the need for improvements to the port of Ostia had been recognized by Julius Caesar, but that it had been too great and too difficult a project. Likewise, Claudius's plan was grand, and so expensive that his advisors tried to dissuade him from carrying it out. Nevertheless, his foresight enabled the Roman population to be well supplied with food and other items of every kind for centuries afterwards.

Suetonius wrote:

> *"He formed the harbour at Ostia, by carrying out circular piers on the right and on the left, with a mole protecting, in deep water, the entrance of the port. To secure the foundation of this mole, he sunk the vessel in which the great obelisk had been brought from Egypt; and built upon piles a very lofty tower, in imitation of the Pharos at Alexandria, on which lights were burnt to direct mariners in the night."*[13]

Whereas Portus 1 had around 2 ha of harbour, the harbour created by Claudius was about 100 times bigger, affording several km of berthing space.[14] Perhaps, most remarkably, it extended into the sea, protected by artificial moles to the north and south, and with a lighthouse on an island between them (Fig. 6-4).The northern mole was 1.6 km long, the southern one about 1.3 km and it could handle around 300 ships. Its entrance was 200 m wide and the breakwaters were built of enormous 6 to 7-tonne blocks of a form of limestone called travertine - the same material as was reportedly used to build the Pharos - held together with iron clamps and pins. It took 12 years to build, after which Claudius's successor, Nero, rejoiced with a special coin depicting the fabulous harbour (Fig. 6-8).

Ancient writers, of whom Suetonius was one, suggested that the lighthouse had been built upon an artificial island created by sinking a large ship. The ship in question is another of the remarkable stories of history. Caligula, desirous of a great monument to adorn the Circus of Nero in Rome, ordered that a 25 m-tall obelisk already built in Alexandria's *Forum Julium* in 30 BCE should be shipped from Egypt. This characteristically ambitious Caligulan task was achieved by means of a gigantic ship, thought to have been about 7,400 tonnes. The work was completed satisfactorily and the ship, which might be better described as a floating platform, was redundant, lying abandoned in Puteoli. Engineers decided to use it as the foundation for the new lighthouse.

Writing around 20 BCE, the Roman engineer, Vitruvius, was well acquainted with the technique of using formwork to create an enclosure in the sea that could then be dried out and filled with the materials to make a solid stone structure.

> *In the designated spot, formwork enclosed by solid (or oak) posts and tie beams must be let down into the water and firmly fixed in position. Then the area within it at the bottom, below the water, must be levelled and cleared out, working from a platform of small crossbeams. Afterwards, aggregate broken in the trough and mortar mixed as specified above is to be placed within, until the space inside the form has been filled with the concrete structure.*[15]

By the time of Claudius, it seems that sufficient experience of building in the sea had been acquired to undertake the ambitious project. Ninety years or so earlier, Julius Caesar, recognizing the need to expand Portus 1, had decided that the difficulties were too great. Thus, it seems that most of the experience of this type of building had been gained from around 50 BCE onwards. Similar underwater concrete constructions had already been undertaken at Caesarea, Cosa, Alexandria, Egnatia, and in the Gulf of Naples. Portus 2, however, presented new challenges, for the site chosen was exposed to the open sea and the area was subject to frequent flooding from the Tiber. The ground was marshy and salt-laden, and the constant deposition of silt was yet another problem.

Here, then, we are told about an accepted Roman construction method whereby hulls of old ships were filled with concrete and sunk to provide the formwork for a solid foundation for a building at sea. Brandon writes:

> *"The ballast was probably unloaded at the harbour construction site to allow mixing with lime in the appropriate proportions; then the mortar would have been reloaded in the hull, along with tuff or heavier weight aggregate, forming a marine concrete. When the ship was only slightly buoyant, it probably was told a few hundred metres to the gap between the two breakwaters and*

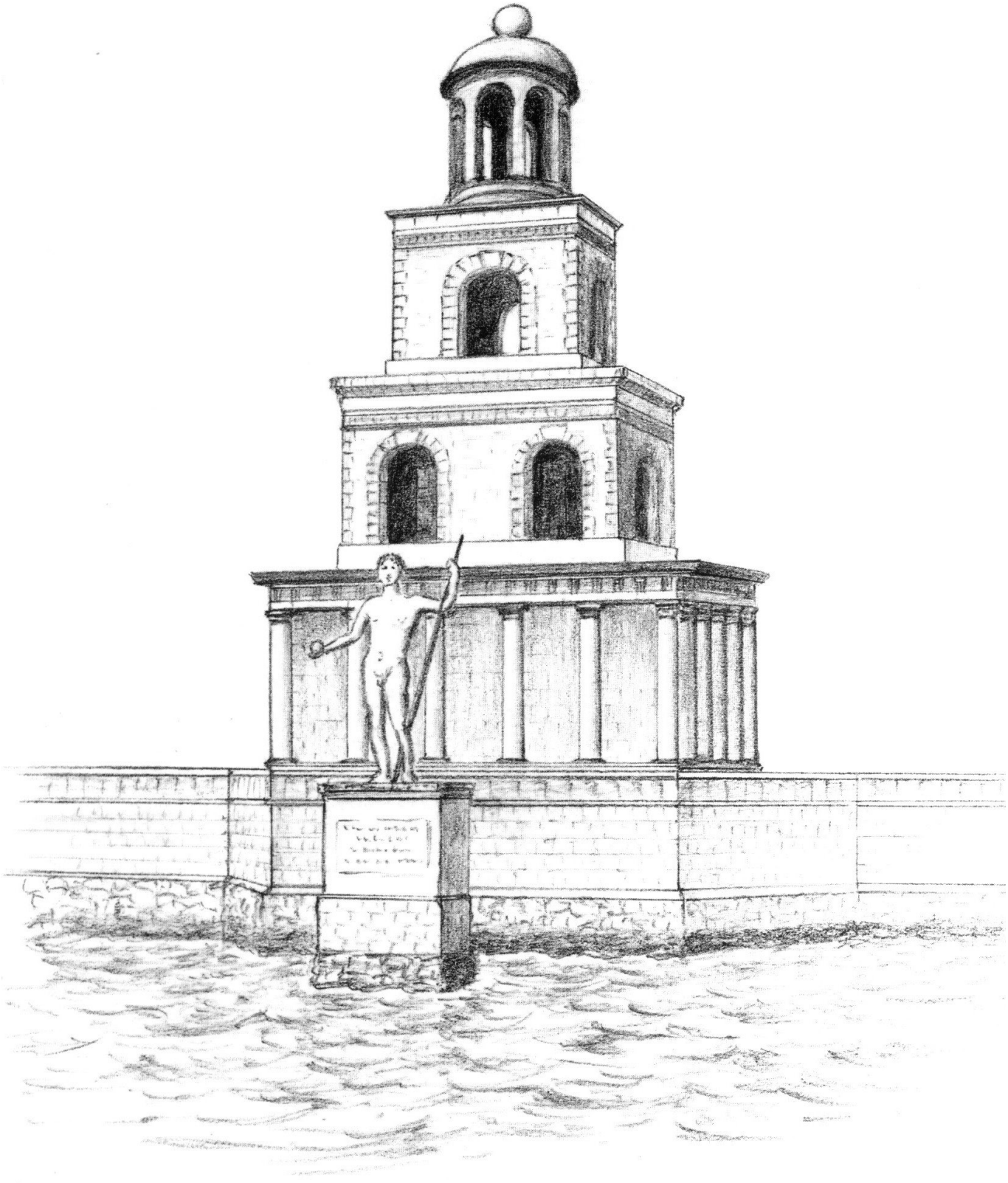


Fig. 6-7 A representation of the lighthouse at the entrance to the Claudian port (Portus 2) at Ostia, constructed around 42 CE.[48]

Fig. 6-8: The Coin struck by Nero in celebration of the completion of the Portus Augustus Ostiensis (Portus 2) 54 CE.[49]

sunk with the addition of more concrete."[16]

Suetonius tells us that Claudius:

"built upon piles a very lofty tower, in imitation of the Pharos at Alexandria on which lights were burnt to direct mariners in the night."[17]

There is no doubt about the existence of this lighthouse, since it is written about extensively and depicted on many mosaics, in drawings, on reliefs, on funerary slabs, and on coins. Doubts about its location have persisted but recent archaeological work by Keay, Goiran and others have at last pinpointed its exact site (Fig. 6-5).[37] Situated on private land, it has not been excavated.

The depictions of the lighthouse show a number (four is most common) of diminishing sections with a fire on top, Fig. 6-7. The lower sections were either square or rectangular in section and the top was cylindrical, a firm echo of the design of the Pharos at Alexandria. The stone cylinder to provide the hearth for the fire seems to be a design having a strong religious basis. In a harbour of such sophistication it is hard to imagine the light from the lighthouse being something as crude as a wood fire. Romans were creative enough to devise a system of oil burning lights that would have performed the necessary function. Sadly, there are no details yet known as to whether this is correct.

From the harbour a wide channel was created to join the Tiber along the ancient course of the river. It was known as the *Fossa Traiana* (after Emperor Trajan) although it was actually constructed by Claudius. This *Fossa* made the land between it and the Tiber at Ostia into an island called the *Isola Sacra*. Barges towed by oxen could now shortcut the silted section of river at Ostia and transport goods offloaded directly from the harbour to Rome. Alternatively, small boats now had direct access from the landward side of the harbour to the Tiber.

The harbour was called *Portus Augusti Ostiensis* or *Portus Ostiensis*. There are many illustrations that depict the new harbour with its substantial commercial and residential focus. The same year, it is recorded that some 200 ships were lost in the harbour, probably due to a tsunami caused by the violent seismic activity of Vesuvius.

The use of the word *navalia* is common in the context of Roman ports. This is generally used to denote the harbour facilities for navy ships, and more precisely, shipsheds. Blackman wrote:

"Shipsheds were a standard feature of military harbors in the Roman period."[18]

These were generally used for military ships, but occasionally for merchantmen. It is likely that the Romans developed their *navalia* from designs already used by the Greeks at Piraeus, Rhodes and Alexandria, and by the Phoenicians at Carthage. Shipsheds have been carefully investigated at Rhodes from the third and second centuries BCE. Covered docks with stepped roofs were typically 40 m in length and 6 m wide; they had a central ramp, inclined at about 1 in 10 covered with a timber top surface 3 m wide. (Shipsheds were not shipyards, however. Construction was generally carried out elsewhere.) Boin reports shipsheds in Portus 1 that have received little attention from archaeologists thus far.[19]

Portus 3

In 103 CE, the Portus was expanded again by Trajan, who built a hexagonal lagoon behind the original harbour. (Perhaps this was a site of even greater protection for his ships because of the great destruction caused by the tsunami.) The new hexagonal harbour (Portus 3) was called *Portus Traiani* or *Portus Traiani Felicis*. The harbours of Claudius and Trajan together were called *Portus*

Augusti et Traiani Felicis, but also *Portus Uterque* (Both Harbours). Both were linked by a complicated arrangement that included another small harbour known as the *Darsena*.

Some representations of the later versions of the harbours show additional towers, both on the ends of the moles and inside the harbour itself. For example, it is said that there was a leading light on a mole that marked the link channel between the Claudian and Trajanic basins. This is unconfirmed at present but seems sensible - indeed, probable in a harbour network of such complexity and size. References are rare, but refer to it as Trajan's lighthouse.[20] Whether there were also lighthouses marking the ends of each of the Claudian moles of Portus 2 seems less likely.

During the first 150 years of its existence Portus was a district of Ostia. Sometime after 306 CE, Constantine made Portus an independent city, *Civitas Flavia Constantiniana*, although it was usually referred to as *Portus Romae* or *Portus Romanus*. It had its own bishop in 314 CE.

Over the centuries that followed, Portus suffered many severe actions at the hands of aggressors. The city was destroyed by the Goths in 408 CE, and by the Vandals in 455 CE. Portus was captured again by the Goths in 537 CE. In spite of this, it remained an important harbour, but by the eighth century, silt once again became a problem when Trajan's basin became inaccessible. In the ninth century there were further invasions by the Saracens, which led to the foundation in 842 CE of the fortified settlement *Gregoriopolis* to the east of Ostia, by Pope Gregorius IV. The last year the harbour was still in use is 879 CE, and by the 12th century, the *Fossa Traiana* was no longer navigable.

One of the most influential depictions of *Portus Romanus* is the one shown in Fig. 6-1, a painting exhibited today in the Gallery of Maps in the Vatican. Though it cannot be an accurate representation in every way, it does contain all of the main elements that archaeologists and historians agree on. One clear feature is the famous hexagonal basin of Emperor Trajan, which was restored and filled with water in the years 1919-25. Today, it remains on private land and is seriously overgrown with very little obvious archaeological remains (Fig. 6-5). Fortunately, thanks to a great effort over the past 30-40 years, big advances in our knowledge are now being made.

Portus 3 was a most successful maritime hub, capable of supplying a city of a million people with everything it needed. Part of its success was the complex network of canals and river connections, as well as warehousing and roads that enabled the distribution of goods with extreme efficiency.

A complete description of this system is beyond the scope of this book and the interested reader is referred to the extensive work by Keay and others.[21] [37] The entire network of waterways between Ostia and Rome was maintained by a group of men known as *curatores*, a function established under Tiberius. Flooding of the entire system was a frequent occurrence and this maintenance organization was essential in maintaining the flow of goods.

Definitive evidence has now been provided that Portus 1 was dredged from the 4th c. BCE to the end of the 1st c. CE, whilst Portus 2 and 3 were dredged from 1st to at least the 7th c. CE.[37]

Significant remains of Ancient Ostia can be seen today, an analysis of which is given by Boin.[22] However, apart from the hexagonal Trajan basin, there are no obvious signs of any of the three ports, all of which remain under the soils of both developed and undeveloped locations.

According to Boin:

> *"A well-travelled government man, Cassiodorus, who lived in the sixth century CE" wrote that "the twin towns of Ostia and Portus flickered in the night like two lights, or eyes, to approaching sailors."*[23]

Sadly, he made no mention of lighthouses, a frustrating fact that happens too often for pharologists studying ancient history. We must rely completely upon the archaeologists, most of whom have bigger fish to fry.

Centumcellae (Civitavecchia)

The first occurrence of the name *Centumcellae* is from a letter written around 107 CE by Pliny the Younger and it is believed that the harbour was constructed, beginning in 106 CE, by the Emperor Trajan. Figs. 6-9 and 6-10 depict the Trajan harbour at *Centumcellae*, known today as Civitavecchia. A seaport on the Tyrrhenian Sea, it is located 80 km west-north-west of Rome.

After a long period serving as the second port of Rome, from around the 530s, *Centumcellae* was

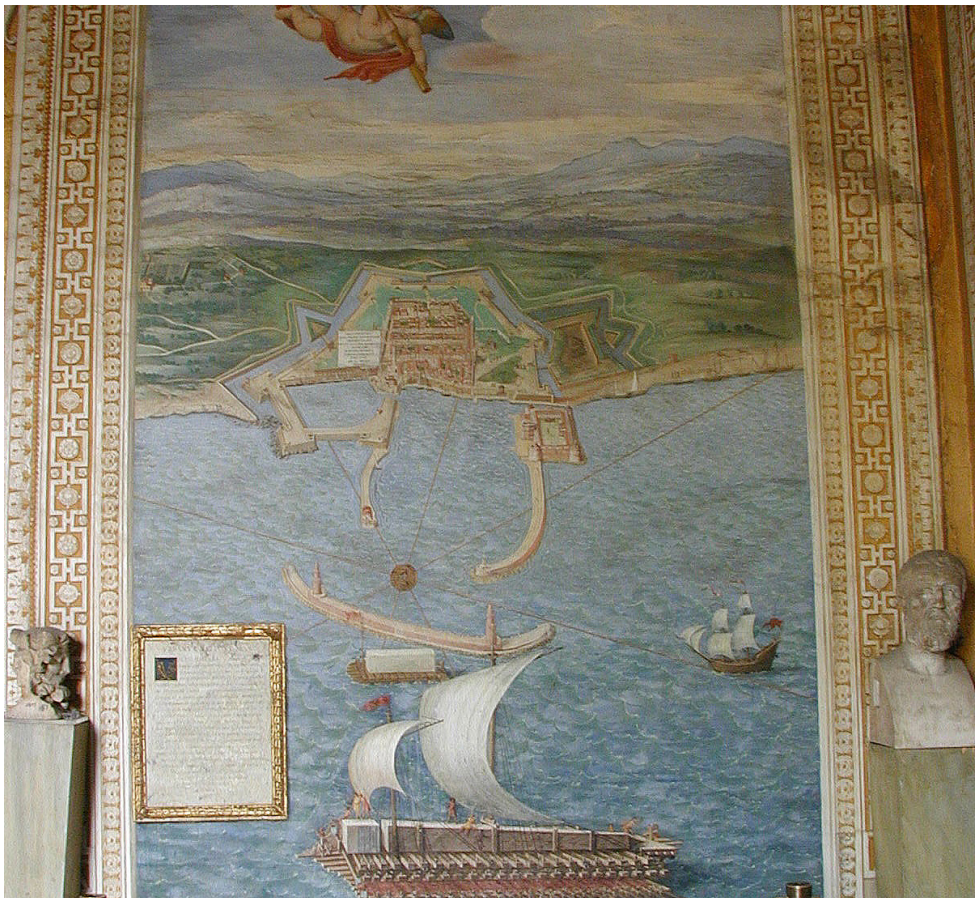
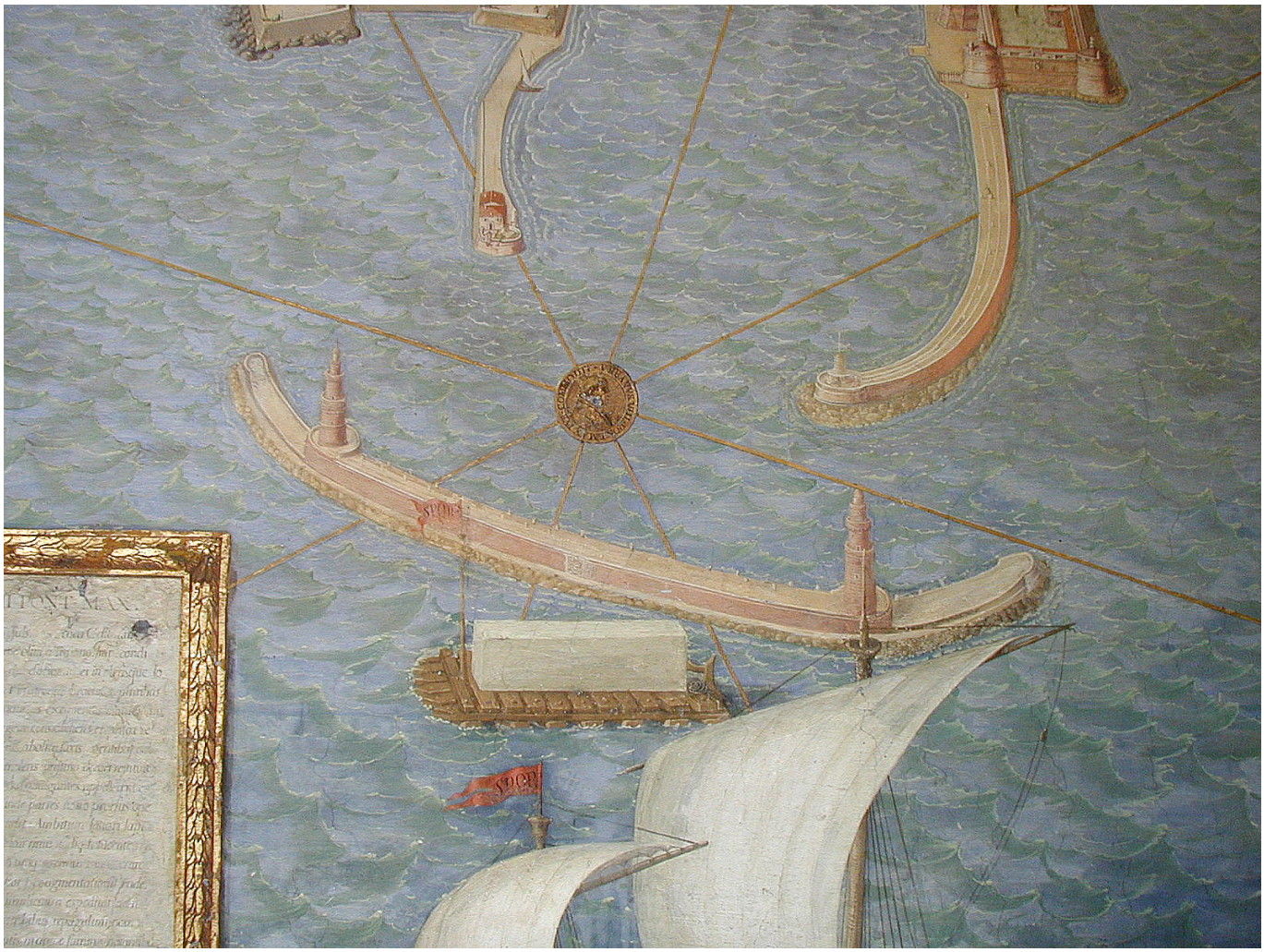


Fig. 6-9 (left): A 16th c. painting of the Trajan harbour at Centumcellae, displayed in the Gallery of Maps in the Vatican Museum at Rome.[50]

Fig. 6-10 (below): A close-up of Fig. 6-9, showing the breakwater with a lighthouse at each end and other tower structures on the moles that may or may not have been used as lighted aids to navigation.[43]



a Byzantine stronghold and it continued to flourish for a further three centuries until it was taken by the Saracens in 828 who drove out many of its inhabitants. The port saw some redevelopment as well as fighting for its occupation until stability was obtained under Pope Leo VII. Eventually, the city's name was changed to *Civitas Vetula*, hence Civitavecchia. In 1431, it was acquired by the Papal States under Pope Eugene IV. It became a free port under Pope Innocent XII in 1696 and by the modern era was the main port of Rome.

The precise role of the Roman port of Centumcellae remains a matter of debate. There was overlap in the years of availability of *Portus Romanus* and Centumcellae, and the urgency of the situation may have required the rapid establishment of Centumcellae while Portus was being finished. There was no connection to Rome by water from *Centumcellae* so all goods had to be moved by road along the Via Aurelia.

Keay and Meiggs favour the idea of "integrated strategic planning" adopted by Trajan to use *Centumcellae* as a port for import and export of goods between Rome and the fast-growing northern Mediterranean market. The theory supposes that Portus was assigned the same role for goods between ports to the east and in north Africa, as well as being the main administrative centre for all four ports - Rome, Ostia, *Portus Romanus* and *Centumcellae*. [10 37]

Like *Portus Romanus*, *Centumcellae* was an artificial port that was built specifically to satisfy a growing commercial need. Its extensive undersea constructions were on a roughly comparable scale to Portus, although the overall result was rather smaller. Furthermore, there were more demanding natural conditions in play at *Portus Romanus* that made the works significantly more difficult there than at *Centumcellae*.

The main harbour was formed by two piers and a breakwater. The picture in Fig. 6-10 is a close-up of the entire port shown in Fig. 6-9. It clearly shows lighthouses on each end of breakwater. This is a non-trivial observation because it suggests that the lighthouse was an integral part of the whole port design. Trajan also ordered the construction of a second, inner harbour, just as he had done at *Portus Romanus*. It was accessed only from the outer harbour. Both inner and outer harbours, although somewhat smaller than those at Portus are still used to this day, as shown in Fig. 6-11.

The building process was described as follows by Pliny the Younger:

> *"I was delighted to be summoned by the Emperor [Trajanus] to act as his assessor at Centum Cellae, where I am now. [...] The house is really beautiful: it is surrounded by green fields and faces the sea-shore, where a natural bay is being converted with all speed into a harbour. The left arm has already been reinforced by a solid mole and the right is in process of construction. At the entrance to the harbour an island is rising out of the water to act as a breakwater when the wind blows inland, and so give a safe passage to ships entering from either side. Its construction is well worth seeing. Huge stones are brought by large barges and thrown out one on top of another facing the harbour; their weight keeps them in position and the pile gradually rises in a sort of rampart. A hump of rocks can already be seen sticking up, which breaks the waves beating against it and tosses them high into the air with a resounding crash, so that the sea all round is white with foam. Later on piers will be built on the stone foundation, and as time goes on it will look like a natural island. The harbour will be called after its maker, and is in fact already known by his name; and it will save countless lives by providing a haven on this long stretch of harbourless coast."*[24]

Unfortunately, he makes no comment about lighthouses, presumably because the works were still in progress and lighthouses would have been the last to be built. We do, however, note the depiction in Fig. 6-9 of one the large stone blocks being shipped by wooden barge, as described by Pliny. Sadly, the full story of *Centumcellae* is one of uncertainty and ambiguity. Even the origin of the name is unclear, largely because of vagaries of translation. The name might refer to Trajan having a palace with one hundred rooms, but the name could also be a reference to the large number of caves in the area. Nevertheless, the port would be called a "new town" in today's society since it appears to have come about only in early Imperial times.

Far less is known about the Roman port facilities at *Centumcellae* than at Ostia. Unlike Ostia, however, where the silting has preserved a good deal of

Fig. 6-11: Plan of the port of Roman Centumcellae superimposed over today's port of Civitavecchia. 1: Outer basin; 2: Inner basin; 3: Torre del Lazzaretto (remains still existing, as in Fig. 6-14) 4. Site of the Torre del Bicchiere, now destroyed; 5: Site of possible lighthouse; 6: Site of earlier lighthouse - a "Faux" or lighthouse replica now stands on the site, as seen in Fig. 6-14; 7: Via Aurelia running close to the port along which goods were transport to Rome. Image: Google Earth with additions after Keay et al,[37] Clearly, the complications due to the modern construction over the remains of the Roman structures make archaeological interpretation extremely difficult.[51]

Fig. 6-12: (above, top): Civitavecchia in an old painting by Arnaldo Massarelli. The Torre del Lazzaretto is on the far left. Lighthouses are placed at sites (4) and (6). Site (5) has a statue that may have replaced an earlier structure.[52]
Fig. 6-13 (above, middle): A reconstruction of the port of Civitavecchia.[53]
Fig. 6-14 (left): The remains of the Torre del Lazzaretto (3) with the "Faux" Lighthouse to its left.[54]

the works by 'moving them' inland, the shoreline at *Centumcellae* was unaffected and much of the Roman works have been buried underneath later constructions that form the modern port, Fig. 6-11. The historical uncertainties extend to poor clarity about the number and positions of the lighthouses. In the southeast, the port is dominated by four massive towers of a medieval fort, but it seems that there were four other large towers that could have been lighthouses at one time or another (labelled 3 to 6 in Fig. 6-11).

In particular, the outer breakwater shown in the centre of Fig. 6-10 and the southeastern mole on the right of the Figure have both been lost beneath the modern moles (Fig. 6-11). The southeastern mole was the bearer of the *Torre del Bicchiere* (4), whilst the northern mole was ended with the *Torre del Lazzareto* (3). Parts of the Roman foundations of the *Lazzareto* tower are still visible, and so is a good proportion of the antique arches on the mole that leads to it. Reliable images are very scarce. The paintings in Figs. 6-9 and 6-10 show two towers (5 and 6) on the breakwater that look like lighthouses. However, it is the *Lazzaretto* tower (3) that is generally given credit as being the main lighthouse of the port.

In fact, almost nothing is known for certain about the lighthouse(s), but we can be confident that the geometry of at least the main lighthouse was copied from its contemporary, the Claudian lighthouse at *Portus Romanus*, itself strongly influenced by the Alexandrian Pharos.

A print by Arnaldo Massarelli of the 19th c. shows the four towers, three of which (3, 4 and 5) appear to be similar, large diameter (20 m) cylinders, Fig. 6-12. These may have been sized to match the other towers that were part of the medieval fortifications and it could be that the original Roman constructions were much smaller in diameter.

The tower labelled as 6 is always different in illustrations, and seems to have been the main port lighthouse. In Massarelli's artwork it does appear as a replica of the Claudian Ostia tower built on a broad polygonal base. If there were a lighthouse at *Centumcellae*, it appears to me that it was here.

Giardina views the circular towers (3 and 4) as a Roman innovation in lighthouse construction, and that 3 is a historic tower of priceless value to pharology. I believe he is wrong on both counts. It seems certain that 3 was used as a lighthouse at some point, but not in Roman times. This difficulty in distinguishing the nature of the elements of the port in Roman and Medieval times leads to too much uncertainty in identification of the lighthouses at *Centumcellae*. Much more archaeological investigation is needed at this site.

Portus Pisanus (Pisa)

We have seen that over the two millennia that have elapsed since Roman times, changes to the coastline of western Italy have caused significant problems for our identification of ancient lighthouses. *Portus Pisanus* is another such site, for 2500 years ago it was marshland with a series of lagoons and a connection to the sea.

The broader area seems to have been settled since ancient times, but the earliest settlers who became known as the Etruscans started to use the waterways for access between their growing town and the sea. History has reported a port that served the town we now call Pisa, and our ancient recorders describe great activity over four or five centuries. Unfortunately, the geographical changes have been so great and documentation is insufficiently precise that archaeologists disagree over its precise location.

De Graauw's catalogue gives several possibilities that range from locations inside the Pisa city boundaries to the port of Livorno in the southeast. Livorno is blessed with several beautiful medieval lighthouses, but no evidence for older towers is available at present. Curiously, a location just south of Livorno called Antignano seems to derive from *Ante Igne* (before the fire) and indicates a tradition of lighting fires to show the way into the ancient port. There are other reports of towers (watchtowers perhaps?) along the coast.

It is disappointing that our understanding of the detailed history of this region is poor, but until much more research is done, we must accept that there were probably one or more lighthouses in the area, but we shall not know for the foreseeable future.

Fig. 6-15: At Terracina, light from an ancient temple of Apollo, high on the hill at Anxur behind the town, was probably used to guide mariners. All that remain today are the lower levels of what was once a magnificent temple.[55] In the town of Terracina, below the temple, a Roman port, reputedly much improved by Trajan, exhibited a harbour light from a lighthouse, of which there are few known details. It is very likely that a lighthouse similar to the familiar design at Portus Romanus was used, and a 19th c. architect named Luigi Canina incorporated such a model into a painting in the Civic Museum at Terracina.

The Bay of Naples

The Bay of Naples is situated over a huge volcanic caldera, called *Campi Flegrei* (the Phlegraean Fields) of which its awesome focus is one of the world's most famous volcanoes - Vesuvius. The eruption that destroyed Pompeii in 79 CE is but one event in a long catalogue of great geological activities. Even today, its ominous presence looms over the great Italian city of Naples. The tracking of geographical changes in the landscape has been much more difficult than might otherwise be the case. Besides the obvious eruptions and earthquakes, there have been significantly large changes to the height of the land compared to sea level. These have resulted in the land looking very different today from the way it was in Roman times. In some places, geological activity has caused hills and craters - some filled with water - to appear, whilst other places that were once in Roman use as port facilities are now typically 6 m underwater.

The large natural feature that is the Bay of Naples must always have attracted early mariners because of its many sheltered anchorages and suitable landing sites. In particular, the northwest of the Gulf around the Bay of *Puteoli* offered a multitude of favourable locations which we shall investigate in this section. Despite the volcanic activity, the geothermal properties of the land were a great asset. Water was plentiful, much of it already hot, and there was ample opportunity for luxurious bath houses and villas. The area was viewed so favourably that by the first century BCE it had become the top destination for wealthy Romans who built some of the finest villas ever seen, centred on *Baiae* where during Nero's tenure as Emperor, he resided in the best house of all.

Besides the two islands at the northwestern end of the Bay of Naples, *Isola d'Ischia* and *Isola di Procida*, the mainland terminates with the *Bacoli* peninsula at Cape Misenum (*Capo Miseno*), a grand waypoint that would have guided many navigators. Topped by a modern lighthouse today (Fig. 6-20), viewed from the sea, the Cape assumes immediate importance to the navigator, as shown in Fig. 6-21. Even had it not been marked by a

Fig. 6-16: The Bay of Naples, dominated by the volcano Vesuvius. The geological properties of the land skirting the bay had an enormous influence on the history of the Roman Empire...[56]

beacon many centuries before the Romans arrived, it was surely the site of assistive support to Roman vessels of the *Classis Misenensis* heading for their home port.

Long before the arrival of Greek settlers who have been shown to have occupied a large cave on the eastern side of the promontory about 250 m north of the Cape, neolithic dwellers occupied the region. But our understanding is that people from Euboea (Greece) gained their first settlement on Italian land at *Cumae* in the ninth century BCE where significant ruins can be seen today. The nearby site of a temple complex is likely to have been used for a Greek navigational waypoint, as I have discussed extensively in Part 3. The Cumaeans were prevented from gaining any ground to the north by the Etruscans, with whom the Greeks competed for many years afterwards. The pendulum swung in 474 BCE when the Cumaeans drove the Etruscans out of southern Italy and from Rome too. The presence of *Cumae* influenced the gradual development of the area, which became popular because of many health-giving hot springs. By the time the area had been developed under Roman control it had become the top luxury resort favoured by Caesars. During spring and autumn, the wealthiest Romans spent time in their beautiful adjoining beach villas, whilst during the summer heat, they retreated to the cooler altitudes in the hills.

The region has numerous offshore islands - large and small - of which Capri (*Capreae*) is perhaps the most famous. Two important lighthouses may have existed here - a larger one succeeding a smaller one. All of the larger islands have held a certain significance for at least a short part of the history of the classical period. Notoriously, during the Punic Wars, around 216 BCE, Hannibal tried to gain control of the *Bacoli* peninsula, including the two strategic islands of *Ischia* and *Procida*, but failed to do so.

There is nothing to suggest that any lighthouse or lightstructure existed here before the Pharos, apart from the temple of *Cumae*. However, the

region was adjacent to important strategic waters and in Roman times was host to the fast growing Roman navy. As such, it seems to have hosted lighthouses at *Portus Baianus* (*Baiae*), *Porto Miseno* (Misenum), *Portus Iulius* and *Puteoli*. Indeed, the Bay of Naples might be regarded as one of the first conurbations since the histories of the towns of *Puteoli*, *Portus Julius*, *Baiae*, *Misenum* and *Cumae* are closely linked (see Fig. 6-17 and Fig. 6-18).

Puteoli (Pozzuoli)

One of the great advances in building technology came about here largely by accident. Material found all around the Bay of Naples, and especially at *Puteoli* (Pozzuoli), was especially good for making concrete that set in marine environments. In particular, engineers named a powder material pozzolan after ash from *Puteoli* that gave most valuable cementitious properties when mixed with lime-based substances.[25]

The earliest lime mortars were made of slaked lime mixed with silica (sand) and water, and were used in the Near East around 12 kya. Some authors claim that the Romans did not invent their 'special' mortars, but nevertheless they were lucky to have plentiful supplies of the best kinds of cementitious materials and used them to considerable advantage.[26] The property that pumiceous ash could be mixed with lime products such that it set even when exposed to the sea was a somewhat serendipitous engineering discovery, but was a major factor in the development of Roman power for it gave them most of the best port facilities in the world.

It was late in the 3rd c. BCE when pozzolanic mortars were first produced on a large scale in the region of *Campi Flegrei*, and it was adjacent to the natural harbour at Puteoli in 199 BCE that port facilities began to be constructed to aid transport of these valuable building materials around the region. (For comparison, it was from the middle of the 1st century BCE that significant advances to the construction of buildings took place in Rome.)

At *Portus Cosanus*, the harbour was laid out around 100 BCE and is thought to have included a lighthouse, Fig. 6-23.[41] The breakwater consisted of a series of substantial rectangular piers built of pozzolana-mortar concrete on top of a rubble-mound foundation. These piers or columns (Roman: *pilae*) may have been linked by a walkway made of wood. At Puteoli, a mole was built about a hundred years later. It was around 372 m long and 16 m wide, and its *pilae* supported a concrete walkway on which was a grand promenade. Fig. 6-19 shows the 19th c. remains of the Roman jetty at *Puteoli*. These piles were used to form the basis of the new mole at Pozzuoli in the 20th c. so their archaeological value, together with any evidence of a lighthouse, has been lost. However, there are plenty of written references in the classical literature to a lighthouse on the end of the mole. The consensus is that most of the larger harbour works were built by Caesar Augustus, and that grander versions were added later.

In this period, it seems that engineers considered an arched mole would provide sufficient protection for ships without causing a build-up of silt on the inner side. Later, these ideas were abandoned in favour of continuous solid moles.

There is plenty of evidence of wooden shuttering and formwork to be found on underwater concrete remains. The Romans understood that their concrete mixes took time to cure once they had been set in place and full strength was achieved only after months and even years. Thus, it made sense to leave wooden cladding in place as extra protection for the works while the concrete achieved its maximum capabilities.[27]

The Romans began building along the foreshore of the Bay of Naples from about 200 BCE. However, the area is thought to have been thinly settled with fishermen long before that. At *Puteoli*, the Romans developed a previous settlement called *Dicaearchia*, established by Greeks from Samos in 520 BCE.[29] Its history in the early period is vague, except for its famous successful resistance to a siege by Hannibal in 214 BCE.

The Bay was a prime landing area for vessels approaching Rome from the south, one of its famous transit passengers being the Apostle Paul who landed in 61 CE on his way to Rome. Three extra days of sailing were saved by landings at Puteoli rather than Ostia. By 125 BCE Puteoli was being referred to as a lesser Delos, by which it was compared to the ancient Greek port of Delos that had been regarded as the greatest market in the ancient world.

For *Puteoli* to attract such favourable comment we might conclude that it had impressive facilities and may indicate that the long mole running west-

wards from the shore had been completed; also that it may have had a lighthouse on its extremity. On the other hand it may have been simply because of the vast array of goods available there. Nevertheless, the harbour facilities did eventually include those items and the evidence for the mole is well established.

As for the lighthouse, it may have been toppled by an earthquake and dragged into deeper water by two ships that were moored to it. This interpretation is due to the recent discovery of the two sunken ships in deeper water of the bay.

The emporium at *Puteoli* continued even as Ostia and *Portus Romanus* were taking over the focus of the huge quantities of imports brought to Rome, but it was as a bazaar and purveyor of fabulous items that kept it in the eye of wealthy Romans. This role for *Puteoli* as part of the playground that the Bay of Naples had become was reflected in the grandiosity of its structures, and the port was certainly one of those.[28]

Baiae and *Portus Baianus*

The harbour and port facilities constructed in the Bay of Naples were extensive. Recent underwater archaeology by extraction of concrete core samples at *Baiae* has shown that two concrete moles were built, the northern or starboard one being 209 m in length and the southern or port mole being 232 m long. They were 9.5 m in width and the channel was 32 m wide. The pumiceous ash used for the concrete was in plentiful supply in the area, but the lime materials were imported.[29] *Baiae* and the Bay of Naples were the site of one of the infamous stunts carried out by Emperor Gaius (Caligula) when he ordered the lashing together of many ships so as to create a floating bridge across the Bay. He would have been perfectly familiar with the famous feat of Xerxes who similarly built a bridge of ships for his army to cross the Hellespont. It seems that Caligula had been told as a boy that he had as much chance of becoming emperor as of riding his horse across the Bay. It was something that was very negative in his life and he had never forgotten it. So, with suitable wooden planks fitted across the hulls of the ships and with his floating bridge in place, Caligula did indeed ride his white stallion across the Bay from *Baiae* to *Puteoli* on one day, and, as if to prove once and for all that it was not a fluke, in reverse on the following day - taking a chariot with him according to some authors. There is now good evidence in support of the story, as reported by Paget.[30]

Portus Iulius (Julius)

Moles even larger than those at *Portus Baianus* were constructed to form an entrance to *Portus Iulius*, Fig. 6-17. Built by Agrippa in 37 BCE they are more than 220 m in length, 20 to 30 m in width and define a channel of 40 m width. Although they are entirely underwater now (and visible using Google Earth, Fig. 6-18) they were constructed partly on land when the sea level was lower. Nevertheless, this represents a major building feat. In addition there are numerous *pilae* (columns) that extend seawards from both moles. Even more surprisingly archaeologists have found, at a site known as *Secca Fumosa* (Smoking Shoals), a dense cluster of *pilae* even further out in the Bay where it is thought platforms were built to enable Romans to enjoy hot springs that were emerging from the seabed.[31]

The Second Punic War (known popularly as the War with Hannibal), 218 to 201 BCE, in which the Romans continued their challenge to the power of the Phoenicians, focused the minds of the military commanders, for it was now that they began to appreciate the importance of a navy. The possession of a fleet (known as a *classis*) and warriors who were at home fighting on the sea was an essential asset - one that went on to prove its worth repeatedly over the next two or three centuries. Yet the navy was never accorded the respect given to the Roman army. It was the navy who time and again rid the high seas of pirates and other marauding groups, and made the seaways safe for the great numbers of commercial ships plying the many routes towards Rome.

In the 4th c. BCE the navy was all but non-existent, and in the early 3rd c. was easily defeated in a sea battle with Greeks from Tarranto. In the First Punic War, a now substantial Roman fleet fought battles with Phoenician settlements in Sicily and came off worst on several occasions. Nevertheless, much was learned about the implementation of sea power so that for the contest with Hannibal, their power was sufficient that the great general was forced to move his forces across the land rather than risk them at sea. The only significant action for the navy was during the siege of Syracuse (214

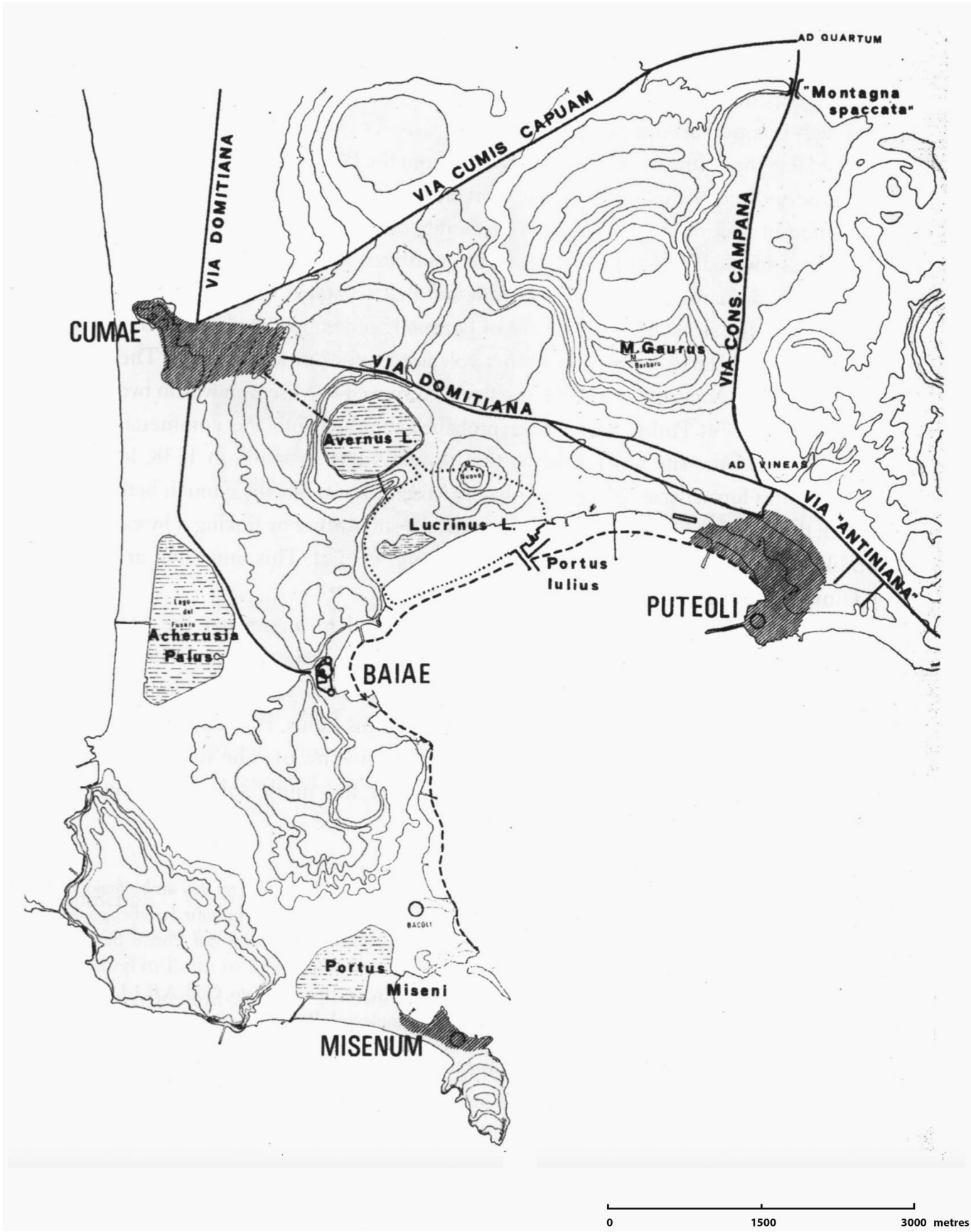


Fig. 6-17: Map of the western portion of the Bay of Naples, showing five important centres of Puteoli, Portus Iulius, Baiae, Misenum and Cumae.[61] The Roman shoreline is shown as a dashed line. Noteworthy points are: (1) the Puteoli mole built from the western point of the promontory and site of a present-day mole; (2) the entrance to Lake Lucrinus (Lago Lucrino) through a pair of moles and a short canal; (3) the entrance from Lake Lucrinus into Lake Avernus (Lago Averno) via another canal.[57]

Fig. 6-18: Satellite image prepared from Google Earth.[58] Lakes are shown as green balloons; possible lighthouses by yellow pins. The area covered by the maps in this and the previous figure has been subjected to a great deal of artificial change since Roman times, much of it under-investigated by archaeologists, and covered by modern buildings and other construction works. A proportion of it is also now under water: the white line between Baiae and Portus Iulius indicates the approximate shoreline. Many channels (and some tunnels) were cut to join the numerous stretches of water. For example, Lago Fusaro (previously known as Acherusia Palus) may have been the harbour of Cumae in antiquity - a channel exists today, running east-west, cut through the isthmus separating the lake from the sea. Since 2000, the undersea Baiae area has been the subject of a great deal of recent archaeological investigation and a large array of palace and villa complexes have been mapped. A strong contender for an important lighthouse is marked as Miseno Pharos. The red line indicates the sight line to a similar structure described as the Villa Jovis (High) light. The site marked 'Cumae' is considered to be an ancient Greek temple light.[59]

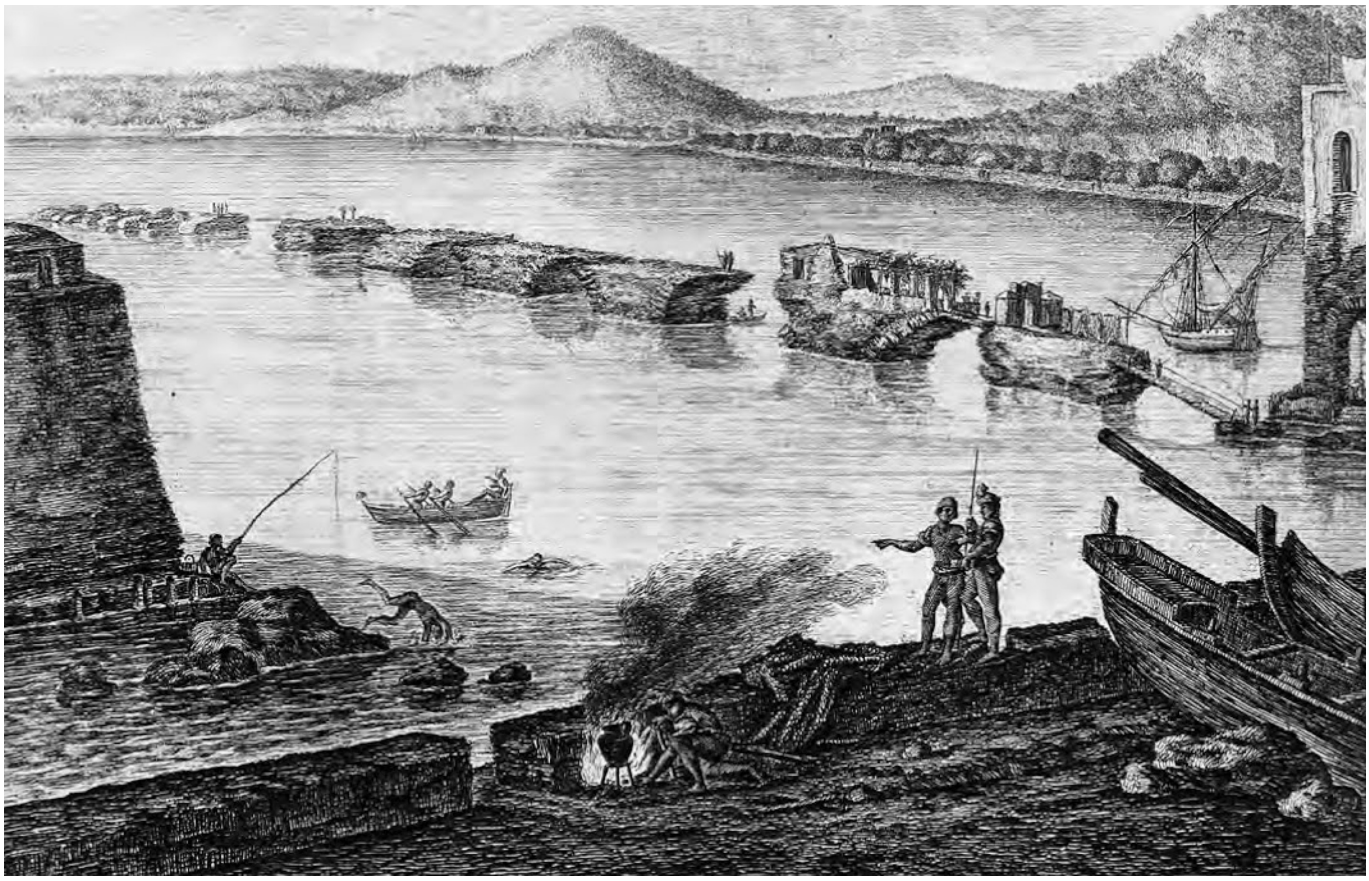


Fig. 6-19: A 19th c. print of the harbour of Roman Puteoli showing the remains of the arched mole, as it was seen just before the present-day mole was constructed around it.[60]

to 212 BCE), an event noted for the use by Archimedes of parabolic mirrors to focus the sun's rays and set fire to Roman ships. Nevertheless, the Romans prevailed and Archimedes lost his life. However, science took a great step forward with the knowledge of how light could be controlled using curved mirrors. (See the discussion in Part 5.)

An early development was the creation of a naval port called *Portus Iulius* (In Latin there was no letter 'J' - letter 'I' was used instead and pronounced as a 'Y') for the Roman Western Mediterranean fleet, later called the *Classis Misenensis* after its home port. (The equivalent base on the east coast was at Ravenna.) The port was created to give Octavian greater resistance to attacks on merchant ships from the rebel Sextus Pompeius, son of Pompey the Great, who was giving serious opposition to Octavian during what is called the Civil War of 37 BCE. Octavian employed Marcus Agrippa to take charge of his fleet and to find it a secure port from where they could launch an attack on Sextus Pompeius. There was a great deal of work involved, and all done in secrecy. Agrippa joined two lakes on the northern shore of the Bay of Naples, Lake Lucrino and Lake Averno, and gave them access to the sea by means of a break in the narrow isthmus separating Lucrino from the sea. His plan worked perfectly and his fleet was able to overcome Pompeius at *Cumae* and the Battle of Naulochus of Sicily in 36 BCE.

In recent studies, two pairs of parallel moles were reported in shallow water where they once would have guided Roman ships into the protective custody of sheltered lagoons at both *Portus Iulius* and *Portus Baianus*, Fig. 6-18. Indeed, the former is clearly visible beneath the water close to the shore at Lucrino using Google Earth.[32] Although history suggests a tradition of lighthouses on the ends of such moles, there is no evidence that they were present at the entrances of *Portus Julius* or *Portus Baianus* since they would have advertised the presence of the supposedly secret naval base. Additionally, the life of the port was short because of silting. *Portus Baianus* was used for a short time but its facilities were limited, and probably restricted to the small number of craft serving the wealthiest residents. Consequently, naval facilities were eventually enlarged and re-sited at Misenum.

Fig. 6-20: The present lighthouse (E1620) at Capo Miseno (Cape Misenum) viewed from the north.[61]

Fig. 6-21: The present lighthouse at Capo Miseno viewed from the seaward, southern side. Mariners sailing to northern waters of Ostia and Rome would pass on the left; those heading for Misenum, Portus Iulius or Puteoli,would pass on the right. It is hard to imagine a time when this waypoint would not have shown a light to assist navigators. With so many berths for the Roman fleet at Misenum the Romans must surely have lit this headland? [62]

Misenum (Miseno)

By the 1st c. BCE, access to *Portus Iulius* was becoming problematic through a rapid build-up of silt. Extra capacity was required for the Roman fleet and a new location was chosen at *Misenum* where there was actually a better, larger natural harbour and a beautiful geographical feature just behind the high promontory of the Cape.[33] Here, again, contact with an isolated lake, *Lago Miseno*, could be established by means of a short canal from the sea, thus creating an inner harbour that was well protected from bad weather and useful for ships in reserve or repair. Meanwhile, the outer seawater harbour was developed to a greater extent to take advantage of the geographical features by building a breakwater. The site of the old breakwater is visible today close to the new one, as is a considerable amount of sunken material, evident from inspection of the shallow waters of the harbour using Google Earth. Of special note is a line of square blocks thought to be the bases of pillars that could have been bridged to form the mole. However, there is very little written evidence of a lighthouse being built here, except to say that it would have been quite consistent with standard Roman practice to have a small lighthouse at the end of the breakwater, named *Punta Terrone*. Giardina suggests that the entrance to the port was marked by a light here, and another immedi-

ately opposite on the point of the *Isla Pennata*.[34] Both of these sites are underwater today. Pennata Island was joined to the mainland in Roman times. Writers have often confused *Misenum* and *Portus Iulius*, which we have seen are not the same – the latter predating the former and being required for expansion of capacity. Whether this confusion arises because the Romans transferred the name of *Portus Iulius* to *Misenum* when the former site was out of service is unclear. As for Cape Miseno, sadly, there is no evidence that this headland was ever lit. Paget notes the presence of a small rocky island right at the end of the Cape, but reports no sign of presence in antiquity.[29] I have already suggested that this should have been at the top of the Roman list of sites for creation of an aid to navigation. However, I have not mentioned the difficulty of access. In view of the many other enormous difficulties that were overcome by Roman engineering, it seems trivial to suggest that no light was placed on Cape Miseno because it was hard to reach. Such a light would have required light keepers and constant deliveries of provisions and fuel, but this could have been achieved by a short sea trip around the bay. It seems that another solution was found. In 1951 an archaeologist called Amedeo Maiuri discovered the remains of a large structure which he attributed to either a lighthouse or a *specola* (observatory). Clearly, it might have served both of those functions. Measurements show that the distance from the lighthouse to a sister tower on Capri at *Villa Jovis* (see below) was 30 km and a clear, unobstructed view of both from each other was possible.

Capreae (Capri)

Southeast of Capo Miseno at a distance of 28 km lies the island of Capri (Roman: *Capreae*). It is thought to have been inhabited from times when it was part of mainland Italy, for there have been archaeological finds that prove the existence of Neolithic settlements. However, the island assumed a greater significance from around 750 BCE when it was settled by Greeks from *Cumae* who are thought to have used it as part of a network to control the seas around that part of the coast.

By the fifth century BCE the island was under the control of a wider Greek authority acting from *Neapolis*, later Naples. After the Battle of Actium in 31 BCE, Octavian arrived in Capri and liked it so much that he arranged to exchange ownership of Capri for his own island of *Ischia* (see Fig. 6-16). Octavian (later known as Augustus) used his island as a holiday home and built many residences of aristocratic status, including two grand villas – *Villa Jovis* and *Villa Imperiale* on the northeast and northwest tips respectively.

After Augustus' death, ownership of the island passed to Tiberius who lived there from 27 CE to 37 CE. There is clear evidence of the existence of a lighthouse on Capri. In the grounds of *Villa Jovis* the remains of a decrepit tower still stand some 100 m south of the main accommodation area of the Palace, Fig. 6-22. This old tower is labelled *Villa Jovis* (Low), for here we have an interesting new development in lighthouse history.

The Roman lighthouse template we have studied so far almost entirely used lighthouses as the markers to port entrances. Now we find clear evidence that they were also used as waypoint beacons, that is, fires on high points to assist with navigation rather than just to find the entrance to a safe harbour. However, in this case, the tower has deliberately been labelled as the 'Low' light, for Krause pointed out that it would not have been visible in a complete 360 degree sector around the island, and would have been obscured by the geography and the palace itself.

Suetonius wrote that a few days before the death of Tiberius, the lighthouse on Capri was destroyed by an earthquake. Clearly, the remains suggest that it was not entirely lost.[35] However, it is possible that the visibility limitation had been recognized, and that a new, much taller tower was built in a more secure location away from the cliffs where its height and position would enable it to be seen from all positions at sea around the island. Krause has suggested that there was a great lighthouse on the site marked *Villa Jovis* (High). He proposes that it stood 60 m tall and shone a light at a great distance across the Bay of Naples and all other sea roads to the north and south.[36] Using the same principles that were applied to the Alexandrian Pharos, here was the palace occupier's grand gesture, marking his impregnable house with a wonderful beacon to be admired by all. It is a fascinating and plausible proposal that, unfortunately has received no support that I can find.

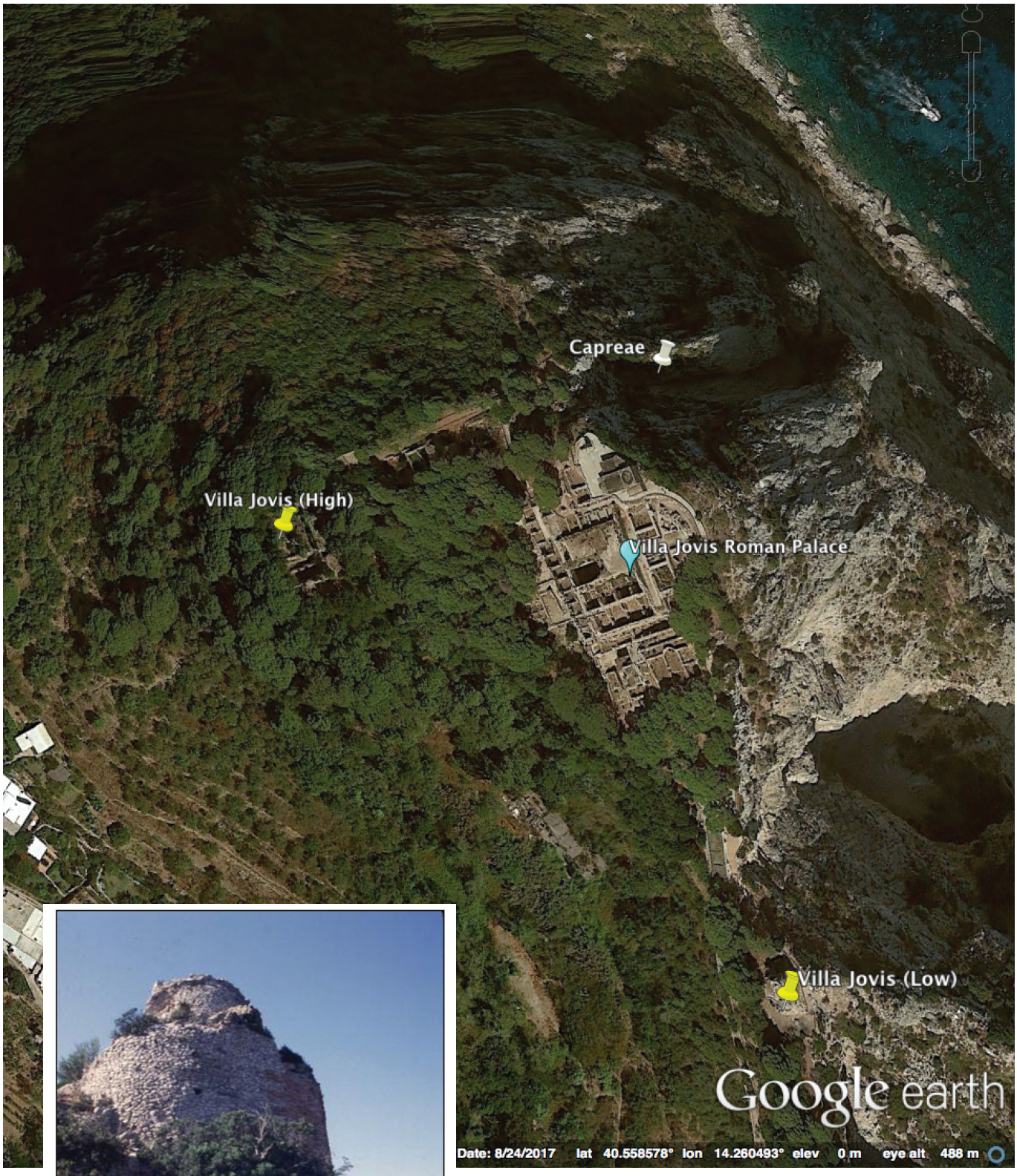


Fig. 6-22: Satellite image of the northeast corner of the island of Capri.[63] The image shows the remains of the Imperial Palace of Emperor Augustus known as Villa Jovis. There are two sites where lighthouses were built, marked as High and Low. Inset (left) is a photo of the remains of the Low lighthouse where it stands precariously on the edge of a precipitous cliff.[64]

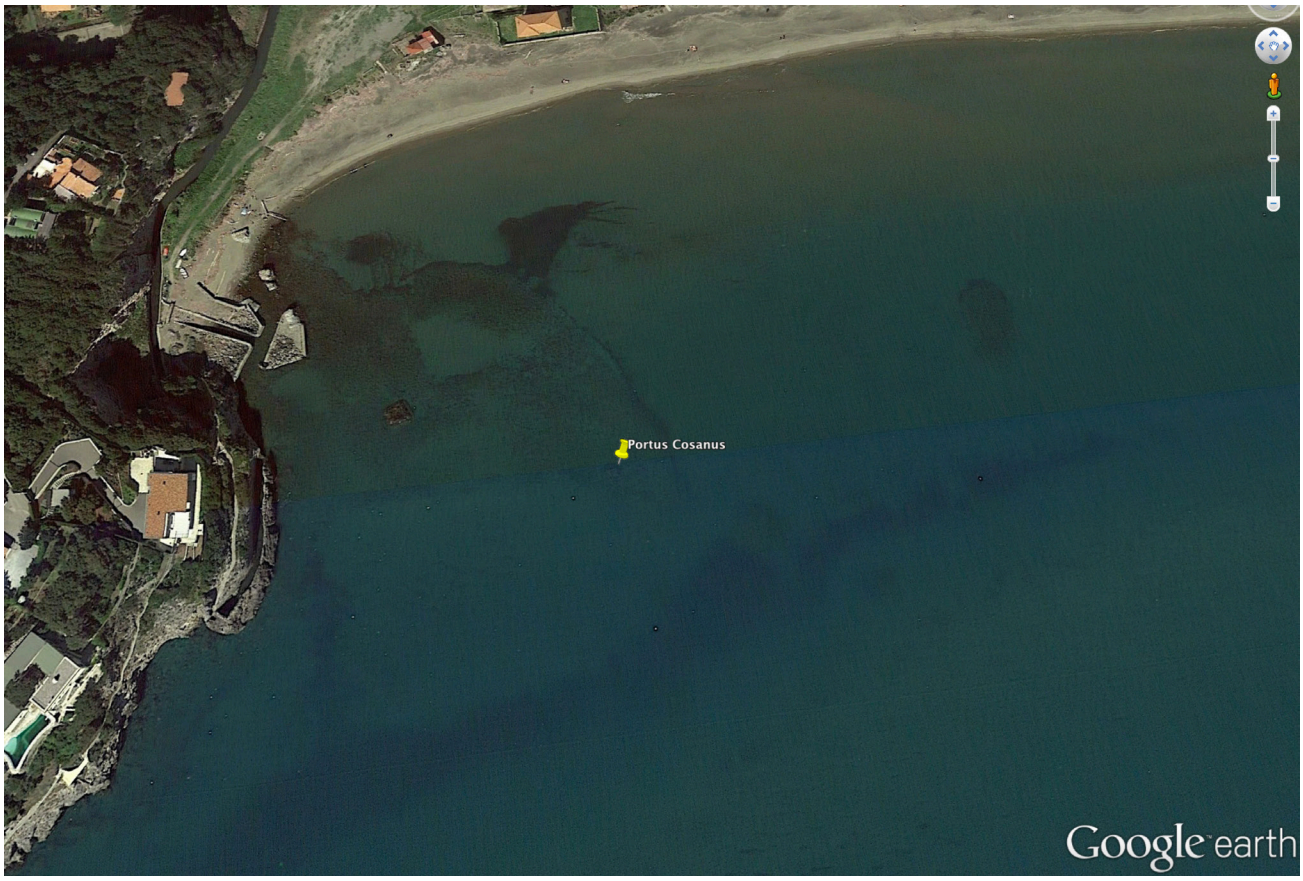


Fig. 6-23: Underwater features of the Roman port at Cosanus (north of Rome) are clear from the satellite image. The site proposed for the harbour lighthouse is indicated in the centre, almost at the confluence of two moles of an inner harbour. [65] [66]

Portus Cosanus (Cosa)

As the Romans expanded their republic in the 3rd c. BCE, they came into conflict with a social group called the Etruscans about 150 km north-west of Rome. Once they had established control over the region, they founded a military colony called Cosa in 273 BCE, which helped to complete their acquisition of the land of Etruria. During the next two hundred years or so it experienced a turbulent period until conditions stabilized under Augustus.

Initially, its main attraction was its geographical position that was especially favourable for a port sheltered by a great protrusion into the sea.

We might consider that a port created to support the Roman military would not have had a lighthouse because it might invite attack from opposing forces. However, once the military period was over, the port became a thriving centre for fishing whereby the luxurious harvest captured by its fishermen were then processed and exported, making excellent profits for the new landowners. It could have been during this phase of its life during the 2nd c. BCE, that Cosa acquired a lighthouse.

Recent analysis of the underwater structures by the ROMACONS team of archaeologist has provided new evidence regarding the structure of the port, although no definitive evidence for a lighthouse has been found. The best theory remains a proposal by McCann in 1987 that the pier known as No. 5 was the foundation of a lighthouse, situated close to a conjunction of two moles of an inner harbour.[78] Giardina discusses evidence in support of there being a square tower, three stories high, with a fire on top.[37] This comes from a small clay model of a tower found on land in the vicinity of a temple. The model looks very much like a possible lighthouse, although its square shape puts it in a category of structures that are not based upon the Pharos pattern. In any case, archaeologists are confident that, besides being the earliest commercial fishery, Cosa was the earliest Roman port that was constructed using tuff and pozzolana concrete.[38] Perhaps the early installation of a lighthouse, built after the Pharos, but not reproducing its form, was also an innovation?

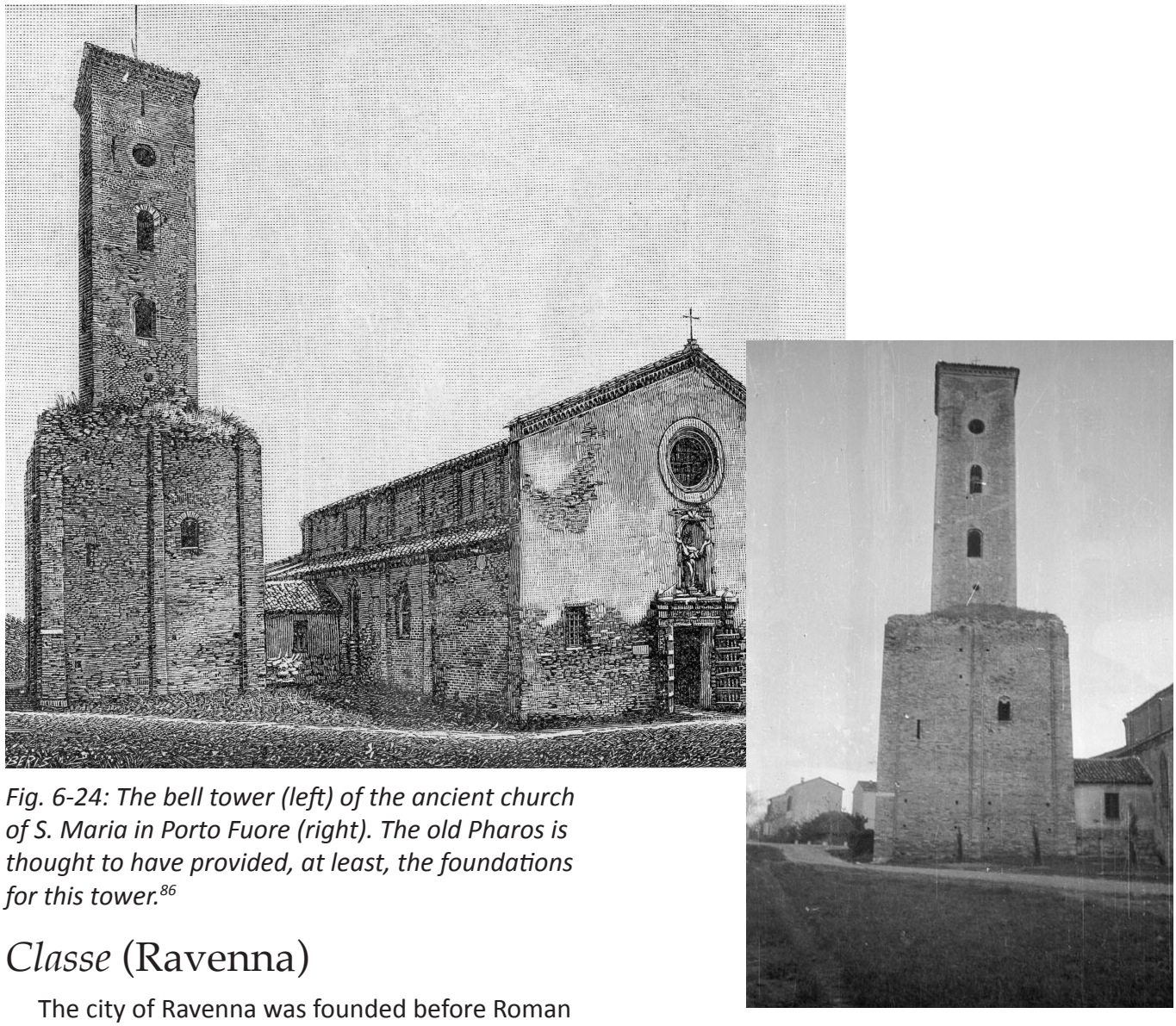


Fig. 6-24: The bell tower (left) of the ancient church of S. Maria in Porto Fuore (right). The old Pharos is thought to have provided, at least, the foundations for this tower.[86]

Classe (Ravenna)

The city of Ravenna was founded before Roman times, possibly by ancient proto-Greeks (Pelasgic) and then Etruscans. The land was marshy and of the same nature as at Venice. Built around these swamps and lagoons, and with access to the sea (though not on the coast), a port serving Ravenna grew up to the southeast of the city. It was Emperor Augustus who dedicated the port - now called *Classe* or *Classis* - as home port for his eastern navy. Later, as had also occurred at Ostia, Trajan made many improvements such that the port was reportedly able to hold as many as 250 warships. It was Pliny who described the tower at *Classe* as having a Pharos-like structure, probably similar to the design used at Portus Claudius (see Fig. 6-7). It may be no coincidence that a similar building attached to the church of Santa Maria in Porto Fuori was used as a bell tower.[39] The tower shown in Fig. 6-24 existed until 1944 when it was completely destroyed. The similarities to the Pharos are too great to ignore. The fact that it was sited some distance away from *Classe* is unimportant; such a tall tower would have required better foundations than were available in *Classe*, and its great height would have made a light visible over a great distance.

Hutton makes an unequivocal identification of the site if not the tower itself:

> *"The mighty tower which rises beside S. Maria in Porto Fuori has been thought to be in part the famous Pharos of which Pliny speaks. It is almost certainly founded upon it, but the lower part in its huge strength is, as we see it, a work of the end of the twelfth century, as is the lofty campanile which rises from it."*[40]

Perhaps having followed the guiding light at a distance from the Pharos, ships were then led by a smaller lighthouse directly into *Classe*. Sadly, there is no better interpretation at present.

Fig. 6-25: Satellite image of the Straits of Messina separating Sicily (left) from the mainland of Italy (right). Present day lighthouse locations are shown as purple pins; ancient lighthouse sites are yellow pins. Capo Peloro marks the northern entrance to the Strait and was the site of an ancient aid to navigation. Romans constructed a significant stone tower that eventually became incorporated inside an old fortification that has only been investigated in the 21st c. The settlement around the site became known as Faro. The ancient port of Messina was chosen where there was a natural sickle-shaped feature protecting the harbour (centre left) and an ancient light is supposed to have been shown from Punta San Ranieri. It is unclear whether the lighthouse depicted on the coin in Fig. 6-26 was intended to represent Messina or Capo Peloro.

The Straits of Messina

Ancient navigators needing to sail around the south of what we now call Italy were forced to take their chances in the Straits of Messina that separated the mainland from Sicily. In Part 1 we met Homer's hero, Odysseus, who was forced to steer a dangerous course between a six-headed sea monster called Scylla, which inhabited dangerous rocks close to the mainland, and another monster called Charybdis living in whirlpools close to Sicily. The rocks of Scylla are close to the modern lighthouse of the same name (E1766, Fig. 6-25), whilst on Sicily there has been an ancient site called Faro for an unknown time. The site of an ancient lighthouse called Capo Peloro has recently been determined to be within the grounds of an old military fort called the *Forte degli Inglese*. Here the remains of a Roman lighthouse have been discovered.[41] The modern lighthouse of Capo Peloro (E1806) stands nearby on its own site about 80 m away. We note once again that the importance of the site of Capo Peloro is for a waypoint denoting the entrance to the strait, not as a marker of a port. Indeed, the place chosen for a port here is at Messina (ancient *Zancle*, Roman *Messana*), Fig. 6-25, where a natural curved shape that the ancients thought similar to a sickle formed a natural harbour. Tradition indicates that a lighthouse was built here on the site known as Punta San Raineri where a modern lighthouse is also located (E1814). Despite great confidence of its existence we have no image of its form.

Around 40 BCE, a coin was struck showing the lighthouse of Messina on the obverse and Scylla on the reverse, Fig. 6-26. Giardina is of the opinion that Scylla represents the Straits, whilst the pharos image represents the port.[42] However, there are contradictory indications that the lighthouse on the coins was actually built at Capo Peloro, an idea supported by the naming of the area as Faro. There is no doubt that Romans used signal towers extensively, and in such strategic locations as those along these Straits, there would have been many such towers. Clearly, we are in no position today to distinguish between those towers used for military signalling only and those that may have been used also for navigational purposes. Hence we can only conclude that all of these sites must be considered as bearing ancient aids to navigation.

A ship entering the Straits of Messina at night from the north and heading for Messina port would have found day markers of some kind - perhaps even lighted beacons - on either side of the entrance, one on Capo Peloro and the other at a site on the opposite shore somewhere between Scylla (E1766) and Punta Pezzo (E1770). It would need to sail some 11-12 km in a strait line to make port, which would have been visible thanks to a night light located somewhere in the port, but probably at the Punta San Ranieri (E1814). On the mainland, this area - indeed, a large portion of southern Italy - became known as *Magna Grecia* because of its popularity with early Greek settlers. The culture and language remained in the region of *Reggio Calabria* for a long time during the Roman era. There has been a strong tradition of a light being exhibited at Roman *Rhegium*, but there has been almost no discussion of it in recent years. There remains much doubt about this location.

Fig. 6-26: A Roman coin minted by Sextus Pompey of Sicily ca. 42-40 BCE shows (left) the Pharos of Messana on the obverse. It is surmounted by statue of Neptune holding a trident and rudder. Below in the foreground, a galley sails past with Aquila in the prow and a trident at the stern. The reverse (right) shows the monster Scylla, her torso of dogs and fishes, wielding a rudder as a club with both hands.[67]

Fig. 6-27: Satellite image of North Africa showing sites where there is evidence for ancient lighthouses (yellow pins). Sites where lighthouses might be expected but for which there is no known evidence are shown (white pins).[68] *Sites for Cyrenaica are inset top right.*

North Africa

The coast of North Africa is extremely unexplored from an archaeological viewpoint. Many of the sites of interest are well-known, yet lie in ruins where they have been mostly undisturbed for centuries, Fig. 6-27. Of course, the north African countries have not been subject to the same degree of development that has taken place in Europe, so the archaeological sites remain in full view on the ground,with almost no readily available documented studies to explain them.

There are some frustrating exceptions. The ancient city of *Tingis* (Tangier) has no readily available port archaeology; neither does *Rusadir* where today the bustling Spanish city of Melilla continues the ancient tradition of an emporium but with no sign of an ancient lighthouse. We might speculate that the tradition of Berber / Phoenician culture predominated and the Roman urge to rebuild port facilities with a lighthouse was missing.

We have already considered the history of the Phoenicians and discovered that these people of the sea were the first to develop a network of ports and harbours, especially along the North African coast. Although the earliest sites were mapped out by explorers from Phoenicia, much of the development work was achieved once the great city of Carthage had been established. We have already studied the evidence for a lighthouse at Carthage and found none. The theory presented here is that Phoenician navigation may well have depended upon recognition of lights viewed from the sea, but that these were always displayed from sites of religious worship. I believe there were no Phoenician-built structures for use specifically as lighthouses. Having suffered catastrophically at the hands of the Romans during the Punic Wars, virtually all of these Phoenician/Punic facilities became part of the Roman empire in the south.

We now understand that Roman engineers had become expert in the development of harbour structures that usually conformed to what had become a standard pattern - the construction of one or two moles from the shore into the sea so as to create a safe mooring with as much shelter from bad weather as possible. Where small islands or islets existed offshore, they were often incorporated into the overall design. Sufficient quayside space was made to enable the efficient loading and unloading of stores and warehousing erected where

necessary. Scope to carry out repairs to ships was allowed for in the larger ports, with shipsheds and ramps where possible. Last, but not least, at least one lighthouse was built to show arrivals the safe passage into the port. We can confidently state that all of the available evidence of ancient lighthouses in North Africa dates from the Roman era, beginning in the first century BCE.

In the absence of the same kind of archaeological evidence that has been obtained elsewhere, especially in Italy, we are left in the invidious position of knowing that there were many such ports and harbours along the great coastline of North Africa, but unable to precisely specify exact positions of all of the lighthouses built by the Romans.

On the other hand, our understanding of the ways in which the Romans developed their port facilities strongly suggests that at many, if not all, of the sites that we now associate with Roman activities, there were, indeed, harbour lighthouses. These may also have been used for signal stations, although in the context of a port installation the lighthouse function must have predominated.

Inspection of the sites listed here and in more detail in the catalogue, reveal many similarities.

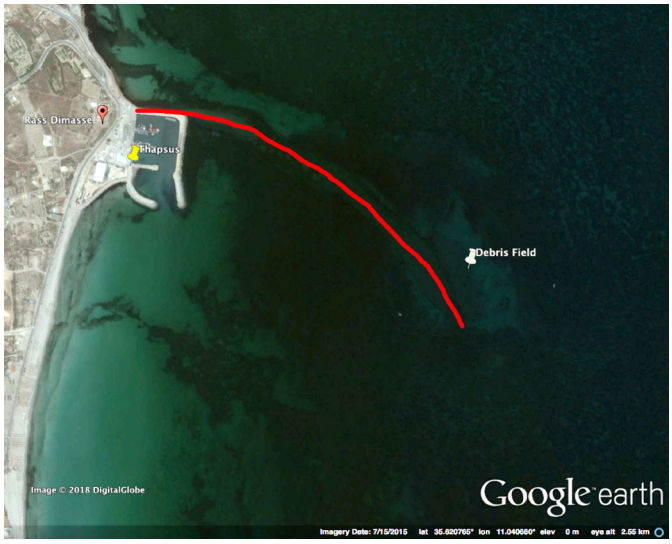


Fig. 6-28: A satellite image of the ancient port of Thapsus where there appears to be the remains of a large mole along the direction of the red line, and a destroyed lighthouse now underwater at the site marked 'debris field'. The size of the works undertaken at this site by Roman engineers surprised the archaeologists working on the study.[76]

A good number have substantial remains now underwater at close proximity to the shore and have received at least a preliminary investigation. The latest satellite imagery has provided valuable insights into the possible locations of collapsed structures and other debris, as these pages will attempt to show.

Cyrenaica

Today, Cyrenaica is a very large area of eastern Libya, deriving its name from the Roman name used for the region around Cyrene. It was strategically important for shipping in the eastern Mediterranean, especially when ships had been blown off course by unfavourable winds. Variously inhabited by Berbers, Egyptians, Greeks and Persians, it came under Roman control in the first century BCE and a number of small ports developed to service Cyrene which lay some 10 km from the coast. Of these, the five most important towns in the fifth c. BCE were known to Greeks as the *Pentapolis*: *Berenike* (Benghazi), Cyrene, *Apollonia*, *Taucheira* (Tocra) and *Ptolemais* (Barca) - see the inset to Fig. 6-27.

Caesarea Mauretania (Cherchell)

Around 400 BCE, a settlement was founded at *Iol* (Jol) by people of Phoenician origin from Carthage. Later under Roman control, in 29 BCE Augustus designated the region as Mauretania under the rule of King Juba II who renamed his capital *Caesarea Mauretaniae* in honour of Augustus. Under Carthaginian influence, we can be sure that a suitable temenos was set up for the benefit of votive offerings and that would have been an aid to navigation. However, at some point, probably during the 1st c. BCE a lighthouse was built, and we might surmise that the same location would have been suitable, a site on the top of a small offshore island later known as Joinville.[69] The island became joined to the mainland to form an improved harbour. Sadly, very little precise information is available on the archaeology of this site. It is possible that the original harbour was slightly to the east of today's little port, where a greater promontory offered more shelter than that offered by an island. Indeed, Giardina describes two harbours side by side - a commercial port and a smaller, better protected military port, the two connected by a narrow channel.[70] Some of the Roman remains were examined before their loss in a 19th c. redevelopment. Giardina presents a photograph of what he proposes are the lower parts of an octagonal lighthouse structure of three storeys, the topmost being a round cylindrical stone section to carry the fire.[71] Indeed, the octagonal remains are visible from present Google Earth images.

Fig. 6-29: The harbour at Cherchell in Algeria that was originally called Caesarea Mauretaniae and the site of a Roman lighthouse. It was situated on an island on the left of the image above, as indicated. [77]

Fig. 6-30: A close-up view of the island on the left of Fig. 6-29, showing the hexagonal foundations of the Roman lighthouse; also shown is the present lighthouse at Forte Joinville. [78]

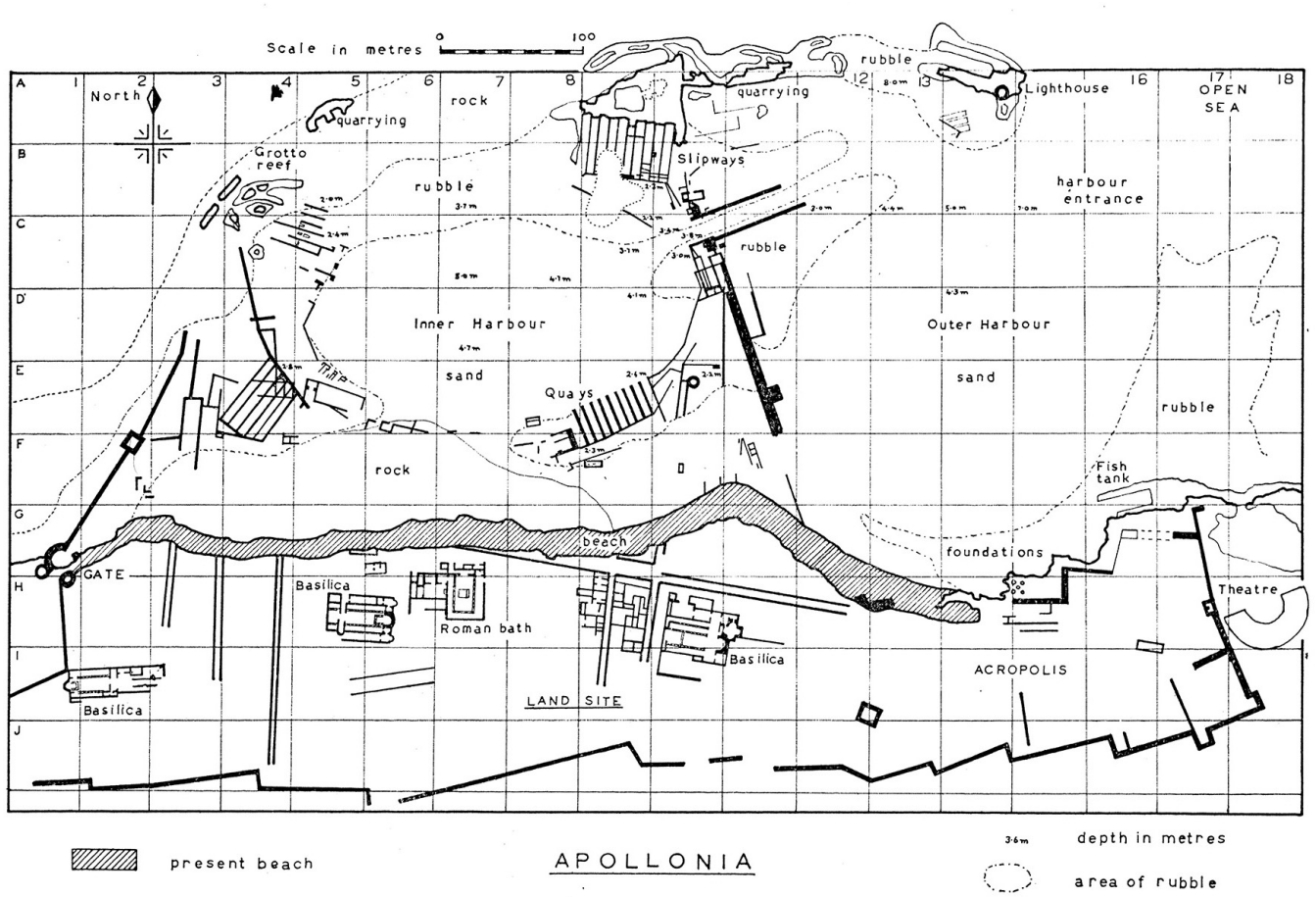


Fig. 6-31 (above): A map derived from the archaeological study of Apollonia by Fleming in 1958-9. The lighthouse site is indicated on the small islet, top right.[79]
Fig. 6-32 (below left): A satellite image of the ancient port of Apollonia.
Fig. 6-33 (below right): A satellite image of the foundations for what looks like a hexagonal lighthouse on the small offshore islet at Apollonia.[80]

Apollonia was one of several significant ports. Originally founded by Greeks, much of the ancient port is now underwater, but there is a small island remaining above water on which it is thought a lighthouse once stood, Figs. 6-31 and 6-32. Close inspection of satellite images suggests a hexagonal or octagonal shape that has been interpreted as the foundation of a Roman lighthouse, Fig. 6-30 and Fig. 6-33. A similar situation obtains at *Phykous* where supposed remains of a lighthouse have been found both underwater and on the promontory to the west. At *Ptolemais*, the site of the ancient lighthouse was re-used for the modern structure on the headland adjacent to the port.[81]

Fig. 6-34: Artist's impression of the lighthouse on the mole at Leptis Magna.[82]

Leptis Magna (Labda)

In Libya, about 130 km east of Tripoli, lies an ancient site first settled by people of Phoenician origins who called it *Ipqy*. A natural harbour was created there where a small promontory projected into the Gulf of Sirte. An occasional outflow of storm waters entered the rear of the port where, from the late 7th c. it served as part of the Phoenician trading network and for a long period came under the influence of Carthage. Only after the defeat by the Romans during 3rd Punic War in 146 BCE did it acquire some kind of autonomy, only to be absorbed into the Roman dominions by 111 BCE. Fig. 6-36 shows a current satellite image of the geography of the land, with the ancient port indicated. Clearly, the site suffered from severe silt deposition, despite its rejuvenation several times as a useful and popular port. In 194 CE Emperor Septimus Severus gave it a special boost because it was his home town, and the port reached a peak of activity during his reign. By this time, a grand lighthouse had been built on the end of the western mole . According to Bartoccini[72] the lighthouse had three stories, with arched windows, Fig. 6-34.

Fig. 6-35 (above): The remains of a large lighthouse originally constructed on the end of a mole at Leptis Magna in present-day Libya, 130 km east of Tripoli. The square base is clearly visible, and what appear to be steps on the left. The sea is continually attacking the foundations and badly affecting the remains on the seaward side.[83] Fig. 6-36 (below): Satellite image of Leptis Magna and the old harbour now completely silted up. The red line indicates the original edges.[84]

Caesarea Palestina (Sebastos)

King Herod is a well-known character from history, remembered as a "bad guy" by Christians. He was also responsible for a remarkable feat of engineering when he ordered the construction of a grand harbour complex, near modern Caesarea, that has been accorded many names, *Caesarea Palestinae*, *Caesarea Maritima*, and Sebastos to name but three. Sebastos is the Greek equivalent of Augustus. The name *Caesarea* is a source of much confusion because of its occurrence in many other locations around the ancient world.

Herod's construction is remarkable because it was executed from 22 to 10 BCE, earlier than the works we have considered at *Portus Romanus* under Emperor Claudius. Furthermore, the harbour was built in a place where the site was quite exposed to the force of wind and waves, and in deeper water. A clue to its selection as a site for a port rests in the fact that it had already been in use by Phoenicians who had called it *Stratonos Pyrgos*, a name that suggests an ancient fire-tower. It has appeared on many occasions as Strato's Tower and Straton's Tower. It could be argued that such a name for a settlement in a sparsely populated part of the coast, indicates the measure of importance attached to the site as primarily about the location of a fire tower.

The length of coastline between Alexandria and the Phoenician ports to the north was a busy seaway, and it was necessary to have a harbour where ships could take shelter in bad weather, or simply rest their crews. However, the coast was long, featureless and devoid of settlements in which to take rest and shelter, so the ancient peoples decided to use this site, almost exactly halfway between Jaffa in the south and Akko in the north, a distance of 100 km - far too much for a single leg of a coast-hopping journey. Grateful to find a place of safety after a long journey, the ancients - probably Phoenicians or Greeks, possibly both - made sacrifice to their Gods. In keeping with what we know about these practices, they would have looked for the highest point for their altar, but if none was available, they may have constructed a tower on top of which they could perform their rituals. The site was well chosen, for hundreds of years later, when a substantial amount of development had already taken place, *Stratonos Pyrgos* became the basis of Herod's wonderful construction.

Aerial views of the site show a broken ring of dark water extending hundreds of metres into the sea, Fig. 6-37. It marks the residue of a great concrete enclosure that has been the subject of extensive underwater archaeological study over recent decades.[73] Most studies of the port prior to that had been limited to analysis of ancient texts. Many interesting things have been discovered by the analysis of the data, but there remains an active debate about the location of certain structures, including the lighthouse(s). Oleson has devoted considerable effort to the translation of text by Flavius Josephus (37 to 100 CE) who described Herod's port in some detail when it was at its peak activity. He wrote about several towers, but unfortunately did not actually describe them in the function of lighthouses.[74] In a sense, this could point to the fact that towers - even those based upon the Alexandrian Pharos - were multi-functional, acting as large stores for consumables, barracks for troops, signal towers for communication, watch towers, means of impressing visitors, and aids to navigation by producing smoke by day and fire by night. The role of a tower as a lighthouse, though important, was not at the top of the priority list where a writer would consider it essential to describe.

The building of this ambitious harbour was the first of its kind outside of the immediate Roman territories. Herod was closely allied with the Roman authorities and made sure he paid maximum respect to the reigning Roman emperor. It required technology that was not available on site and so and the import of goods and employment of human experience either from Rome itself, or, perhaps more likely, from Alexandria, was essential.

A startling discovery was made when analyses of core samples from the concrete distributed across the underwater site was made, for it became clear that great quantities of volcanic ash from the *Puteoli* region had been imported to make the concrete. A broader strategy then became clear: in times when large numbers of ships were transporting grain from Alexandria to *Puteoli* to feed hungry Romans, it would have been senseless to send them back empty. In any case, at the very least, empty ships needed ballast to prevent them from capsizing. Therefore there is a firm theory that ships returned to Alexandria via the building site at the fledgling *Caesarea* port taking with them cargoes of building materials.[38]

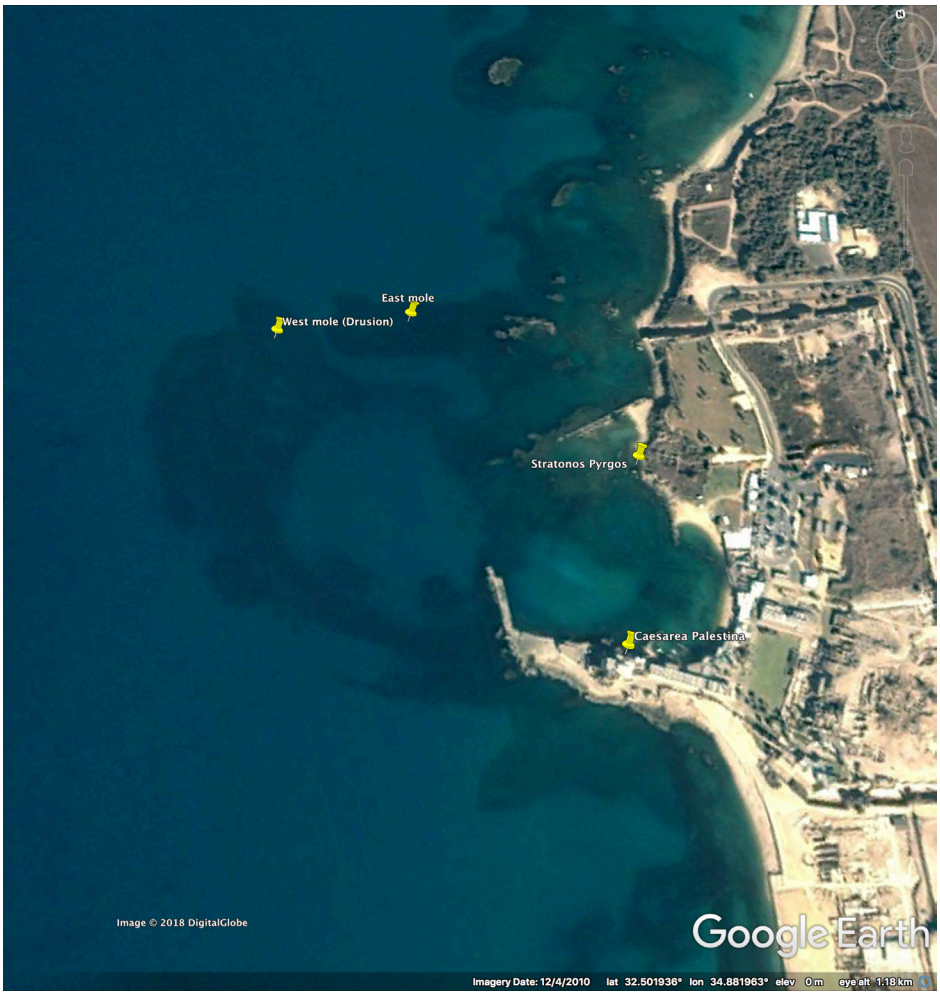


Fig. 6-37: Aerial view of the harbour at Caesarea Palestinae (Sebastos), built by King Herod 22 to 10 BCE.[85] An inner and outer port are clearly visible underwater. The port entrance was on the more sheltered northerly direction and it is on either side of this entrance - labelled east and west moles - that towers are thought to have been constructed. Two towers may have stood just outside the entrance, bearing statues of Meriamme, Herod's favourite wife, and of Phasael, a dead brother. Hippicus, a friend killed in battle was the dedication for a third, larger tower that was built on the end of the east mole, on the port side of the entrance. On the starboard side (west mole) of the entrance, where there is the greatest concentration of underwater debris, it is commonly accepted as being the site for a grand lighthouse on the same design but smaller in scale, as the Alexandrian Pharos. This lighthouse was known as the Drusion tower. The lengths of the moles were punctuated with minor fortifications at regular intervals. Another lighthouse tower in the inner harbour cannot be ruled out.

We have been most fortunate that the remains of the harbour have not been obliterated by subsequent development and to date there has been more underwater archaeological investigation of the site than at any other ancient harbour site in the Mediterranean.[75] Analyses have shown that the materials of the moles were inferior in performance, partly because of a wide variation in composition of both mortar and stone. It is thought that this was due to inadequate supplies of constant quality or perhaps a shortage of suitably qualified foremen. Subjected to sea conditions of greater ferocity than on the Tyrrhenian Sea, greater degrees of damage have been inflicted on the port facilities. In one catastrophic event on 13 December 115 CE, an earthquake of magnitude 7.5 occurred at Antioch to the north. A tsunami was created that struck the harbour and caused substantial, but not terminal damage. The harbour was greatly reduced in capacity after that, and never returned to the grandeur of the previous century.[40]

Fig. 6-38: An artist's impression of the entrance to the port of Fréjus at Forum Iulii.[121] Tritons are shown at the top corners, as were used at the Pharos of Alexandria.

France (South)

Forum Iulii or Julii (Fréjus)

Massalia and *Forum Iulii* (Fréjus) became the two most important Roman ports in the entire region - captured ships were taken to Fréjus after Octavian defeated Mark Antony at Actium in 31 BCE, and it continued to play an important maritime role for more than 600 years, long after the Roman hold on it ceased.

In the middle of 1st century CE at the time of the creation of *Forum Iulii*, this coastline was a narrow band of approximately 100m wide at the south of the Butte Saint-Antoine. Further recent archaeology has revealed much information on the ancient port, although some controversy remains.[86] As with so many other ancient ports, Roman Fréjus is now buried beneath land created by silt deposition over centuries. It is now known that the harbour opened directly into the sea.[87] Access to the port, which butted directly up to the forum was by means of two quays to the north and south of the entrance, and each is thought to have carried a decorated lighthouse similar to the model used at such ports as *Leptis Magna* and *Caesarea Palestina*, Fig. 6-38.

A Triton monument was discovered at the entrance to the harbour. This statue and the remains of a Roman building at the end of the northern quay nearby, have been interpreted as a lighthouse on the end of the north quay at the port entrance.

About 100 m south, researchers have proposed the site of a similar, second lighthouse on the end of the southern mole very close to where the *Lanterne d'Auguste* stands today, Fig. 6-39. It should be pointed out that this south tower exists only as a solid foundation today and a competing argument is that it might have been a small temple. Many people have given the role of a lighthouse to the *Lanterne d'Auguste*, However, this solid structure has no internal access and could only have functioned as a daymark. Recent studies suggest that it was built at a time when increasing silting of the harbour entrance had rendered the lighthouse towers redundant.

Over centuries, silt from the nearby river Argens had built up against the south mole, greatly hindering access to the harbour. There is reason to believe that a channel or canal had to be kept open to the sea which was receding rapidly to the south away from the port. This may have rendered the existing lighthouses useless, and thus the *Lanterne d'Auguste* was used in an alignment with another high visibility unidentified port building.

A third lighthouse was situated on the Île du Lion de Mer. Identified as a round tower of about 9.5 m diameter, it would have been the primary beacon that ships would have navigated toward.

As ships approached the harbour, the Triton lighthouse on the northern side of the channel into the harbour and the other lighthouse on the southern side would have marked the entrance and thus provided safe passage into the calm waters of the harbour. [88] [89]

Massalia (Marseilles)

The old French port of Marseilles was originally a settlement for bronze age people of whom there is little evidence remaining. When *Phocaea* was destroyed by the Persians in 540 BCE, it resulted in a mass displacement of people, many of whom came to *Massalia* for refuge. As the port became more permanently established it was named *Massalia* around 600 BCE by the Greek inhabitants – the first Greek settlement in France. It evolved quickly during the first hundred years of its existence to 500 BCE, "becoming a very large town on the scale of the Western Greek cities."[90] Massaliot traders were importing Roman produce and wine for dissemination throughout Gaul, whilst keeping the Romans and others supplied with rare metals such as tin from Britain, French commodities and especially slaves. By the first century BCE it had evolved into a significant Graeco-Roman port.

Massalia remained an independent city state until it mistakenly challenged Julius Caesar by supporting his opponent Pompey. After losing a battle with Caesar's troops in 49 BCE, it was soon after taken into the Roman empire.

As the most important city state in the south of France, Massalia exerted a wide influence over the region. It remained an active trading and cultural centre until the fifth century CE, retaining the Greek language until then, and converting to Christianity at an early stage, apparently due to the hosting of Mary Magdalen in the first century CE.

Fig. 6-39: La Lanterne d'Auguste.[122] The tower is of solid stone and could not have been a lighthouse, as is often claimed.

Such was the extent of development over the centuries until the present day that little archaeological evidence remained until 1967 when the first significant remains were discovered.

As with so many of these similar Roman port sites, the precise layout of the respective areas of land and sea is very different today from what it was then.

The extent of the water area of the old *Massalia* harbour was much larger in the earliest times and penetrated to the foothills where it became marshland. The marshes were gradually eliminated and substantial harbour walls were established to support the growing amount of shipping arriving and departing through the port.

In the light of the few opportunities for full archaeological investigation that have been possible in the Old Port area, a good idea of the layout of the ancient harbour is now available, but no clear evidence for a lighthouse, despite some written reports that a lighthouse existed at *Massalia* on the Tête de More.[91] This may be a result of confusion with another location to the west of the town at today's Fos-sur-Mer.

Fig. 6-40: A map of Marseilles from 1572, showing the old port and the fortified town with a number of possible sites for lighthouse structures. The most likely sites are at the narrow entrance to the harbour.[123]

Bouches du Rhône

A problem arose once more because of silting - a constant issue wherever there was increased use of land, whether for settlements or agriculture. Land use results in the creation of fine soil particles which are washed into rivers by rainfall. Clearly, the River Rhône, known to the Romans as Rhodanus, was an important land route to the north of Gaul and this great river became more loaded with alluvial materials than other smaller rivers. Just as in the case of the Nile, the Rhône delta region became the site of great areas of deposits that interfered with navigation and which was beyond the scope even of Roman engineers to clear. In 103 BCE, under the instructions of the great General and Consul, Gaius Marius, his troops built a canal (the *Fossae Marianae*) southeast from the Rhône just below Arelate to the *Golfe de Fos*, so bypassing the marshes in the south.[92]

Once again, Strabo is clear on the history. With respect to the mouths of the Rhodanus:

> *"Polybius reproves Timaeus by saying that there are not five but two; Artemidorus says three; Marius, later, seeing that, in consequence of the silting, its mouths were becoming stopped up and difficult of entrance, cut a new channel, and, upon admitting the greater part of the river here, presented it to the Massiliotes as a meed of their valour in the war against the Ambrones and Toÿgeni; and the wealth they carried off from this source was considerable, because they exacted tolls from all who sailed up and all who sailed down it. Nevertheless, the mouths still remain difficult of entrance for ships, not only on account of the impetuosity of the river and the silting up, but also of the lowness of the country, so that in foul weather*

one cannot descry the land even when close to it. Wherefore the Massiliotes set up towers as beacons, because they were in every way making the country their own; and, in truth, they also established a temple of the Ephesian Artemis there, after first enclosing a piece of land which is made an island by the mouths of the river. Beyond the outlets of the Rhodanus lies a sea-water marsh; it is called Stomalimne, and it has a very great quantity of oysters, and, besides that, is well supplied with fish. This lake was by some counted in with the mouths of the Rhodanus, and particularly by those who said there were seven mouths, although they were right in neither the latter nor the former; for there is a mountain intervening which separates the lake from the river."[93]

Thus we find a clear reference to the construction of lighthouses but for the purpose of entering and transiting the canal, not as markers to the port of Massalia. It seems frustrating that we are unable to conclude that an ancient port such as Massalia had at least one lighthouse to mark its entrance.

Some might take the view that the context we have been clarifying in this work make it quite illogical. There surely was a lighthouse here, but that we simply have not found the evidence yet. This is a valid viewpoint, of course, and we can apply this situation to many other sites of ancient ports. It reflects the reality that there is a great deal more work to be done by archaeologists.

Narbo Martius (Narbonne)

The *Via Dolmitia* was the first Roman road out of Italy into Gaul where its final intended destination was *Hispania*. Built in 118 BCE, the road was already an ancient thoroughfare, determined by the geography of the region. The road crossed the river Atax (now the Aude) by means of a seven-arch bridge and it was here that the first settlement of *Narbo Martius* (now Narbonne) was established in that year. The location was chosen for significant development when it was realized that a sea route to Narbo (as it was known colloquially) was possible. Though located some 10-12 km inland, it was possible to navigate directly into Narbo with the help of a waterway called *Canal de la Robine* that was built from a nearby system of lagoons and an entrance from the sea thought to be at Grau de la Nouvelle.

The town of *Narbo Martius* was significantly developed in 45 BCE by Julius Caesar who offered the land to his loyal Tenth Legion for further settlement, whereupon it enjoyed a period of prosperity and was considered the second most important port in the northwestern Mediterranean after Ostia.

The Atlantic Transit

The voyage from the Mediterranean to northern Europe was long and arduous, Fig. 6-41. Once outside the Pillars of Hercules, Roman ships were exposed to the full force of the Atlantic Ocean and the broadside of waves driven by prevailing westerly winds, not to mention the notorious swells across the Bay of Biscay. It was an incentive for the Roman transport network to develop and maintain a inland route along France's major rivers, Rhône-Saône-Seine, a complete waterway except for a short distance overland between the last two. It led to the development of a busy port in the *Pays de Caux* called *Juliobona* (Lillebonne) where there might have been a small port lighthouse. From there, ships would sail out of the Seine into the English Channel and onward to Britain and the North Sea, as ships do today from the port of Le Havre. For large cargoes there was no alternative. The Atlantic transit required the highest levels of seamanship. We have already concluded that Phoenicians were well capable of this difficult voyage. Their master mariners were entirely comfortable, it seems, with taking the shortest routes across great expanses of ocean. On the other hand, many sites of Roman occupation are known along the route, and we can be confident that Romans generally preferred coast-hopping journeys, keeping to a well-known route with seamarks to assist their navigators.

Coastal sites where Roman ships regularly sought rest and recuperation are Balsa, Espichel, Berlengas, *Julio Briga* (La *Coruña*), *Campa Torres*, La Rochelle, Brest and Saint Matthieu. Some of these had lighthouses; others may not have. The wonderful lighthouse at *Julio Briga* will be discussed shortly. Of the other places, only *Campa Torres* has been seriously suggested as the site of Roman pharos.

Fig. 6-41 (Above): Satellite image showing the long Atlantic voyage made by ships destined for northern Europe. The value of La Coruña is clear. Phoenicians were the first to explore this part of the Atlantic Ocean, especially once it was known that the Isles of Scilly and Ouessant were sources of tin. Having secured the directions from La Coruña, small changes would lead to any one of three destinations. This early knowledge was acquired by the Romans who used it to advantage. With a lighthouse for a way-point, Romans could set sail to Gesoriacum (Boulogne) and Dubris (Dover).[124]

Fig. 6-42 (Right): At the far northwest corner of the great Hispanic peninsula lies a city today called La Coruña. It is the site of one of the world's finest lighthouses and owes its existence to Roman technology.[125] *Although it has been modified from time to time during the second millennium, it still retains its Roman core, which makes it the oldest working lighthouse in the world.*

The World's Oldest Working Lighthouse: the Tower of Hercules

The most cursory glance at Fig. 6-41 shows at once that a site on the northwest tip of Spain dominates the route to the north Atlantic Ocean for ships from the Mediterranean. History tells us that it was in the first century CE that Roman power was expanded into the lands of northwest Europe after the initial explorations of the previous century. Other sites must have been tried, but it was at La Coruña that the construction of a vital port was decided upon. Perhaps that choice was made because others had already been using it?

A Pharos, 55 m in height was constructed on a rock 57 m above sea level. The lower 34 m corresponds to the masonry erected by Roman engineers around the end of the 1st c. or the early 2nd c. CE. Today, the original tower is even more grand, thanks to a major restoration completed in 1791 under the instruction of architect Eustaquio Giannini who augmented the Roman core with a beautiful granite cladding, and then added a further 21 m in height of the tower.

The beautiful external design we see today in Fig. 6-42, though not an exact copy, is a strong echo of the Egyptian Pharos, with its segmented, diminishing structure. The lighthouse stands on a 19th c. base that is about 32 m wide; the quadrangular lowest section is 14 m in width and 34 m in height. This is essentially the extent of the original Roman tower. Atop this is an octagonal tower with triangular section reinforcements in the corners. This short tower is crowned by another, smaller one that is the base for the lantern and accommodates the modern lighting equipment.[94] [95]

It is remarkable that we know the architect of the lighthouse. The name of Gaius Sevius Lupus, from the former province of *Lusitani* (near present-day Coimbra, Portugal) is the only one that we know as having built a Roman lighthouse, and is commemorated in an epigraph at the foot of the tower. The Romans knew the lighthouse as *Flavium Brigantium* or *Farum Brigantium*, but the names *Julio Briga*, Corunna and *Brigantum* have all been applied to the tower during its long history. The name recognized by the UN for its World Heritage Site Status is the Tower of Hercules (Torre de Hércules). The unique status of this lighthouse is summed up in the UNESCO citation:

> *The Tower of Hercules constitutes an exceptional testimony to Roman civilisation by being the only preserved example of a lighthouse of the ancient world, which, despite the time that has passed since its construction, continues to fulfil its function as a maritime signal in the 21st century.* [96]

The origin of the lighthouse on this site has been the subject of continued controversy. Many authors have presented arguments for the existence of a tower prior to the present Roman building.

Ancient folklore associates the site with Hercules, who fought an evil Spanish king called Geryon in a battle that lasted for three days and nights. When Hercules finally emerged triumphant, he supposedly built a lighthouse to celebrate his victory and founded a city that he named *Crunia* after the first woman who lived there and with whom he fell in love.

An association between the Phoenicians and Hercules (who was known to them as Melqart, see Table 4-1) claims that it was they who had built the first lighthouse on the site, a structure that was later built upon by the Romans. In my study of Phoenician maritime history I discussed the possibility of lighthouses being built by this leading community of seafarers. The conclusion was reached that there was no evidence for Phoenician-built lighthouses in the sense that we understand them today. However, it was likely that lighted aids to navigation were provided by the activities occurring at sacred sites in commanding positions adjacent to the sea. Indeed, it is even possible that people travelling by sea around this geographically significant waypoint, developed navigation marks long before the arrival of the Phoenicians and were the reason why the Phoenicians called here rather than elsewhere.

The strongest evidence for the origin of the site is to be found in Celtic history at a date in the 2nd c. BCE. It concerns an Irish Celt called Breogán, son of Brath, who conquered the area and its Spanish inhabitants. According to legend, it was he who founded the city of *Brigantia*, now La Coruña. In the Celtic religion, Brigantia was the name of an important goddess. The word *briga* meant "high" or "holy" in the ancient Celtic language. Besides the Galician realm of *Brigantium*, there were also

Fig. 6-43: The lighthouse at La Coruña occupies a site with a commanding view to the Bay of Biscay and the North Atlantic.

Fig. 6-44: Archaeological Excavation beneath the lighthouse reveal substantial Roman foundations.[126]

A **B**

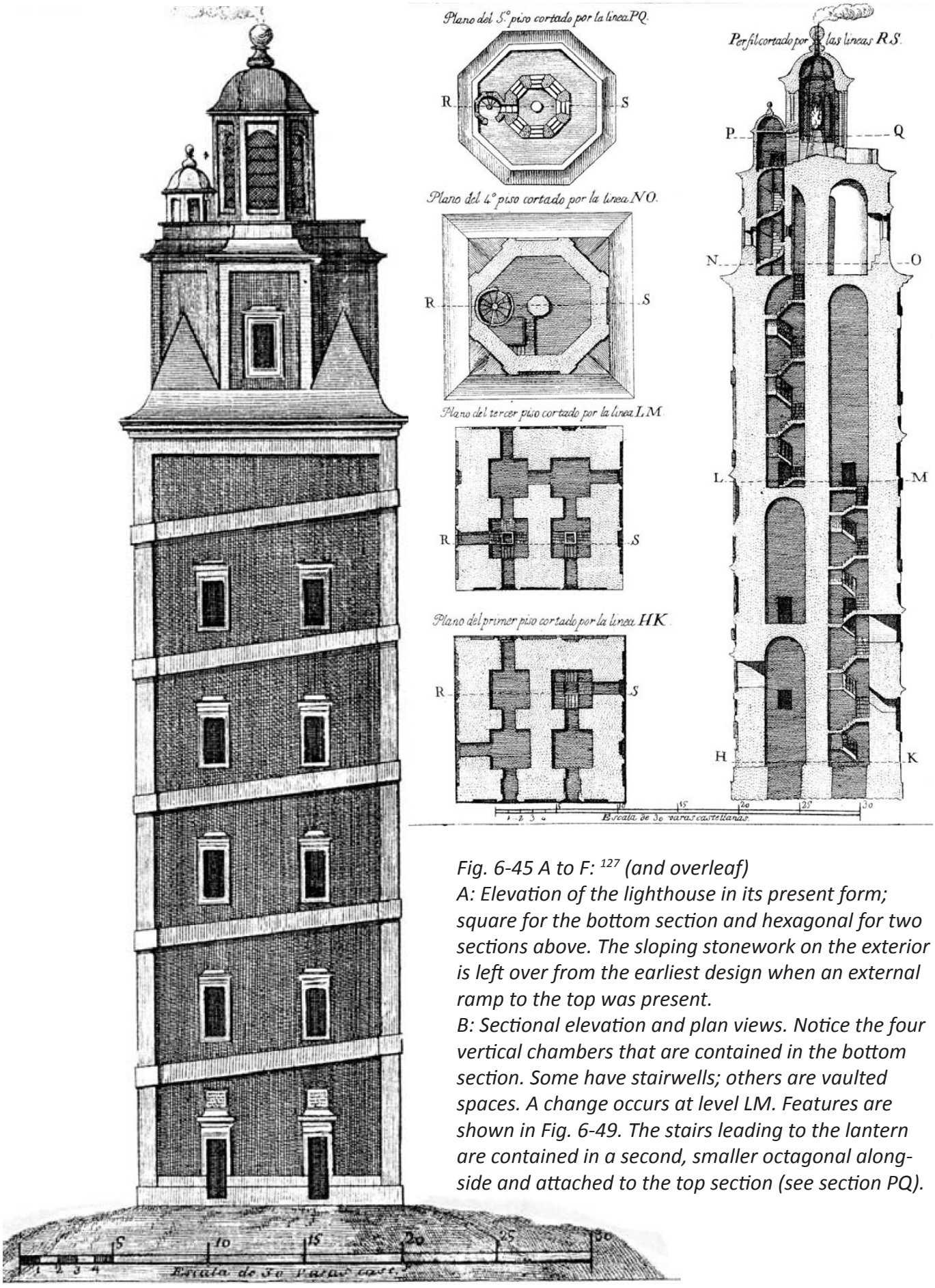
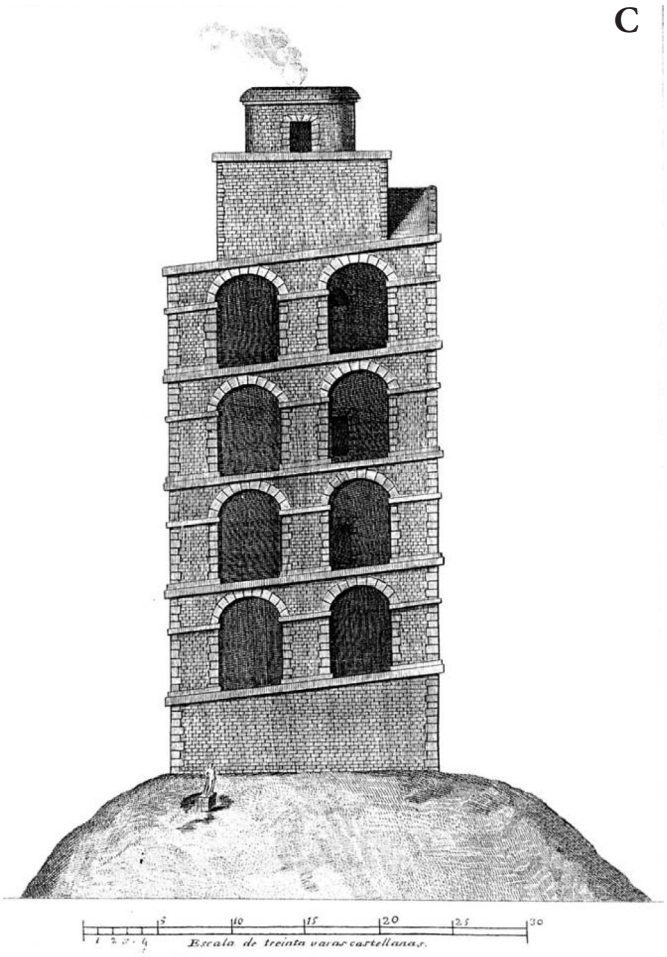


Fig. 6-45 A to F: [127] (and overleaf)
A: Elevation of the lighthouse in its present form; square for the bottom section and hexagonal for two sections above. The sloping stonework on the exterior is left over from the earliest design when an external ramp to the top was present.
B: Sectional elevation and plan views. Notice the four vertical chambers that are contained in the bottom section. Some have stairwells; others are vaulted spaces. A change occurs at level LM. Features are shown in Fig. 6-49. The stairs leading to the lantern are contained in a second, smaller octagonal alongside and attached to the top section (see section PQ).



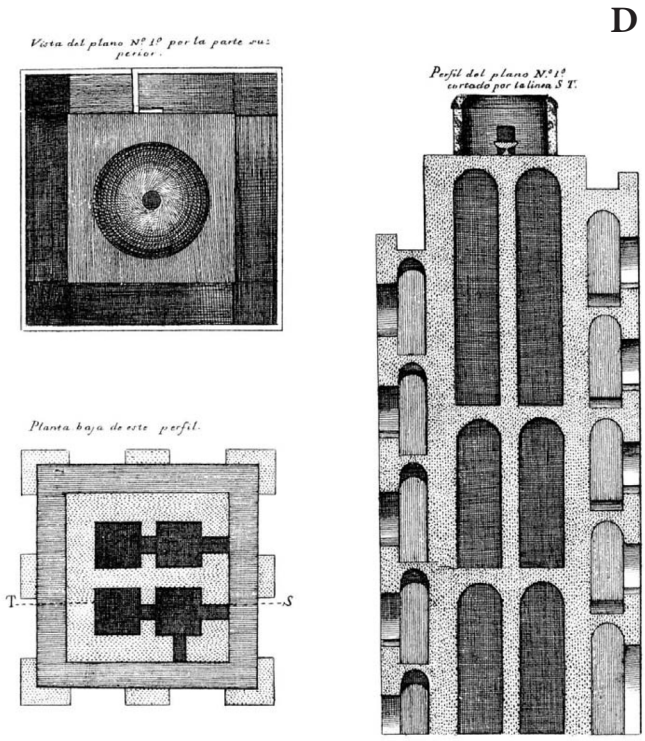
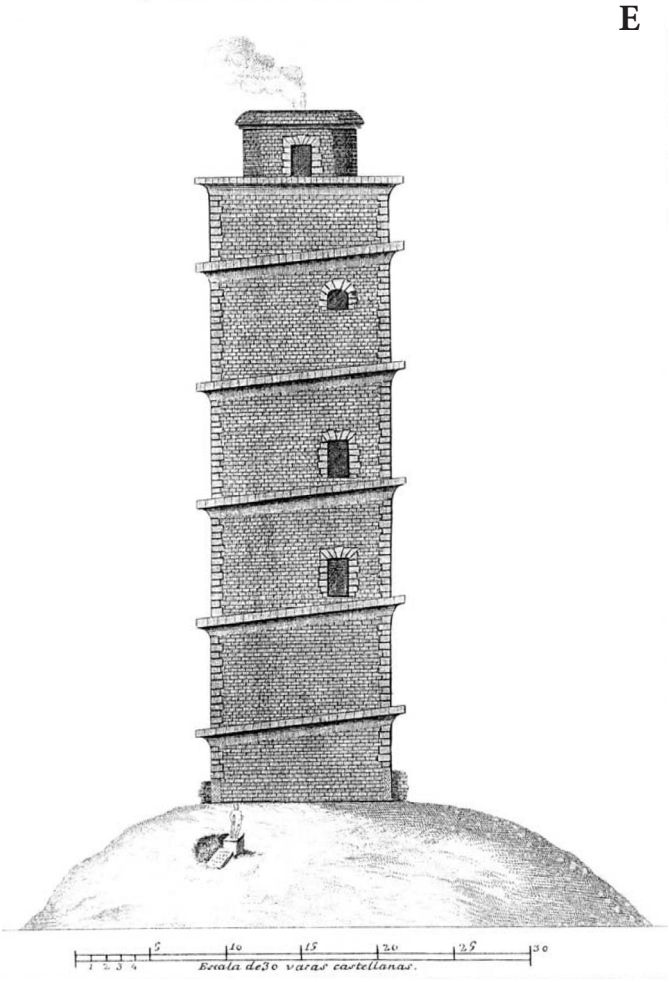
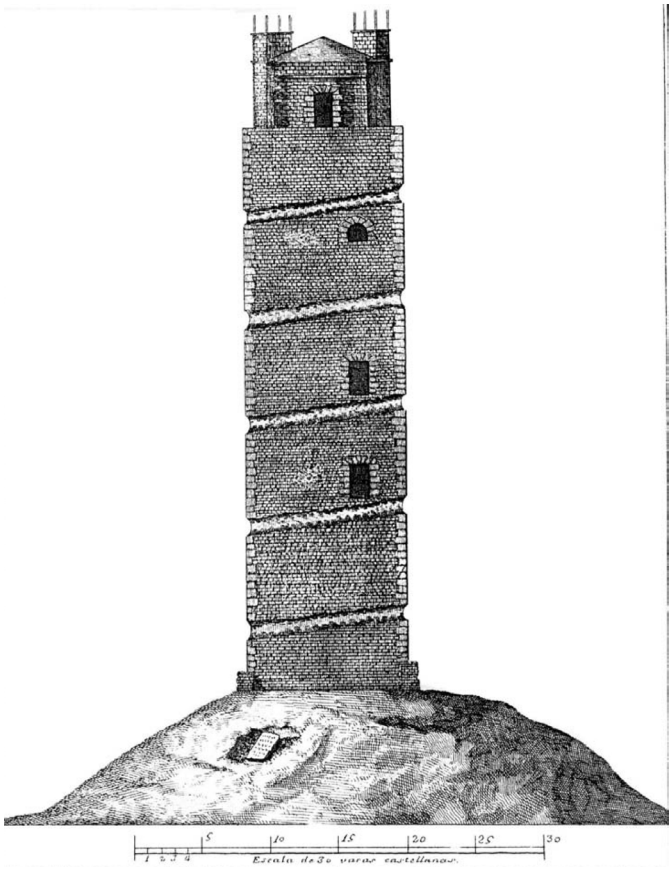


Fig. 6-45 (contd)
C: An impression of the original Roman tower.
D: Cross-section and plan view through the tower.
E and F: Rebuilt designs following serious damage.





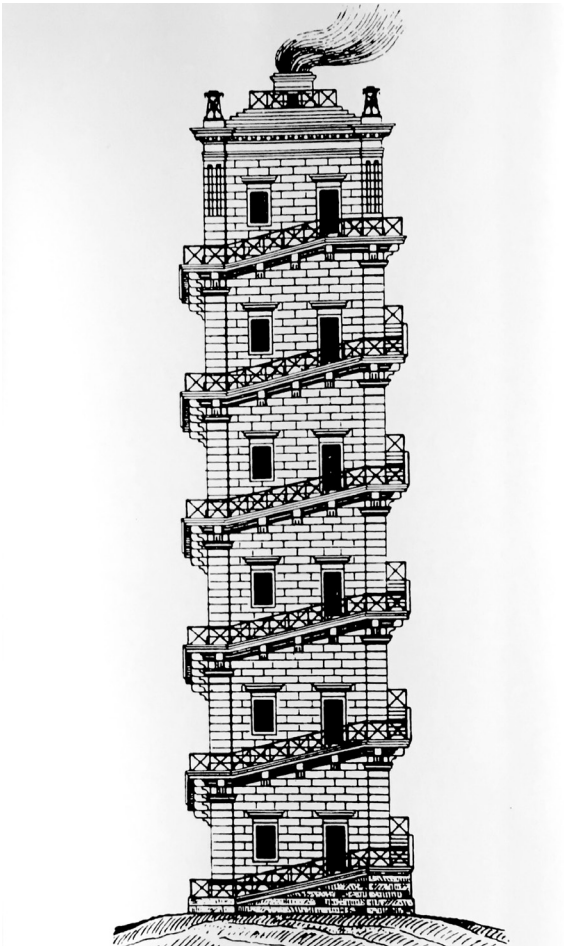


Fig. 6-46 (above left): A reconstruction of the lighthouse as it looked before the 1791 rebuild. The external staircase is now included to match door-sized openings in the square tower. Some of the doors were later blocked up, as shown in Fig. 6-45 E and F.[128]

Fig. 6-47 (above right): Substantial modifications were made to the structure over centuries. The mixture of different stonework provides good data for archaeological analysis.[129]

Fig. 6-48 (below right): One of the central stair wells. The wall on the left is clearly very old - probably Roman. Different floor levels are visible when looking down through the central shaft.

Fig. 6-49 (page opposite): photographs showing different internal parts. Top left is a high, vaulted and domed ceiling to one of the chambers with what looks like a small religious sanctuary ahead. Top right is a view of the square stair well with a modern balustrade, also shown in Fig. 6-48. Bottom left is a view of a window showing the wall thickness and the substantial stones arranged to support a window opening. Bottom right is a similar shot from one of the upper landings.[130]

two other kingdoms of *Brigantia* in Ireland and England and there was regular contact between them.[97]

The earliest known reference to the lighthouse at *Brigantium* was written around 415-417 AD:

> *"At the second angle of the circuit circumnavigating (Hispania), where the Gallaecian city of Brigantia is sited, a very tall lighthouse is erected among a few commemorative works, for looking towards Britannia."*[98]

The clear implication in the reference is that a direct route to *Britannia* existed, rather than a long, indirect coast-hopping route.

As Roman power diminished, the tower saw long periods of neglect and even deliberate destruction. In 844-846 it received serious damage during battles with Viking and Norman invaders. A line of watchtowers was built along the Galician coast and the lighthouse became vital in the defence against further invasions. Unfortunately, once more in 1015 AD a Scandinavian fleet led by the future king of Norway Olaf Haraldsson reached the city of Flavium Brigantium and further damage ensued. It finally became extinguished around 1100 CE and for centuries was a ruined monument and by the 16th c. had become a source of materials for local builders, despite efforts by the local government to protect it. Then, in the 17th century, as the port became a greater factor in increasing the wealth of the city, the council took the decision to repair and rebuild the tower. Finally, new life was given to the lighthouse with its full 1791 restoration.

The North Sea

Van de Noort is another archaeologist who has pointed out the differences in viewpoint that arise when the focus of history and prehistory is moved from land to sea.[99] In this section I shall consider the ancient history of the North Sea, an area that has perhaps received less attention overall than the coastal Mediterranean regions and where an appreciation of changing landscapes is essential in achieving understanding of the human impacts on ancient coastal areas.

It is well known that the North Sea and the English Channel - in geological terms - were only recently created as a result of the melting of the ice sheets at the end of the last Ice Age. It is an example of a shallow inland sea (also known as an epeiric sea or an epicontinental sea) that covers central areas of continents (Europe, in this case) during periods of high sea level that result in marine incursions.[100] Precise details are unnecessary here, but the area was still undergoing significant geographical changes when *homo sapiens* began to occupy the lands around 15 kya. One point worth noting is that changes to sea levels occurred when land that had suffered depression under the great weight of glacial ice was able to release pressure by upward motion once the ice had melted. Later, changes to coastlines were further made when the increasing human agricultural activity led to a consequent rise in alluvial deposits as major rivers carried them to the North (and Baltic) Sea. Sadly, much of the earliest activities of humans along the coast now lie underwater and are therefore little-known. On the positive side, however, we can conclude that the time is now appropriate for archaeologists with a marine focus to more thoroughly investigate the great number of sites of which so little is known, and to draw a more detailed picture of the ways in which harbours, ports and their associated aids to navigation were employed.

Although there are no archaeological finds to prove it, we can be confident that skin-covered boats were the earliest designs used for the waters of the North Sea for four or five thousand years following the retreat of the ice sheets.[101] Indeed, even before the basin was filled with by the sea, it is probable that skin-covered boats were used to cross rivers. All the skills necessary to build them were present at the time. Despite the absence of finds of contemporary boats after centuries of biological decay, many paddles at least have been found preserved in mud. In contrast, log boats have been found preserved across the entire region and appear to have been used for many millennia.[102] Only with access to bronze tools did ship building technology progress to the kinds of boat designs that used joined planks of wood, as evidenced by many finds in the estuarine muds of the UK.[103] Capacity of such boats improved rapidly in parallel with the larger plank sizes that became possible from around 2000 BCE. It was Julius Caesar who first reported the use of sails in northern Europe.[104] He reported that Gauls whom he called

Veneti were in frequent contact with the British using ships that bore sails. We must presume that this technology arrived in the region in centuries before Caesar chose to write about it.

Apart from a very few pre-Roman sites already mentioned with reference to Phoenician voyages of exploration, the catalogue presented in this book contains citations of a number of locations at the edges of the North Sea where it is thought that lighted aids to navigation may have been used. It is unfortunate that the supporting evidence for most of them is so scant. However, some of these sites will become a far more important topic for discussion in the next volume of this series on Medieval lighthouses, but for now it is sufficient to note that virtually all of the present references deal with the Roman presence in northern Europe.

Van de Noort discusses the idea of 'sailing nurseries' first proposed by Irwin in 1992.[105] The idea has already been discussed in relation to Broodbank's proposal for the expansion of settlements in the islands of the Aegean Sea whereby the principle of island hopping was used to facilitate the crossings of large expanses of sea.[106] Irwin's sailing nursery proposal is that it is the challenge of travel from one island to the next that encourages the development of navigational skills. Van de Noort points out that the same ideas apply to the situation in the shallower North Sea whereby intermediate stages in the transition process leading to the full development of the sea resulted in the presence of networks of islands and other coastal sites that enabled short hops between sites that were visible to one another.[107] As this process developed, the use of lighted aids to navigation could have occurred in parallel. Other early methods for charting the progress of a sea voyage beyond sight of land would have been encouraged by careful observations of such variables as sea water colour - which can change depending upon the proximity to river mouths, currents - which are determined by the bulk flows of the Atlantic and change markedly across the North Sea, and the flight paths of seabirds - which would have been known for their routes to nesting colonies, as well as the well-known techniques from Bronze Age times of knowledge of stars, weather patterns and winds. This deep and specialized expertise was jealously guarded by navigators, for it gave them important roles in their communities.

So, there is good evidence in support of complex connectivity between communities across the entire North Sea from a period soon after the ice sheets retreated, aided by the presence of islands and a speedy increase in seamanship and navigational skills. Long-distance contacts across the sea are evidenced by many finds of artifacts from many different cultures from as far back as Neolithic times. Local smelting and casting of bronze was perhaps the most important reason for the development of maritime trading patterns from 1500 to 800 BCE and there is proof in this period of interaction from as far afield as France and Spain. Indeed, we are already aware of the visits (albeit, infrequent) to the far west of the region by Phoenician and Roman merchants in search of these valuable products. Trading in bronze, and its ingredients - copper and tin - peaked around 1000 BCE. However, fluctuations in demand for certain goods caused significant periods of rise and fall in commercial activities around the North Sea basin.

The period in which Romans occupied the lands adjoining the North Sea is one of obvious interest to us, for we have seen many times how the Romans became pre-eminent in the construction of lighthouses. Sadly, as we search amongst all the research into prehistoric seafaring practices, we find not a flicker of light that can be shed on the use of artificial aids to navigation, unlike the situation pertaining in the Mediterranean. We have carefully examined the Greek and Phoenician cultures in earlier papers and identified many cases in which mariners called upon lights from strategically positioned monuments for directions. The same is not true, however, in the North Sea area where, despite marine activity clearly taking place during the ten millennia BCE, there is no indication of lights being used as waypoint markers until the arrival of the Romans. Even then, as the Roman method introduced the lighthouse into its engineering repertoire extensively throughout the Mediterranean and beyond, we find very few firm examples in the North Sea basin beyond the English Channel and the Dover Straits. Whilst it is clear that the technology of boats, ship building and navigation initiated and propagated worldwide from around 10 kya with little impedance from geographical location, it remains a curious but inevitable fact that the construction of primary artificial lighted aids to navigation did not progress

beyond the casual use of fires until the simple idea of a dedicated fire-bearing structure was taken up by the Romans, having been adopted, of course, from the Pharos of Alexandria.

Lugdunum Batavorum (Calla)

The river Rhine was unknown to Herodotus and is first found in the historical period during the first century BCE when it was recognized as the boundary between Gaul and Germania. It became the natural northern boundary of the Roman Empire, and was accordingly protected by up to eight legions in five bases. As with the Nile, the mighty Rhine river built up great areas of new land by deposition of silt over many centuries, and this land essentially became the Netherlands.

At the mouth of the Rhine, the Romans created a fortification known as *Lugdunum Batavorum* - later Brittenberg. Remains of what was interpreted as the ancient fort were uncovered beneath the sand in storms, but have since disappeared beneath the waves. Some academics believe this was the site at which the Emperor Caligula built a lighthouse, as described by Suetonius:

> *As a monument of his victory he erected a lofty tower, from which lights were to shine at night to guide the course of ships, as from the Pharos.*[108]

Others believe this reference is of the lighthouse at Boulogne, discussed next. This may, indeed, be true, but, it seems very likely that the Romans did build a lighthouse to mark the harbour and their support base for their line of fortifications along their northernmost boundary at this most important strategic position.

The English Channel Crossing

The arrival of the Romans at the narrows of the English Channel brought with it Roman lighthouse technology. We are safe in assuming that the early Roman explorers, possibly following routes they had learned about from others, had followed the coastlines of northern Spain from the Tower of Hercules at Coruña, by way of *Campa Torres* on the present Ligurian coast, and east to *Olasso* (Irun). There, they turned north and navigated the coast of Gaul, along the edge of the Bay of Biscay, around the very treacherous reefs of Finisterre, to arrive at Boulogne where, in sight of the chalk cliffs of England, they established a new camp at *Gesoriacum*, later to be known as Boulogne.


Fig. 1. The Tour d'Ordre, or Old Man of Boulogne, a Roman lighthouse destroyed in 1544

Fig. 6-50: An interpretation of the Tour d'Ordre.[131] *It shows a military presence surrounding the tower, which is located on the northern side of the port entrance (the view is looking south). The tower is exhibiting a signal, rather than a light, which indicates that it was both a signal tower and a lighthouse. There is almost no tapering of the tower with height, which makes the accuracy of the drawing seem less likely, but the twelve storey structure seems to be significant.*

Gesoriacum: Tour d'Ordre

The precise date of the Roman arrival is uncertain, but Julius Caesar is proclaimed as the first Roman to cross the English Channel from France in 55 BCE. We understand that he used the new camp at *Gesoriacum* as his point of departure. It is recorded that the camp was formally laid out commencing in 49 BCE. Florus seems to have been the first writer (in 12 to 9 BCE) to use the name *Gesori-*

Fig. 6-51: A map of the Boulogne area drawn by the French cartographer Pierre Haultin in the mid-16th c. Several fortresses are evident, as well as the Roman lighthouse on the northern entrance to the port.[132]

acum, which stood for the Boulogne settlement for several hundred years thereafter, although sometimes called *Bononia*.[109] Tiberius is said to have visited there in 4 CE. In 37 or 39 CE Caligula also inspected the location that, by then, had become the main crossing point to Britannia, through *Portus Dubris* (Dover). It is said that Caligula wanted to mount a full scale invasion of Britain, but had run out of money to pay for it. Amongst a catalogue of peculiar decisions, he apparently ordered an attack on the sea and that the soldiers collect as many sea shells as they could to carry back to Rome. However, one sensible order was to build a tower high up on the cliffs and this became known as the *Tour d'Ordre* (or *Odre*).

A 19th c. author called Barthelemy wrote extensively about it thus:

> *"On the same shore, a witness of the ridiculous preparations for an imaginary battle, on the northeast of the port, Caligula built an elevated tower. It was a structure of octagonal form, its height from the level of the soil 125 feet [38.1 m], the foundation only six [1.82 m] deep; it*

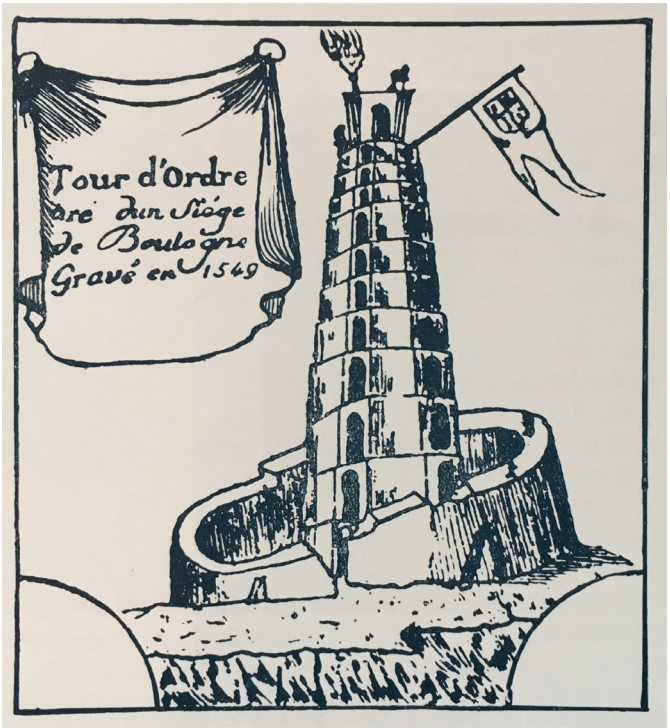


Fig. 6-52: Another image of the Tour d'Ordre with a greater taper than that shown in Fig. 6-50. The tower bears a flag signal and a burning torch.

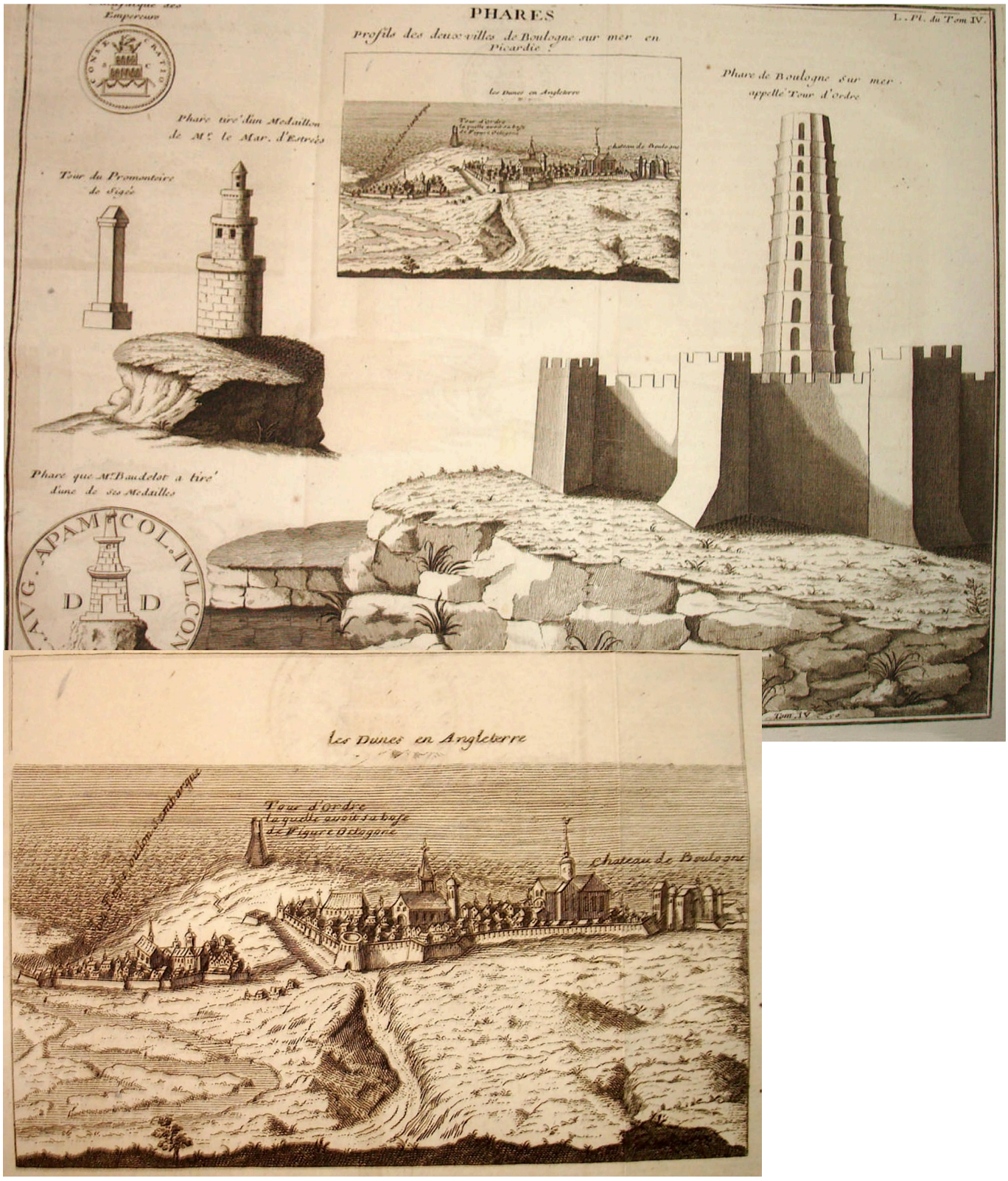


Fig. 6-53: An engraving showing the Phare de Boulogne on the right, surrounded by fortifications added to protect it (unsuccessfully, it appears) against attack by English troops. A feature of the tower is its multi-storey construction, in contrast to the usual Roman design. 12 storeys are portrayed on an octagonal base. (We note also the icon of the Sigeum pillar on the left of the engraving.) In the top centre is a representational image of the lighthouse site that has been enlarged (inset). The chalk cliffs of England are shown in the distance, and the lighthouse carries the annotation that it was built on an octagonal base. The fortification surrounding it is not present in this part of the original.[133] Nowhere on the image is there an indication of the tower's use as a lighthouse or signal station, except in the annotations..

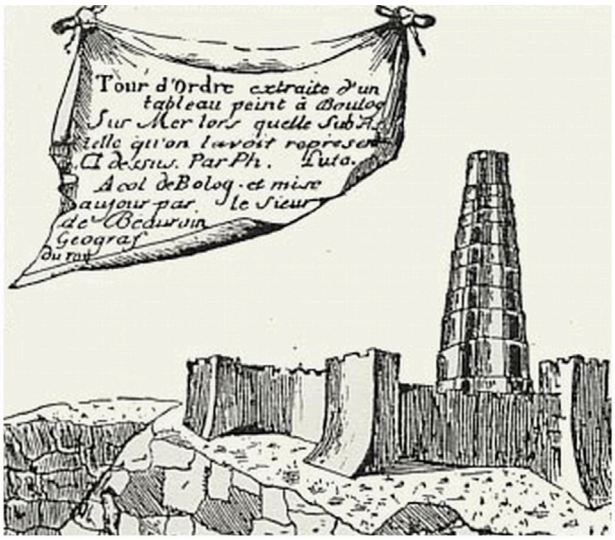


Fig. 6-54: An image showing the Tour d'Ordre in 1546, apparently based upon the original in Barthelemy's work (see facing page).[135]

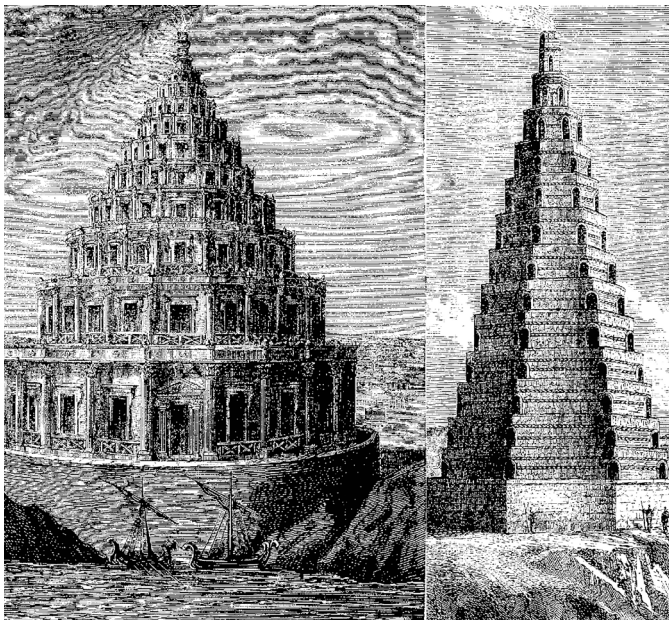


Fig. 6-55: Images presented in a 19th c. paper on lighthouses by Figuier.[136] *Left: an impression of the Pharos; right: the Tour d'Ordre. See also Fig. 4-12, the structure claimed for a Phoenician lighthouse in Cadiz. Such comparisons spark interesting possibilities. The progression from the earliest Egyptian tomb called the mastaba in the pre-dynastic period (6000 to 3150 BCE), to the stepped pyramid of the mid-3rd millennium, and thence to the ziggurat of Ancient Mesopotamia is intriguing. Solid at first, with external steps for access, towers became hollow with internal access when engineering advancements had been made. There are enough data concerning the two phari at Gesoriacum and Dubris to believe these links are real, as well as to add supporting evidence for similar towers elsewhere as at Cadiz and La Coruña, for example.*

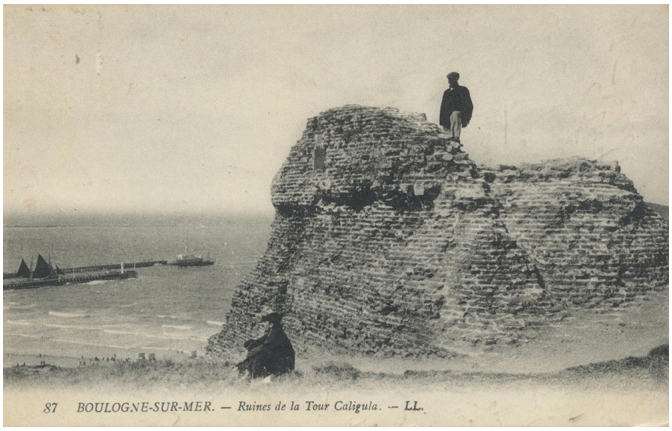


Fig. 6-56: An old postcard showing the remains of the lighthouse in the early 20th c. [134]

was divided into twelve stories, each of which diminished in circumference. The first storey was 224 feet [68.3 m] round, and each of its sides 28 feet [8.53 m] long. The circumference of the last was 40 feet [12.2 m], and the sides 5 feet [1.5 m]. Each storey presented a kind of terrace or balcony to which access was obtained by means of a door placed at each angle of the octagon. Thus the tower had 96 entrances, exclusive of the one which led to the lighthouse that crowned the top; an interior staircase facilitated circulation. The tower was built of bricks, square thick tiles, and stone, cemented with that famous Roman cement, the composition of which the moderns have not been able to discover the secret. First there were three layers of grey stone, such as present found on the coast, secondly two of yellow stone, and the last two of dark red bricks. The architect who directed the work allowed little time for the foundation, when compared with its great height, as he no doubt supposed that being built upon a firm soil, the elevation of which formed a natural rampart, it was proof against every accident.

"The ancient authors we have consulted relate that it was rather more than an arrow's flight from the sea; in 1545 it was about 200 fathoms from the edge of the cliff; but at the time of its construction it must have been much farther. At present the sea has made astonishing progress and gained so much on the cliff, that served, as we may say, for the basis of the tower, and by thus undermining its foundation has accelerated its fall, and in its course buried the stones,

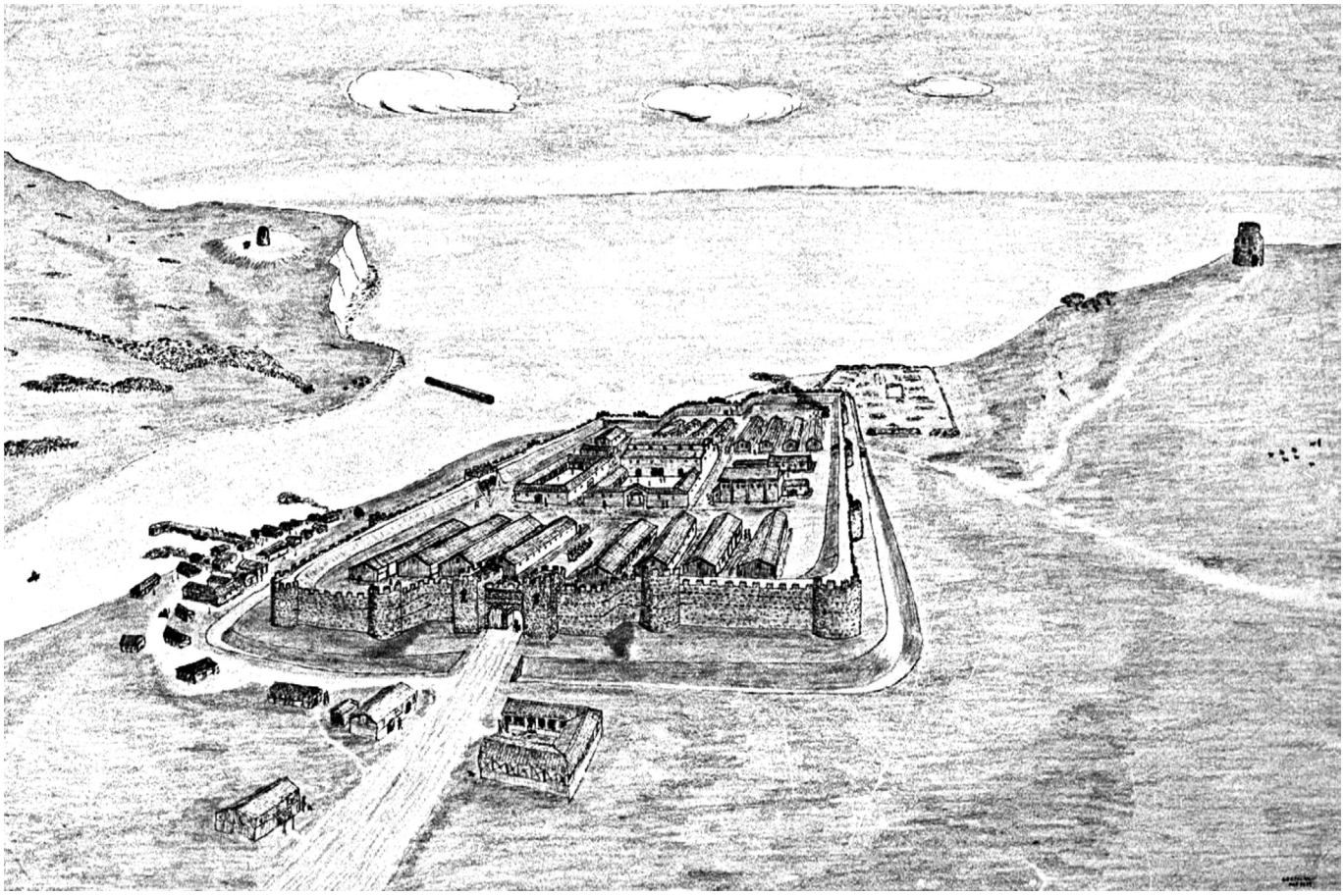


Fig. 6-57: An artist's impression of the Roman garrison at Dover (Roman: Portus Dubris), showing two pharos towers on high ground to the east (left) and west (right). The eastern lighthouse remains today (shown opposite) but remains of the foundations of the western tower, were built over in the Drop Redoubt fortifications. Building is thought to have taken place sometime between 30 BCE and 44 CE.[137]

> *etc., so that at present it is impossible to find the slightest vestige of the tower itself. Now if in three centuries the water has worked away two hundred fathoms of cliff, how much must it have destroyed in 1500 years!"*[110]

In 1533 or 1534, in preparation for an attack from England, the Governor of Boulogne named La Fayette ordered the lighthouse to be surrounded by "four walls flanked by four bastions, built of red bricks, around the outer wall was a ditch which rendered the approach more difficult." However, the upper stories of the lighthouse had by now been altered, causing it to appear from afar as the image of an old man. The resulted in the English giving it the name, 'Old Man of Bullen'.[111] It became more of a watch tower than a lighthouse. Eventually, it was captured by the English, who modified it with yet stronger fortifications, but when it was finally returned to French ownership it was left to decay.

Like the Pharos, this construction had remained in place for about sixteen hundred years, until, suffering increasingly rapid deterioration, its remains finally fell over the eroding cliff edge. The nineteenth century writer Bartholemy described it thus:

> *"Boulogne, although undoubtedly long the place of residence of several Roman emperors, and a military station of the Roman power, yet has but a few remains of its antiquity. Remains of Roman lighthouse and ancient relics in Boulogne are the remains of the Pharos, or burning tower erected by Caligula. It was originally and for many ages called Turris Ardens, or Turris Ardensis, the burning tower, and subsequently known as the Tour d'Odre or d'Ordre. The remains, which present a huge mass of brick work on the top of the cliff, on the eastern side of the harbour, are evidently of Roman origin. They are, however, only a portion of the base of the Pharos. The tower, as described in the memoirs of inscriptions and belle lettres, was octagonal. It had 12 successive galleries, progressively*

Fig. 6-58 (overleaf) and Fig. 6-59 (above): The Eastern Pharos in its surroundings of Dover Castle, founded from the 11th c. CE. Generally assumed to have been built at the time of the Roman invasion in 43/44 CE, its date of construction may have been later - around 130-150 CE.[138]

> *diminishing in size unto the highest, upon which the burning materials were placed as a guide to the entrance to the harbour. The circuit at the base was about 200 feet. It was in existence, though dilapidated by time, until the year 1644 when it fell from the cliff."* [112]

The old postcard shown in Fig. 6-56 seems to give the lie to this statement since it seems there were substantial remains on the cliff edge in the late 19th century.

Britain was finally subjected to a full-scale invasion in 43 CE.

Portus Dubris (Dover)

Across the Channel at a location where there is today a very busy ferryport, the Roman invaders chose to make their new base on a new territory, a camp they called *Dubris* - modern Dover. One of Britain's oldest known ports, the land of its Celtic inhabitants had been called *Dubra*, meaning 'the waters'. The geography was rather different from what we see today, for the location of *Dubra* was at a point on the mouth of a navigable river called Dour where the English shoreline dips down from the tall chalk cliffs on either side. Over time the mouth silted up and was built upon.

Britain had been previously inspected by scouting legionaries under the command of Julius Caesar who crossed the English Channel from *Gesoriacum* in the year 55 BCE. Now it was time for a solid expansion of the Empire into this Celtic land and to establish a firm link across the sea to mainland Europe. In 38 CE, Caligula had tried, and failed to cross, but there was no turning back for troops who followed the orders of Emperor Claudius in 43/44 CE. Current ideas regarding the invasion include the possibility that Roman forces landed not only at Dover, but also farther west along the south coast of England at Portchester in Hampshire, as well as at Richborough in the eastern corner of Kent. Nevertheless, a permanent city was constructed at *Dubris* and two lighthouses were built on the high ground to the east and west to

mark the entrance through Britain's new gateway.

The existing eastern lighthouse at Dover is commonly known as the Dover Pharos, Figs. 6-58 and 6-59. This wonderful, rare building is probably the best surviving example of a Roman lighthouse. For centuries it has received little attention and archaeological investigation. Two comprehensive studies from the early 20th c. have filled a gaping hole in our knowledge. [113] [114] Of these, the second by Wheeler is a vital publication of the details of construction.

Externally the tower is octagonal, with sides of 15 ft (4.6 m) length, but internally it is 13 ft 10 ins (4.2 m) square. The existing height is 62 ft (19 m), of which the top 19 ft (5.8 m) are medieval, leaving some 43 ft (13 m) of original Roman stonework.

The walls rise perpendicularly and holes in the masonry indicate the presence of wooden floors. At the base, the walls are nearly 12 ft (3.65 m) thick, and diminish to 3 ft 9 ins (1.1 m) at the top. In common with similar Roman constructions, especially the *Tour d'Ordre*, the floor area progressively diminishes towards the top, stepping inwards at intervals by around 30 cm. The effect is to make the tower look telescopic. External eroded and crumbling masonry has been periodically attacked to reshape/repair but has changed the form of the tower. Almost certainly, it had a design similar to the *Tour d'Ordre* with multiple stages up the exterior reducing the width by about 1 ft (30 cm) at each level. This suggests an original height of about 80 feet (24 m).

Wheeler believes there were probably eight stages and a parapet above the final floor or roof. Each floor had four arched windows and access to each floor was undoubtedly by wooden ladders. Both tiles and brick were used in the construction. Construction is from flint rubble bonded with double courses of tiles at regular intervals and faced with tufa ashlar.

The windows and doors are arched and are decorated by the alternate use of tufa and tile to achieve a multi-coloured effect. The tiles are of the same pinkish material found in the fort of the *Classis Britannica* and it seems reasonable to suppose that they were built at broadly similar dates. The early phase of the fort has been dated to around 130-150 CE. This may indicate that the oft-quoted date of the Pharos as being around 44 CE is too early. Clearly, the construction of the lighthouses

Fig. 6-60: Satellite map of Roman southeast England, showing the four main lighthouse sites (yellow pins) and other significant sites in Roman Britain (white pins).

postdated the invasion and may have occurred much later as the city was being improved from its initial build.

The western lighthouse is even less well-known, undoubtedly because it is now largely invisible on the surface. Curiously, there was a time in the 16th and 17th centuries when it attracted more attention than its sibling because, from the sea, it stood out in the landscape more clearly because the eastern tower had been rendered less obvious by the heavy fortifications in which it had become absorbed. Unfortunately, the western tower received little or no protection over the centuries, whereupon various decay processes caused it to be almost eliminated from the landscape.

Remains of the foundations of the western tower do still exist, and careful local examination shows another octagonal structure with the same dimensions in plan. It is therefore natural to conclude that the two lighthouses were built to the same design.

It has often been suggested that there was an architectural relationship between the Dover towers and the *Tour d'Ordre*, and in many ways this remains a matter for debate since so little precise information exists. Certainly, cursory inspection of

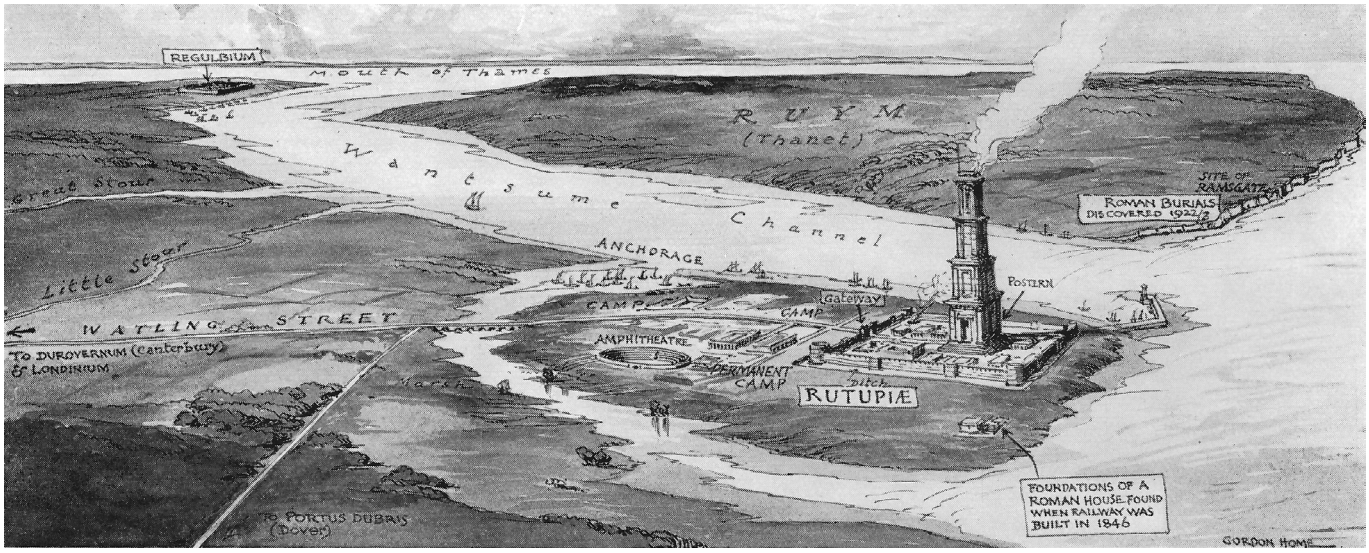


Fig. 6-61: The illustration above shows the eastern tip of Kent, known as Thanet.[139] Although today, it is a single land mass, it is generally agreed that in Roman times Thanet was an island (top right) separated from the mainland (left) by a wide body of water known as the Wantsum (or Wansum) Channel. It has always been assumed that the natural route for channel crossings from Gaul was the crossing to Dubris (Dover), as is indeed the case. However, modern opinion is that many of the earliest crossings were also made to a site in the southeast called Rutupiae, now Richborough. The Wantsum Channel became a shortcut for ships travelling to and from Londinium (London), whereby, after exiting the channel at its northwest point called Regulbium (Reculver), they could carry on up the Thames estuary to disembark directly at Durovernum Cantiacorum (Canterbury), or else all the way up the Thames to Londinium. There is a good chance that a lighthouse was built at Richborough (see Fig. 6-62 below). There may also have been a similar tower at Regulbium, but hard evidence now may have been destroyed by encroachment of the sea. The Rutupiae fort lies at the eastern terminus of the famous Roman road called Watling Street, which passed through Canterbury and London as it carried travellers to the west of England. Thousands, if not hundreds of thousands of people passed in and out of this ancient ferryport for about 400 years.

Fig. 6-62: A satellite image of the remains of the Roman fort of Rutupiae. Built on a modest hill, the eastern wall and part of the southern wall have now been lost due to land movements and modern activities. In the centre of the site are the curious remains of what has been interpreted as a lighthouse.[140]

the images we have and the diminishing octagonal cross-section with height does indicate a similarity.

One could further comment that the designs have diverged from the typical Roman format for a harbour lighthouse. There could be a number of reasons for this. Here, at the extreme edge of the Roman empire, there may have been new ideas in play from a different school of architecture.

Hague speculates that the lighting of a fire atop the towers must have been done on a fireproofed platform, perhaps having stone slabs laid on the wooden floor of the lantern level. Fuel for the fire may have been lifted by means of some kind of crane to the level below the lantern, but the length of its jib must have been long enough to accommodate the projecting base. It would also have been necessary to move the crane around the tower to deal with the different wind conditions and the smoke coming from the fire.[115]

Other English-Roman Sites

It is generally accepted that London was founded on the north bank of the River Thames, inside the boundaries of the City of London, by the Romans around the middle of the first century CE.[116] The difficulties of archaeological study in such an area in the heart of a modern city are obvious, but progress has been made in the second half of the 20th century thanks to more enlightened policies regarding redevelopment projects. Milne gives many details of our current knowledge of the Roman port of London and notes that the Romans built a bridge across the Thames close to where London Bridge is currently situated. Extensive use of English oak was made for the harbour and quays, as well as the usual brick and stone structures. Milne did not know of the recent find of a Roman tower just downstream of the port at Shadwell, which has now been interpreted as a stone-built signalling tower, built before the mid-3rd c. [117] Considering the possibilities that it could have been a mausoleum or a small shrine, the authors concluded their study in favour of multi-functional use, not definitively a lighthouse.

Early maps of Kent show the Isle of Thanet as an island (it is not so today) separated from the rest of Kent by the Wantsum Channel, Fig. 6-61. At the northern end, where the Channel meets the Thames estuary, is *Regulbium* (Reculver). At the southern end of the Channel lies a Roman fort at *Rutupiae* (Richborough) thought to have been the main landing point for the Roman invasion in the time of Emperor Claudius.

A reference to Richborough Castle, written at a time when active lighthouses in Great Britain numbered around a dozen, confidently names the site as having a lighthouse:

> *" … Richborough as the proper seat of that Legion, lying in garison in a Castle there purposely erected, as in respect of the ascent or high rising ground whereon it stands, of singular advantage both as a specula for prospect and espial of enemies and invaders, and as a Pharus or high tower, to set up night lights for the sea-mens better and safer guidance in to the harbour. For that Richborough-Castle was ever other, or of other use in the Romans time I cannot believe." [118]*

When we consider the possibility that lighthouses may have been constructed at each end of the Wantsum Channel, we need to bear a number of things in mind. Archaeological evidence suggests that *Gesoriacum*, *Dubris*, *Rutupiae* and *Regulbium* were all in use at the time when the Romans were establishing a major foothold in England. It is clear that one significant structure was built at *Gesoriacum* and two more at *Dubris*. Given that these four sites became the most important links in the chain of support to England, there is a strong possibility that two more towers existed at *Rutupiae* and *Regulbium*. The latter site has unfortunately suffered great damage from incursion by the sea and there are few Roman clues left to discover. At Richborough, however, much of the layout of the site is clear.

There is a most remarkable feature at the centre of the site in the form of a cross of stone, Fig. 6-62. Investigations have shown this to have a deep foundation whereupon a massive structure could have been built. Around the cross is a large platform of stone and concrete that are joined to the cross but not so deeply seated in the ground.

It could be said that a giant stone peg in the shape of a cross had been driven into the ground so as to firmly fix a large structure with a square base above ground. Many observers feel that this is a strong sign that it was the site of a lighthouse similar to those at *Dubris* and *Gesoriacum*.

Home's artistic interpretation is a good one, whereby the design of the tower is indeed similar

to those better known towers with multiple diminishing sections. Whilst he has shown a square base, it is also possible that the base could have been octagonal. Recent studies of the Roman site at *Campa Torres* have proposed a square foundation for a lighthouse there.[119]

Sadly, no such remains can be found at *Regulbium*, but it seems unlikely that the Romans would not have marked the entry point to the Channel for ships returning from *Londinium* (London).

A little-known but well researched book by Mothersole [120]gives an excellent review of the Roman methods in southeast England. Significant locations are shown in Fig. 6-60.

After a period of growth and relative peace in England under the Romans for almost 300 years, ancient Britons found themselves under increasing attack from the sea by marauding groups of Saxons. The Romans built a chain of nine castles around the coast that became known as the Saxon shore. Dover, Richborough and Reculver, were three of the nine sites.

We note that if there were lighthouses at all of these sites, the castles were built much later - around 300 CE. Whether they all contained lighthouses is a subject for debate with little chance of a successful outcome.

We now know how important signal towers were to Roman military and naval forces, and it is tempting to argue that all of these sites showed lights at night to guide approaching ships. However, we must stress the difference between the perceived use of towers for intermittent signalling purposes and those set up primarily for navigational purposes.

In this work, I have tried to delineate between them and not to include those locations where the primary function was signalling, rather than navigation. Academics will probably disagree over this for many years to come.

Conclusions

1. Ancient lighthouses built after the Pharos of Alexandria have been described.

2. Virtually all lighthouses built post 280 BCE were initiated to support the Roman Empire.

3. Roman lighthouse building used the design of the Pharos as a starting template.

4. Roman lighthouse building reached a peak during the second century CE and covered the full extent of the Empire.

5. The number of Roman lighthouse structures existing today is very small compared to the survival of other Roman structures.

6. The number of confirmed lighthouse sites is very small compared to the number of ports and in consideration of the well-understood Roman port design. This may be due to:

- **a. Loss of archaeological data by over-building;**
- **b. Loss of archaeological data by sea damage;**
- **c. Lack of sufficient archaeological investigation;**
- **d. Changes to the site geography due to silting over two millennia;**
- **e. The number of lighthouse sites that are now underwater;**
- **f. The difficulty in distinguishing signal towers from lighthouses.**

7. We might expect there to have been far more Roman lighthouses than we know about today.

8. Similarities between proposed ancient lighthouse designs and minarets, pyramids and ziggurats remain exciting topics for research.

Notes

1 Photo: Ken Trethewey (2003).

2 A harbour is a protected area of water. A port is a harbour, plus terminal facilities: piers, wharves, docks, store buildings, and an infrastructure of roads and rivers or canals. The Romans used the same word for a harbour and a port: *portus*. The best sailing season was from May 27th to September 14th March 10th to May 27th, and September 14th to November 10th were also considered reasonable periods. In the winter shipping came to an almost complete standstill. This period was called the *mare clausum* (closed sea).

3 Casson (1994), pp149-62.

4 Casson (1994), p152.

5 Casson (1994), p159.

Fig. 6-63: The remains of the ancient lighthouse at Patara, which matches many of the criteria of those in Figs. 3-7 and 3-8.[141]

6 Bellotti (2011).

7 Giardina, p102.

8 Boin (2016), pp18-20.

9 Boin p53-5.

10 Oates (1934).

11 Meiggs (1997).

12 Quote from the site www.ostia-antica.org: "In his Commentaria rerum memorabilium (edition Frankfurt 1614, 301), Pius II Piccolomini wrote (May 1463) 'There are still traces of this tower which can be seen from far out at sea.'"

13 Suetonius: Thomson (2007), Claudius XX.

14 This harbour was actually completed after the death of Claudius whose role in the project seems to have been ignored by his successor, Nero, who dedicated the completed works in 64 CE as Portus Ostiensis and Portus Augusti.

15 Vitruvius: Morgan (1914) 5, 12, 1-6. Quoted and translated in Oleson (2014), p21.

16 Brandon (2014).

17 Suetonius: Thomson (2007), Claudius XX.

18 Blackman (2008).

19 Boin (2016), pp51-57.

20 Giardina p103.

21 Keay (2012).

22 Boin (2016).

23 Boin (2016), p47.

24 Pliny the Younger: Letters. Letter to Cornelianus; Bible: Epistles, 6.31.

25 Oleson (2014), p1.

26 Oleson (2014), pp1-10.

27 Brandon (2014), pp190-191.

28 Dubois (1907).

29 Oleson (2014a) pp260-263. In Oleson (2014).

30 Paget (1971).

31 Oleson (2014), pp260-263.

32 Brandon (2008).

33 http://www.poetryintranslation.com/PITBR/Latin/SuetindexBCD.htm

34 Giardina, p295.

35 Suetonius: Augustus, 49.

36 Krause (2003).

37 Giardina (2010), p107.

38 Tuff is a light, porous rock formed by consolidation of volcanic ash. Pozzolana also known as pozzolanic ash (pulvis puteolanus in Latin), is a siliceous or siliceous and aluminous material which reacts with calcium hydroxide in the presence of water at room temperature (cf. pozzolanic reaction).

39 Pliny the Elder: The Natural History 36 - The Natural History Of Stones, Chapter 18: The Pharos.

40 Hutton (1913).

41 Buceti (2012).

42 Giardina (2010), p93.

43 Public Domain Image retrieved from Google Images 20180113.

44 Photo: MM (2012); Reproduced under the Wikimedia Commons Licence.

45 Drawing by F. Salomon. For details see Ferreol (2016), Keay (2012), Keay (2005), Keay (2011), Goiran (2011). In contrast to the detailed academic studies of Keay and co-workers, a detailed, up-to-date popular description of the archaeology of Ostia and Portus Romanus is also given at: www.ostia-antica.org.

46 Google Earth (2018).

47 www.ostia-antica.org.

48 Zemke (1992), Vol. 1, p6.

49 The British Museum CM BMC132, AN31942001

50 Photo © Ken Trethewey (2003).

51 Google Earth (2017).

52 Old painting of Civitavecchia by Arnaldo Massarelli. A painting in the public domain. https://civitavecchia.portmobility.it/en/itinerari/top-routes/historic-port-civitavecchia

53 d' Ascenzo (2014).

54 Photo Il Lazzaretto di Acquamarina, courtesy of Concorso Fotografico Nazionale Comuni-Italiani.it

55 Photo: Guruman (2014); Reproduced under the Wikimedia Commons Licence.

56 Google Earth (2018).

57 Find this

58 Google Earth (2018).

59 Google Earth (2018).

60 Bodleian Library, University of Oxford; Arch. Antiq. B subt. 18, pl. XIII.

61 Capo Miseno lighthouse. Photo reproduced under CC license: Peppe Guida (2017).

62 Capo Miseno lighthouse viewed from the sea. Photo by Roberto De Martino (2008); now in the Public Domain.

63 Google Earth (2017).

64 Photo of Villa Jovis Low: Amy C. Smith (1993).

65 McCann (1987).

66 Google Earth (2017).

67 www.coinarchives.com

68 Google Earth (2018).

69 Robert L. Hohfelder, Christopher Brandon and 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.

70 Giardina (2010), p51.

71 Giardina (2010), p230.

72 Bartoccini (1958).

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Fig. 6-64: The World's Oldest Working Lighthouse at La Coruña, Galicia, Spain.[142]

Fig. 6-65: The World's Oldest Working Lighthouse at La Coruña, Galicia, Spain.[143]

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.

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