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# The Earliest Harbour Installations on Aegean Foreshores

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This article aims to raise awareness of a few newly discovered prehistoric harbour facilities in Crete. In particular is an unusual, if not unique, slipway suggesting how large ships were hauled up on to the land at Middle Minoan II Kommos. Also, there are huge, successive structures (Buildings T and P) with long galleries that served as shipsheds inviting close scrutiny, as well as comparison with the later Classical shipsheds sheltering elite warships of the Greek city states. The three newly excavated Minoan buildings fit historically into the beginning of a now extended tradition of Classical shipsheds. The latter are compared here with their prehistoric counterparts and briefly discussed concerning origin, development, and aspects of cultural or historical significance.



*Key words:* harbour installations, Aegean foreshores, shipsheds, Kommos, Piraeus, Samos.

Excavation at Kommos, in Crete (Fig. 1) did not occur by chance. It came about after I had worked at Roman Kenchreai, the eastern port of Ancient Corinth, with Robert Scranton, and at the prehistoric Minoan site of Kato Zakros, Crete, with Nikolaos Platon. Where in Crete, an island where the local relative sea level has often risen by more than 1m, I then wondered, could one find a major ancient Minoan foreshore that could still be exposed on land, even if only partially preserved? Thanks to Sir Arthur Evans, who first pointed out the Kommos site (Evans, 1935: 88–91) and Ephor Stylianos Alexiou, who facilitated its expropriation, my wife Maria and I began to explore Kommos in 1976. One of the results was the discovery of the still partially preserved Minoan foreshore with significant remains of harbour facilities, which have already begun to help clarify otherwise unknown aspects of prehistoric Greek maritime activity. To honour our mentors, therefore, Robert Scranton, Nikolaos Platon, and Stylianos Alexiou, for their inspiration and wisdom, this short article is dedicated. In the meantime, our completed Kommos publication series is available, along with all field notes and reports, to promote further research (Shaw and Shaw, 2006; Kommos, nd).

## Bronze Age nautical structures in Crete

### *Slipway and Building AA at Kommos*

On the final day of excavation at Kommos in the summer of 1985, we discovered just below the top of the court in front of Building P (see below) an unusual slab-paved strip (Figs 2–4), about 20m long, that we cleaned as best we could with the little time that we had then. It ran east-west, beginning at the shore and obviously partly destroyed by the sea waves. Later, it was confidently published as a Minoan 'walkway' of the type often found set in the west courts of the Minoan palaces (Shaw and Shaw, 2006: 11, 323; cf. Shaw, 2015: 14–17). Later, fortunately, I realized after some thought, that actual walkways did not have regular channels at right angles to its length, and the pavement we found must, therefore, be something unusual, namely a slipway used for ships to be brought up from the sea, aided by shoring (Fig. 4)(Shaw, 2017, 228–244).[1]

The slipway dates quite early, to the Middle Minoan IIB period, and belongs to what has been dubbed 'Building AA', a huge rectangular platform supported on at least three sides by substantial retaining walls (indicated by the dashed rectangle Fig. 3). In the centre, on the north and south sides, are the North and South Stoas, which may have been set in at the time. The plan suggests that the great project was left incomplete, for few interior spaces are discernible. The cause of the abandonment was most likely the MM IB earthquake that so affected the island. But, as elsewhere in Crete, there would be renewal on a large scale not long after.

Concerning the slipway itself, no immediate parallels are available in Bronze Age Minoan contexts, as far as I know, but our publication (Shaw, 2017: 243), notes that similar slipways are used in modern and Classical boatyards; and can be seen within the Classical shipshed discovered at Kos (Blackman *et al.* 2013: 366, fig. B 10.4; Shaw, 2017: fig. 10.11). Figure 5 shows the slipway in plan, also restored further to the

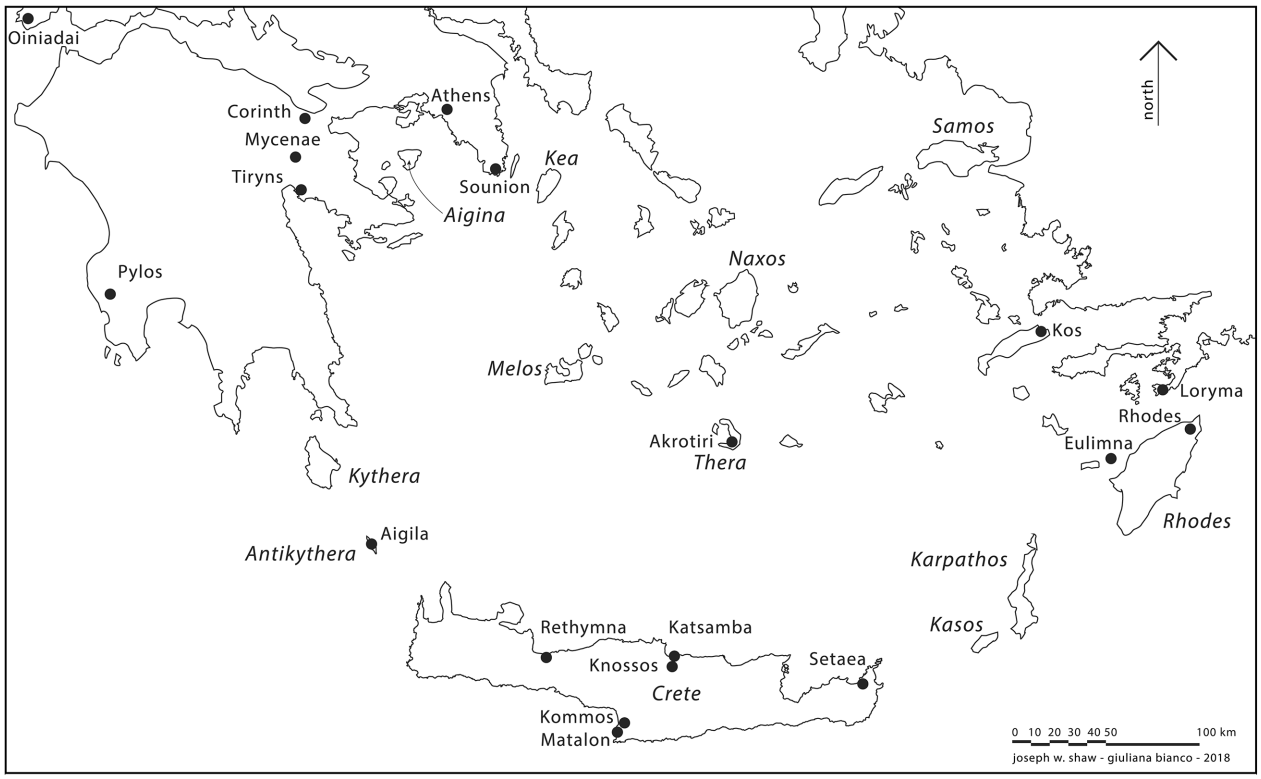


*Figure 1.* The southern Aegean and its islands, indicating many of the shipshed sites, some mentioned in the text. Others are known in Corfu, Cyprus, Cyrenaica, southern France, the northern Aegean, and Sicily (see Blackman and Rankov *et al*, 2013, maps 1–3).

east, at which point a ship could have been pivoted (note pivot point in the illustration) and moved over to the north. Engineer George Poulos has also suggested that five or more medium-sized ships could have been stored together during the winter, non-sailing months, all set on the huge MM platform, and he suggested a possible indication of a post-earthquake compromise made to carry out at least part of the builders' intention.

Giuliana Bianco, our excavation architect, recently pointed out that the slipway (Fig. 3) is parallel to that of a slab pavement found some metres to the east (Fig. 6) (for the general plan see Shaw and Shaw, 2006, Fold-out plan B, Part 1). The pavement rests on clay bedrock, so most likely represents the earliest construction belonging to the AA (MM II) period, when the slipway was also set in. The pavement, only partly exposed—the western, north-south edge, may be the side of the pavement, but it continues below later construction on the north, east, and south—consists of irregular ironstone slabs. Its most distinguishing feature is that it is crossed by a curious, evenly built channel ranging 0.17–0.30m wide, west to east, and 0.04–0.08m deep, which follows the slight east down-to-west slope toward the sea, and all would merge with the slipway on its way west. The eastern end of the slipway is at +2.80m, while the western end of the pavement is at +3.13m. The eastern end of the bottom of the channel is at +3.15m, while the western end is at +3.09m (Shaw and Shaw, 2006: fig. 1.88). Thus the pavement/channel combination belongs together chronologically and, most likely, functionally. No tell-tale artefacts, however, were found during cleaning.

*Figure 2.* The Kommos slipway, looking north-west (J.W. Shaw).

Like the slipway, the pavement/channel was in the open air and, probably, served as part of a platform serving ships in some way. But how? For instance, the channel (and the narrow, north-south one leading to

 

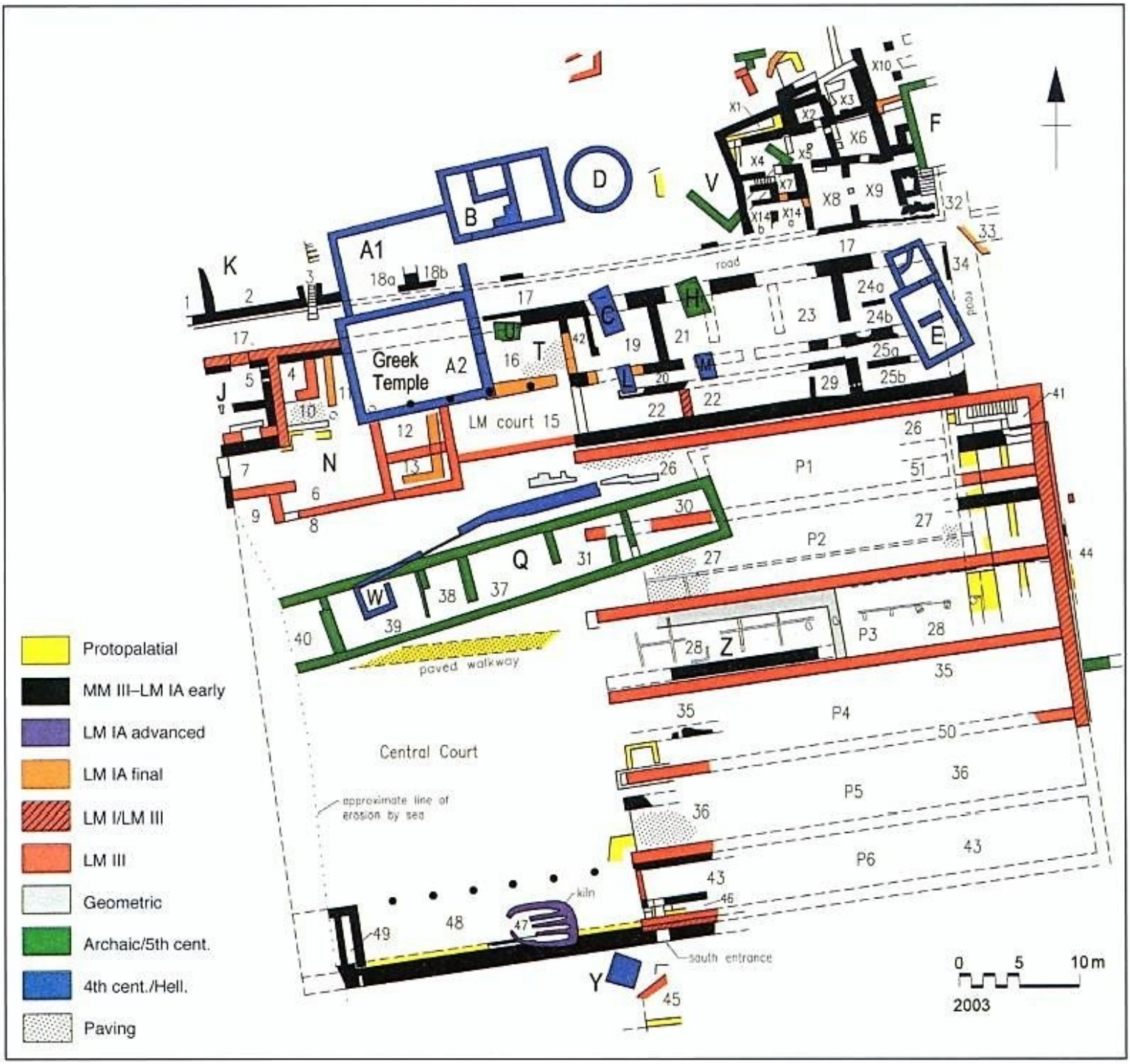


**Figure 2. Period plan of the Southern Area at Kommos, identified in Figure 1 as the Greek Sanctuary.**
G. Bianco. Courtesy J. W. Shaw

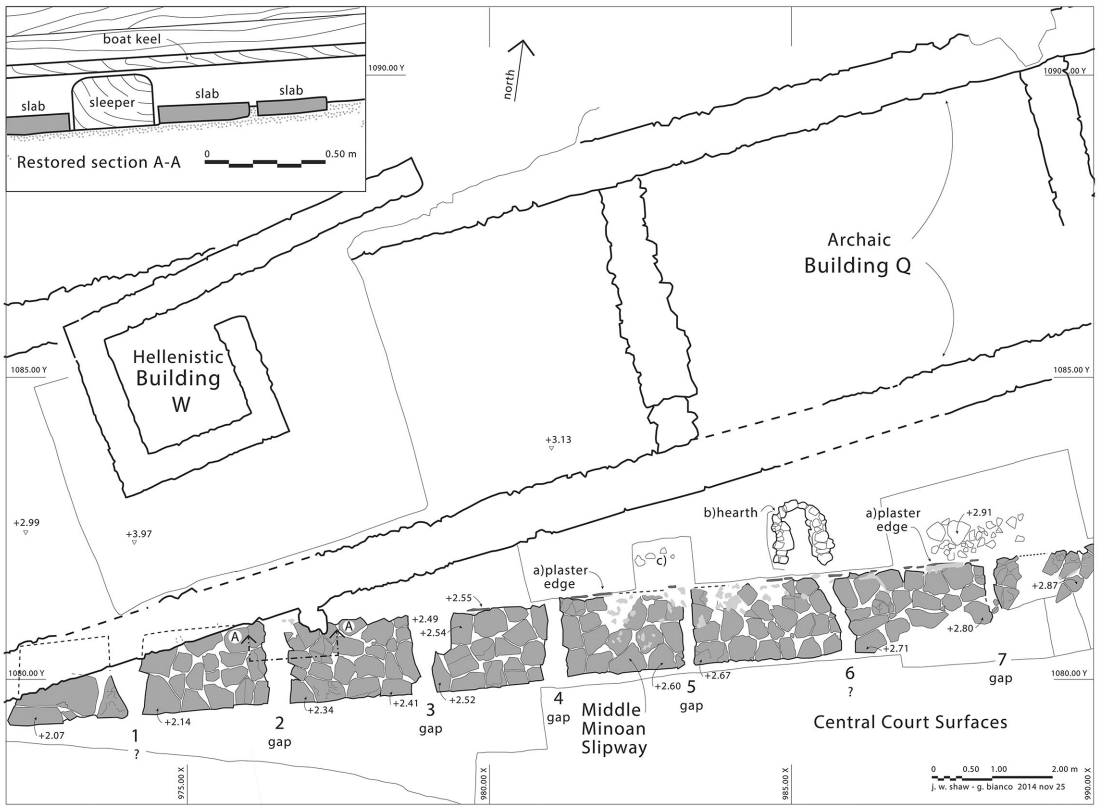


*Figure 3.* Plan of the Kommos slipway (below) with restored section A-A (upper left) (G. Bianco).

it) could have drained the paved platform, when ships were being cleaned. But if the channel were to drain liquid, one would expect the narrower part to be on the east, downhill, not the west. A second possibility is that, with such an evenly made channel, a ship's keel could be partly set into it, and could support the ship, along with the use of wooden side struts. But Çemal Pulak informs me that concerning the only known wooden keel of that approximate period, from the Uluburun wreck found off the coast in Turkey (Pulak, 1999a, 1999bb, and 2002), that the keel was 0.28m wide and would not fit into the channel. Moreover, the first planks attached to the keel would be damaged when the ship was pulled/slipped into position. A third, perhaps more possible solution, is that since the east-west channel appears so straight and evenly made, that a long wooden beam, or series of beams, was set into it, with the top of the beam projecting above the slab pavement. Thus, a boat, brought up from the sea along the slipway, oriented east-west, could be pivoted at any point on the projecting beam, which was greased, and then slid, north-south into storage position (Fig. 5, centre, right). More would be learned if the platform were excavated further east, below Building P's floor. At least the channel, and presumably the slab floor, extend at least 20m more to the east, where the former reappears just west of the north-south wall of Building AA (see Shaw and Shaw, 2006, fold-out plan B, Part 2, upper right in P2 and Fig. 6). There the channel appears to continue partly into Building AA's north-south wall. More likely, rather than functioning as a drain, as in the South Stoa of Building T (Shaw and Shaw, 2006: fig. 1.122, section k-k), the channel served as a socket for the eastern end of the projecting east-west beam suggested in our text. In the meantime, the platform might be understood, at the least, as a working surface of some kind within an open shipyard.

*Newly proposed MM IIB sequencing*

Consideration of the slipway on the west along with the presumably contemporary, extensive paved platform on the east requires a different sequencing for part of Building AA than what has been proposed in the past (Shaw and Shaw, 2006, 11; Shaw, 2017: 232, 241). It now seems reasonable, for instance, to suggest that the paved platform belongs to an important, completed part of AA. But how does one deal with the fact that the slipway was found buried below the 0.10–0.70m-thick MM IIB pebble packing of Building AA's court? What I suggest is that with time, use of the exposed slipway declined, and eventually ceased, and that masses of pebble packing were brought in from along the shore to create an attractive court. Ships

 

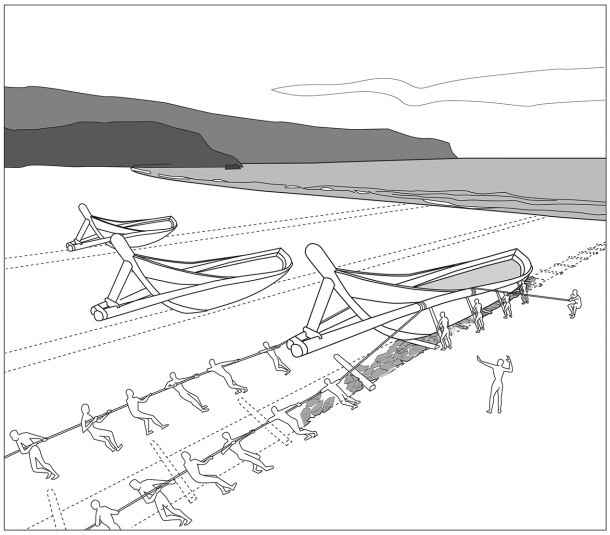

*Figure 4.* A ship being pulled up the Kommos slipway (drawing by the author and Giuliana Bianco). The form of the ship, especially its stern, is based partly on the oared ships shown in the 16th-century-BC Theran miniature frescos from Akrotiri (Doumas, 1992, plates 35–6), also from the model of those same ships in the Maritime Museum of Crete at Chania, Crete. The late-14th-century BC cargo ship wrecked at Uluburun was also informative; its keel was adapted in Figure 3 (inset) from Pulak (1999a, 2002), and Bass (1987, 694–696).

may still have been brought up from the sea by means of another, simpler technique, most likely wooden rollers and sleepers, which, if used without stone slabs, would disappear with time (for slipping and launching techniques in the Classical world, see Rankov, 2013b: 102–109). Supporting that suggestion is that no other slipways have been discovered in the Kommos harbour area, despite the fact that it continued to be used, at intervals, for hundreds of years in connection with later buildings T and P, after Building AA had been deserted at the end of MM IIB.

### *MM III Building T*

In MM III, probably not long after the slipway described serviced ships arriving at and leaving from Kommos, the AA area was redesigned and, this time, was extensively built upon. In the new plan, reproduced here for the first time (Fig. 7), the western edge of that building (Building T) has been restored simply, with a wall with a broad, closable central entrance and two attached structures, one at each end of the western wall, of which the northern one was most likely used to control access to port activities. The southern one (Fig. 7) most likely contained a staircase leading to a loggia above the South Stoa and possibly to a 'west wing' now destroyed by the sea (Shaw and Shaw, 2006: 56 and pl. 1.130). It was a massive structure of two storeys, no doubt with full views of the sea and any arriving or departing ships, as well as of the inner court and stoas. Evans would have dubbed it the 'Teloneion' or 'Custom House' (1921–1935, II (1): 89 and fig. 42). Also shown on Figure 7 are two rooms that potentially served as storage areas for ship equipment such as sails, masts, and rudders (Ta and Tj). With one entrance (Ta) blocked by the columns of the North Stoa, and the other (Tj) by both the South Stoa columns and the southern entranceway, neither could accommodate a ship. The proposed use of the rooms is paralleled in function by the large building, or *skeuotheke*, known to have stored naval equipment in the Zea Harbour at Piraeus (Rankov, 2013c: 479, note 347). The broad east-west road bordering T's massive façade on the north continued at least 20m further, where it united with the adjacent seashore.

Our initial hesitations concerning the role of this extraordinary building T, which did not exhibit the courage that we, and especially Maria Shaw, showed in identifying the use of the succeeding building (P) (Shaw, 1985), have dissipated. T can now be understood as completely devoted to servicing ships that were stored in the ten, broad, east-west galleries, most of them open on to the large court. Associations with 'palatial establishments', save those of scale or architectural technique, can now be dismissed. This change of interpretation has been brought about by a number of factors. A major one is the 'discovery' of the above-mentioned slipway (Figs 2–4), which serves historically to introduce shipping and its care to the Kommos site in a significant way. Also, at least two of our colleagues, Dario Puglisi (2001) and Gerhard Plath (2011) have, following up on our suggestions for LM III Building P, identified T as a centre for seafaring. Additionally, I am tending to view, for instance, the interesting floor arrangement in T's Gallery Tf (plaster floor with numerous separate compartments, see Shaw and Shaw 2006, 50–53, Pl. 1.94) as deriving less from maritime concerns than from activities carried out when the ships were at sea for some months. Finally, general acknowledgement of the overall identification of Bronze Age Greek shipsheds, reasonably withheld for a time, has now enabled us to expand our original, limited interpretation.

The result is that architecturally, T can be considered as a new and different conception upon its founding in early New Palatial Crete.[2] Perhaps, however, a similar building will someday be discovered near Katsamba, the harbour town of Knossos. Apparently, T suffered considerable damage in LM I, so its original function may not have been carried on for very long.

### *LM IIIB Buildings P and N, Kommos*

In LM IIIB need arose for rebuilding, and a large ship storage building (Fig. 8), with a 'Mycenaean' addition of horizontal wooden supports close to its wall base (Shaw, forthcoming), was constructed upon the ruins of the east wing of Building T. There were now six broad, open bays facing the earlier court of Building T. Their roughly even floor levels stepped down slightly

 

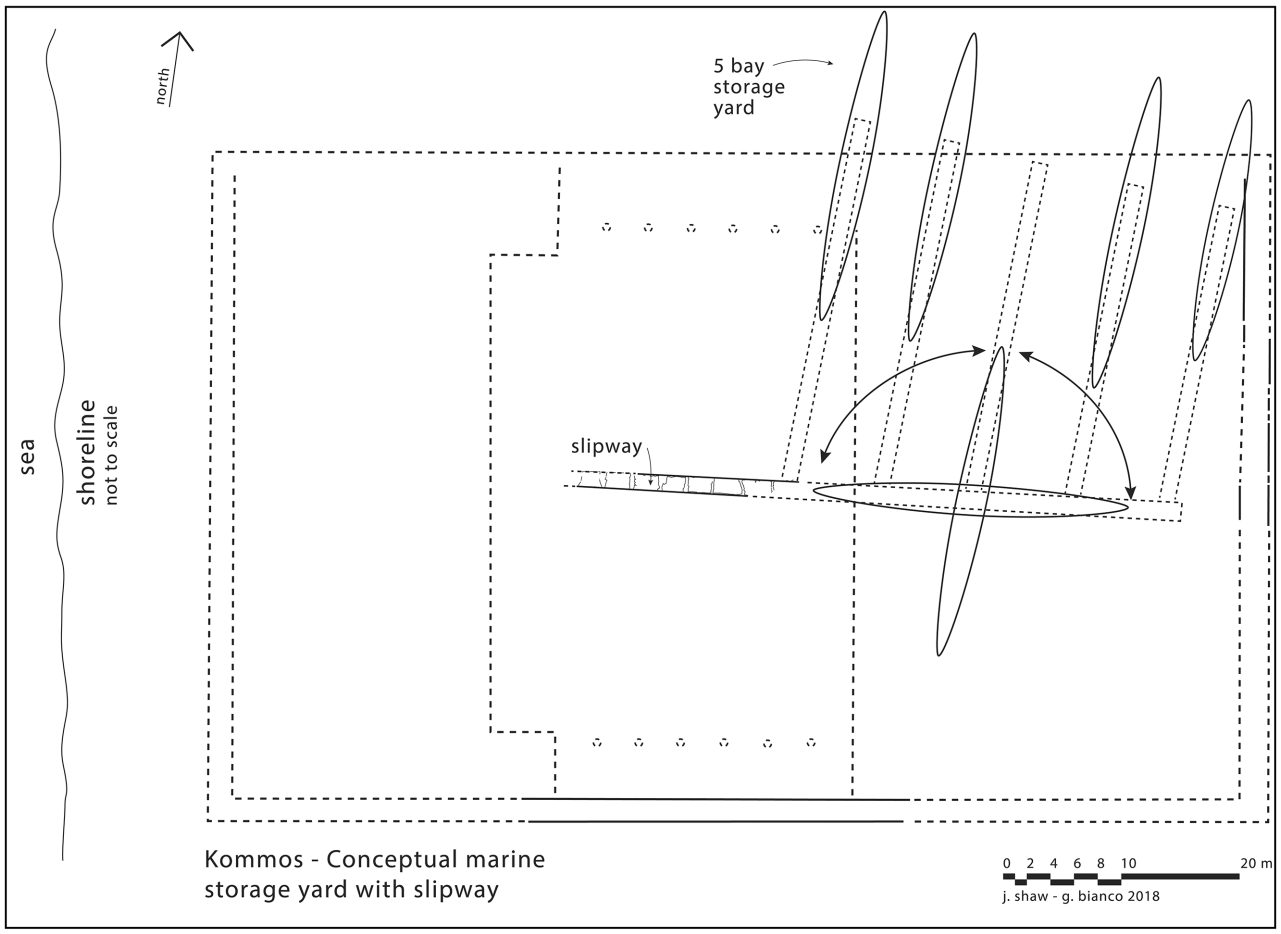


*Figure 5.* Schematically restored plan of Protopalatial Building AA (plan by author and G. Bianco).

from north to south. As calculated from the massive sections of collapsed wall found in the third gallery (Shaw and Shaw, 1993, 174), the flat roof was at least 4m high. Found below floor level near the eastern end of the same space, reused during construction, were two large, pierced limestone anchors for seagoing ships. A detailed geological study of the fossils in them shows that they had been quarried either in Cyprus or Western Anatolia, before being carried to Crete (Shaw, 1995). Transport amphoras found within the nearby galleries and contemporary strata appear to have been of the same type, of local western Mesara manufacture, as those being found recently at Mycenaean centres such as Tiryns and Ayios Vasileios in the Peloponnese. Also, plentiful red haematite recovered, some within the jars mentioned, is similar to that discovered in Classical shipsheds (for example at Sicilian Naxos) and in the shipsheds at Katsamba near Knossos (see below), together suggesting that it may have been used to protect the hulls of ships as a possible anti-fouling agent (Blackman, 2013a: 13; Lentini *et al.*, 2013: 404).

North-west of P, the impressive ashlar building once belonging to Building T (Fig. 7), where administration of its naval activities most likely took place, was renovated. It probably served a similar, adjunct administrative purpose. The pairing of similar buildings in both Buildings T and N/P is remarkable, with the former appearing to be the more professional result.

### *LM I / III shipshed at Katsamba*

By fortunate coincidence, a Greek Archaeological Service excavation at an apartment building site in Katsamba, an area of northern Heraklion near the seashore, has produced a confirmative, contemporary parallel (Fig. 9) to both Kommos buildings T and P. By all accounts Katsamba, perhaps along with neighbouring Amnisos, are the *epineia* or harbour towns of Knossos. In Figure 9 are shown, in effect, two buildings, one of at least three and the other, four, galleries, divided by a passage-way. The galleries ranged 25–45m long (Vasilakis, 2007, 2010, see also Blackman, 2011, 2013a:12; Shaw, 2017: 236). Like those at Kommos, they were about 6m wide, and were set on the foreshore, back from the sea some 150m, at right angles to the open beach. They were destroyed in LM IIIA2, and probably built in LM I. There may have been a protecting court in front of them, as we have suggested

 

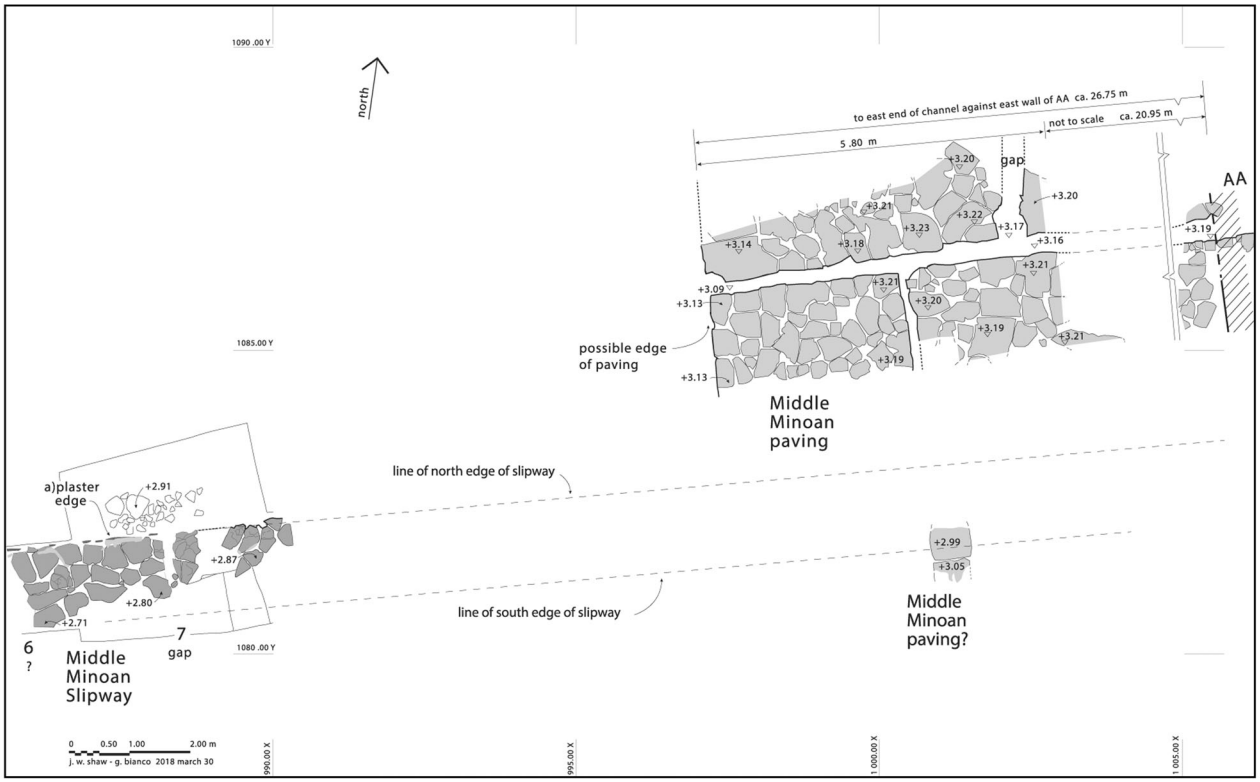


*Figure 6.* Partially exposed slab pavement area (right, centre) near end of slipway (left, centre) belonging to Kommos MM II shipyard. The possible role of the east-west channel is discussed in the text. Using the grid markings, Figures 3 and 6 can be joined after copying.

here for Buildings T and P at Kommos. Unfortunately, excavation was terminated at Katsamba, and any finds, including the pottery discovered, remain to be studied.

## Classical shipsheds in Aegean harbours

Of the ancient nautical facilities surveyed here, from the Aegean Bronze Age through to the Greco-Roman period, this article concentrates on the period before 500 BC, when shipsheds were introduced to house the formidable fighting ships of the various competing city state navies. Below, however, is an introduction to the general characteristics of the shipsheds so that they can be compared with what little we know of those from the Bronze Age. The latter have just begun to be discovered, beginning with those identified in Crete and connected, at least at this point, with the inland population centres near the coasts at the centre of the island. I am optimistic that much more will be learned about sites on Crete, but also those still undiscovered on the Greek mainland and elsewhere on the Aegean Islands. In the meantime, for the Classical shipsheds, one can rely on David Blackman and Boris Rankov's *Shipsheds of the Ancient Mediterranean,* which, along with the studies there by Kalliopi Baika, Henrik Gerding, and Jari Pakkanen, survey all relevant aspects of shipshed history, architecture, positioning, and defence. There is also there the invaluable catalogue, prefaced by Judith McKenzie, of some 24 major Mediterranean sites where the oared military vessels took shelter, usually in naturally protected harbours where stormy weather would have little effect.

### *A brief summary*

The earliest Greek shipsheds, which we first learn of from historian Herodotus in connection with Samos (Herodotus, III: 45), probably developed in the north-eastern Aegean in the second half of the 6th century BC. Perhaps the earliest such structures were developed by towns set next to a broad beach where ships could land, and then be towed on to the foreshore where they would be immune from winter waves. In any case, a preferable alternate positioning was discovered by 500 BC in which safer harbourage was made available in naturally formed harbours, often circular and with headlands, where wave damage could be reduced or even eliminated. Moreover, when shipsheds were built next to calm waters, the bows of the military ships set within them could even be positioned on or just above the water, with the ship being pulled up on a sloping ramp forming the shipshed floor. The most dramatic and well-recorded example of this change is when the

 

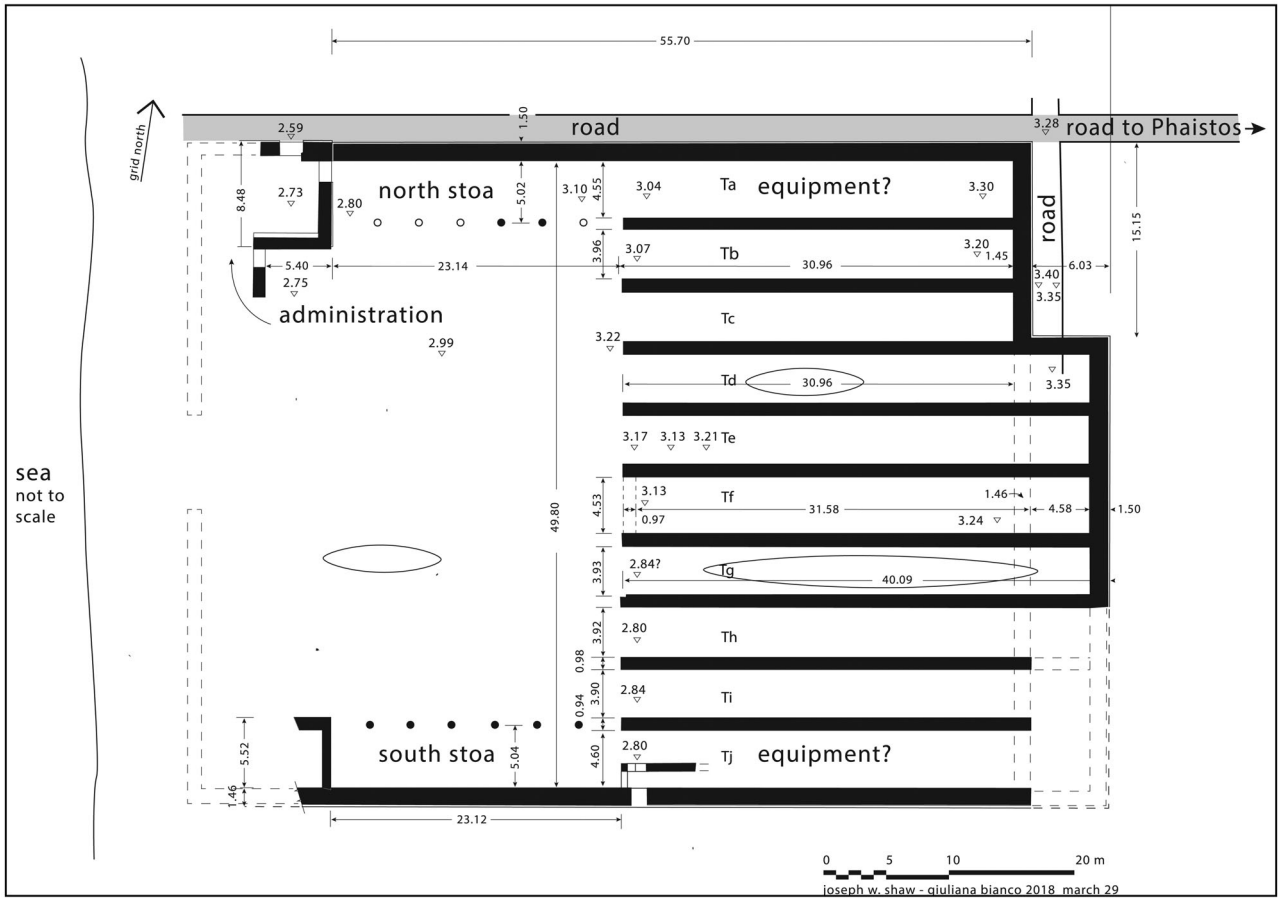


*Figure 7.* New plan of Kommos, MM III Building T, a 'Naval Centre.'

Athenians moved their harbour from the open beach at Phaleron to the safety of the natural and fortifiable harbours at Piraeus.

Again, concerning shipshed placement, for strategic reasons, such as at Matala in Crete (Gerding, 2013c), a ship might be set into a large, presumably unroofed, cutting made into a rocky peninsula; or two might be set side by side into a similar, but roofed, cutting (as at Sounion). More often, and in the case of a more prosperous city state such as Athens, shipsheds would be set together as a compact group, one next to the other, and parallel (Fig. 10), the example of ten sheds being among some 196 epigraphically attested and best preserved shipsheds in the harbour of Zea, built when Athens was at the acme of its power (Rankov 2013c: 479; see also Lovén, 2001, who discussed the dating of the earlier slipway structures in the Athenian harbour, and Lovén and Scholdemose, 2011). The three Athenian harbours, together (Fig. 11), are said to have accommodated some 372 sheds (Rankov, 2013c: 478, 479, 483). A workable departure from this side-by-side arrangement occurred at Aigina (Fig. 12) where a large, four-sided, walled enclosure was built for the military harbour, with three (land) sides lined with shipsheds and the fourth, on the sea side, with the entrance for ships protected by towers on either side, at the end of moles. A further departure in arrangement could occur in the instance of the *kothon*, where an inland harbour could be created to protect ships from the weather as well as from enemies. At Carthage, for instance, a magnificent round inland harbour, reached from the sea via a channel, accommodated some 170 sheds, facing in and set next to each other. In the centre of the harbour, on the so-called 'Admiral's Island', reached by a causeway, were two rows of some 30 shipsheds, arranged end to end (Gerding, 2013b: 309, 311).

Unlike their Bronze Age counterparts, built on flat land, moving the earliest Greek sheds to the water's edge forced the builders, then constructing on a slope, to create a sloping platform, or slipway, up which the ships would be dragged by many men pulling on ropes (as in Fig. 4). The result was that such slipways would sometimes have long cuttings to accommodate ships' keels, or sandy hollows to accommodate the curve of the hulls, and greased wooden sleepers, set at intervals, as at Kos (Baika, 2013b: 366, fig. B10.4), or in the Middle Minoan shipway at Kommos (Fig. 3), which would support the ship. The gradient of such slopes ranged from that of Zea (5.9°)(Rankov, 2013c: 482) to precipitous Sounion (15.83°)(Baika, 2013c:

 

*Figure 8.* LM III B Buildings P (shipsheds) and N looking south-east (drawing by C. Dietrich, 2003, reproduced in J.W. Shaw and M.C. Shaw, 2006. *Kommos V. The monumental Minoan Buildings*, Princeton, NJ: Princeton University Press: frontispiece). An asterisk indicates the location of the earlier slipway. A postulated court yard wall has been added by G. Bianco.

532), versus 4.67° for the unroofed prehistoric slipway (Fig. 3) at Kommos (Shaw, 2017: 238). Concerning the lengths of the slipways, and thus the length of the sheds themselves, they varied somewhat, but with the majority around 40m long (Rankov, 2013a: 91).

Groups of shipsheds, with multiple parallel slipways, were supported in different ways, for instance by lines of columns, stepping down slope to the sea, as at Zea in Piraeus (Fig. 10), or by columns and end-piers, as at Oiniadai (Gerding, 2013d: 414–415), or ceiling-high walls, sometimes pierced by doors affording passage from one bay into another. Almost all were roofed, with their tiled roofs either sloping continuously or stepping down toward the sea. An average shipshed width was 5–6m (Rankov, pers. com., 2018).

## Shipshed types compared

It is difficult to compare the mass of data from so many Classical sites with the little data from prehistoric Crete, but one can venture a short comparison, with the expectation that as time and chance determine, more will become available.

Concerning positioning, for instance, the three shipsheds from Kommos (T, P) and Katsamba (Knossos) are similar to the extent that they were situated 100–150m from the ancient shoreline, and were on the foreshore, at about +4m above relative sea level, now about 2m less because of local change (Shaw, 2017: 249, table 10.2). Also, they were set roughly at right angles to the shore. Classical shipsheds, on the other hand, were set in a line with their ends actually built down into the shallow water, with the ships' bows pointing toward the sea. Also, while both building types were roofed, many roofs of the Bronze Age were very flat and thick, made up of layers of earth and clay, with a slightly sloping upper surface to allow for drainage off to the side (Shaw, 2009: 153–155). Roof tiles were unknown in Minoan Crete at the time (Shaw, 2009: 135). Shipsheds of the later Iron Age were sloped and tiled (Gerding, 2013a: 175–181).

It is probable that the two buildings at Kommos, for the sake of security, had a walled court seaward of the shipsheds, which may also have been true of the Knossian (Katsamba) building, but could not be investigated in the adjacent property.

### *Shipsheds, ships, and their dimensions*

Concerning relative dimensions of ship and shipsheds, I consulted Aleydis Van de Moortel, whom I quote:

> The interior widths of the galleries of Building T that opened up to the interior courtyard varied between 3.89m and 3.97m, with the exception of one of the central galleries that was 4.53m wide (Shaw, 2006: 958, pl. 1.8). The widths of the majority of galleries would have allowed for the storage of ships that were about 3.5m wide, whereas the widest gallery could have held a ship with an overall beam of ca. 4.10m. Our lack of Minoan shipwrecks with preserved hull remains and of models of Minoan warships or merchantmen makes it impossible for us to be certain about the hull proportions of these Minoan ship types, but comparisons with better known later Greek and Roman

 

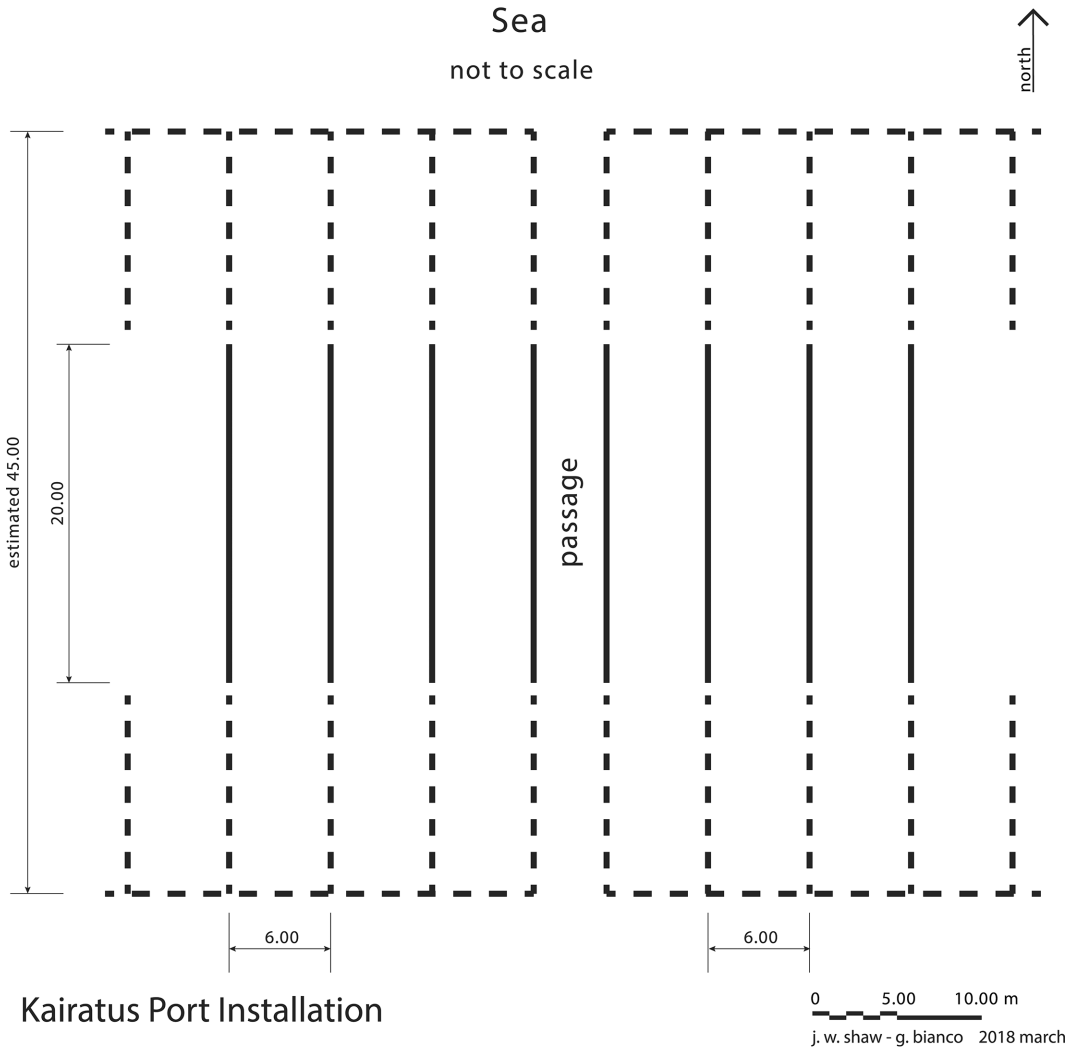


*Figure 9.* Plan of Knossian port installation of shipsheds at Katsamba near the mouth of the Kairatos River (plan by the author and G. Bianco).

ships are helpful. If the galleries of Building T had held long, slender warships, their length is likely to have been 6.5 to 10 times their width, as has been proposed by various authors for later Greek triremes (Rankov 2012; Casson 1995, 82). Thus these Minoan warships could have been 23m to 35m long, and would have fit into the galleries. The higher range of their hypothetical lengths corresponds to that of the longest ship depicted on the LH I Miniature Ship fresco from Akrotiri, which had 23 paddlers and would have been about 33m long (Van de Moortel, forthcoming).

If the galleries had been used to shelter seagoing merchantmen, these would have been much shorter. Depictions on Minoan seals make it clear that the Bronze Age Cretans had specialized bulky cargo ships propelled by sails from at least the Middle Minoan IA Late/IB phase onwards (Van de Moortel, 2017: 265–267, figs 2A–2B). Comparisons with later Greek and Roman ships allow us to hypothesize their length-to-beam proportions as between 1:3 and 1:4 (Casson, 1995: 189–190). Thus, merchant ships with a beam of 3.5m would have been 10.5–14m long, whereas those with a beam of 4.10m would have been 12.3–16.4m long. The lowest hypothetical length is only slightly longer than the estimated length of 9m of the LH IIIC merchant ship that sank off Point Iria, in the Argolid (Vichos, 1999). The longest hypothesized length of merchant ships that would have fitted into the galleries of Building T is comparable to the estimated 15m length of the Uluburun shipwreck that sank off the south coast of Anatolia shortly before 1300 BCE (Pulak, 1999). Finally, depictions on Protopalatial and Neopalatial Minoan seals of ships with sail and oars make it conceivable that the Minoans had merchant galleys that could be sailed as well as oared. To judge from later Greek and Roman merchant galleys, such

 

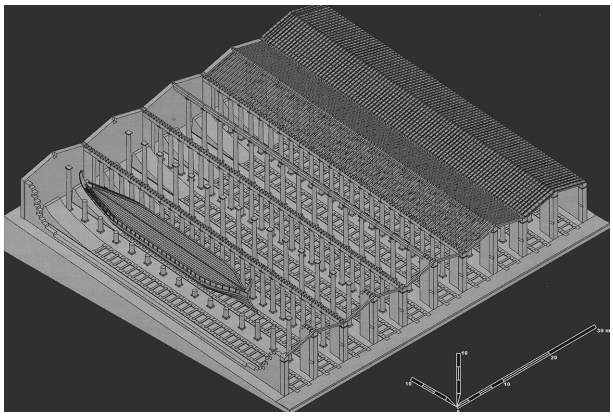

*Figure 10.* Isometric projection of the three-dimensional reconstruction of a ten Phase 3 shipshed complex at Zea harbour, Piraeus (Blackman and Rankov *et al.,* 2013: fig. A5.3 by J. Pakkanen).

ships may have had hull proportions between 5.5–6.5:1 (Casson, 1995: 157–158). Those with a width of 3.5m would have been *c.*19–23m long, and those with a width of 4.1m would have been *c.*22.5–26.5m long; both size classes would have fit comfortably in the galleries of Building T.[3]

The interior widths of the galleries of Building P at an average of 5.06m could have housed ships that were 4.60m wide. With a length of 37.37m, one of those galleries could have accommodated warships up to 36.8m long, with length-to-beam hull proportions of 8.1; sailing merchant ships of *c.*14–18.5m in length; and merchant galleys of *c.*25–30m in length.

## Discussion

### *Influence on Mycenaean installations?*

One still unresolved issue is whether the use of shipsheds during the Bronze Age on Crete spread north to the Aegean Islands and hence to the Greek mainland. Actually, this seems quite likely, rather the reverse of what would happen later, at the very end of the Greek 6th century BC, when the custom of shipsheds was to spread from the north-eastern Aegean south, and thence to many parts of the Mediterranean (see Blackman *et al.,* 2013: plans 1–3). For instance, it seems clear that during the early Neopalatial period on Thera that the densely settled town of Akrotiri, so influenced in its architectural customs by Crete (Palyvou, 2005; Shaw, 2015), was a major sea-power, at least commercially, with its harbour(s) established along its southern periphery, most likely south-east of the town itself. Along that edge of the town, now partly excavated from the deep pumice of the volcanic eruption that buried it, the 'land' (that is the bedrock) leads down, it is thought, to the ancient harbour area, which now might even be under water because of geological perturbations occurring during the great volcanic eruption of Thera (J. Shaw and M. Luton, 2000). At this point, our only slight suggestion of how that lower beached area may have appeared is possibly seen in a seascape wall painting found in the West House (Fig. 13). There, a probably large, single-storeyed building with a flat roof has two of its at least four possible 'openings' toward the sea (thus dark on the interior), rather like what a few of the Cretan shipsheds must have looked like at either Kommos or Katsamba when viewed from the sea (Figs 7, 8)(M. Shaw, 1985: 22–23, pl. IIIb, which has been accepted by Christos Doumas, Director of the Akrotiri Excavations; Shaw and Shaw, 2006: 852; Blackman, 2011: 8). Armed soldiers parade in front, to the right, of the building; women and others walk upon its roof, or sit, or step down from its roof on to the sloping ground leading to the beach area.

North of Thera, along the mainland shore, aside from a few unconfirmed rumours, Bronze Age harbour works are minimal, but the amount of imported Minoan artefacts and pottery remains impressive. All, of course, arrived there by boat. Also, clear Minoan influence visible in the LH/LM III development of the architecture at Pylos, provides another indication on the mainland of Minoan cultural influence (J. Shaw, forthcoming). Beyond Messenia the shore of the Bay of Argos remains a prime area to be searched aggressively. An interesting tie with Crete, and with LM IIIB Building P at Kommos is emerging now in the form of Transport Stirrup Vases that have been found at Tiryns in the Argolid and at Ayios Vasileos in Laconia. The pottery was definitely made in the western Mesara (Haskell *et al.,* 2001; Kardamaki *et al.*, 2016). Given the ceramic evidence that both Kommos and Katsamba buildings were in use at the same time, and a clearly implied import/export arrangement between Crete and the mainland, one may propose the likelihood of similarity in harbour facilities, such as shipsheds, being common to both areas. It is, I believe, just a matter of time before those are discovered and identified on the mainland of Greece.

### *Bronze Age and Iron Age traditions?*

The recent appearance of probable Bronze Age shipsheds on Crete may prompt one to suggest their form inspired that custom during later centuries, the earliest examples of which known to the later Greeks being those of the mid or late 7th century BC at Samos, noted by Herodotus (Herodotus III: 45). That is certainly not my intention. Rather, I am inclined to believe that the very nature of ships brought about similar (but different) adaptations by naval architects, depending where the shipsheds were to be set. The main agent, of course, was the sea; powerful, consistent, unpredictable, pitiless, as even now. As far as the incentive to build the sheds is concerned, it was usually a combination of greed, ambition, a city's pride, the choice of the rulers to build the ships, usually, the triremes used to defend themselves against aggressors, or for control of sea or land that did not 'belong' to

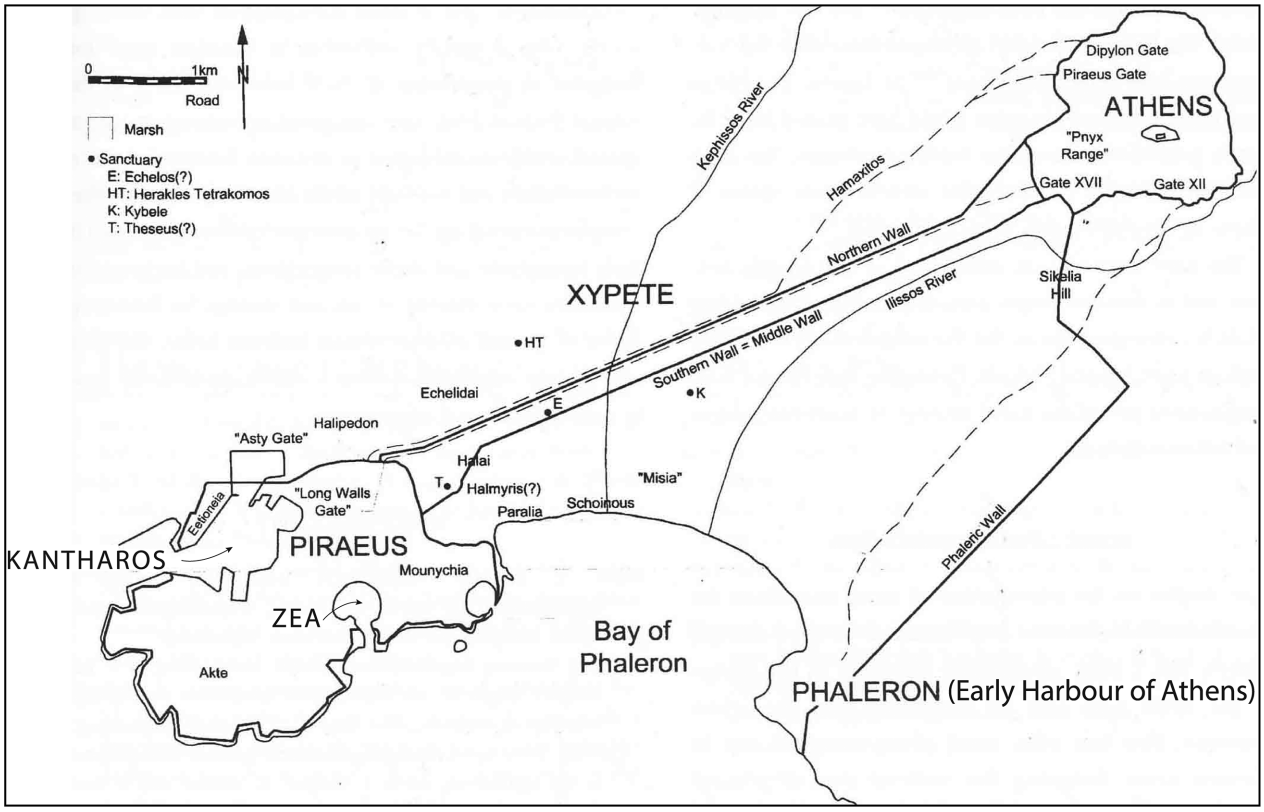


*Figure 11.* Piraeus-Athens plan. The Long Walls linking Athens to its *epineion* and the Phaleric Wall (after Conwell, 2008: 233, fig. 3, in Blackman and Rankov, 2013: 205, fig. A10.12).

them. The sheds' roles were primarily connected with war, although commerce was apparently a role if not the major role of Building P at Kommos, which was found with the remains of many transport amphoras that were part of the group being traded with the mainland. Also, in Classical Greece there was a tradition of organizing harbouring in such a way that the warships were housed in shipsheds in their own distinct area and other, commercial ships were set in commercial harbours, without sheds, as for instance at the south or commercial harbour at Aigina, adjacent to and south of the military harbour (Fig. 12).

### *7th- and 5th-century Greek harbours*

'Shore' and 'Foreshore' are constant themes here when we discuss shipsheds, with the foreshore being understood here as the ground between the water's edge, behind the highest winter wave reach, and the land cultivated or built upon. Relevant to our research here and the history of the use of the shoreline for maritime activity in the Aegean, is the case of Phaleron in Attica (Fig. 11).

Like with many early Aegean shorelines, the early harbour of the Athenians, Phaleron, before changes made in the early 5th century BC was their most convenient access to the sea (Herodotus, 6:116), a trip of some 4km south over level land. The actual position of ancient Phaleron remains unsure: Stella Chrysoulaki, archaeologist in charge of the excavation of a huge cemetery in that area, within the Niarchos property, not far from the shore, writes, 'I have found a piece of stable land and pinpointed it on a map but I don't know if it is the ancient harbor' (Chrysoulaki, pers. comm.). There in Phaleron the beach was open, perhaps almost treeless, and exposed to the full fury of winter waves. Any shipyards and storage sheds for nautical gear, therefore, would have to be placed beyond the reach of the winter waves, or they would at least be damaged. All major naval activity, whether military or commercial, as well as private, had been centred there for some time. In the earliest days there, as Hesiod (*c.*750–650 BC) had advised for his countrymen during the period of fall in Boeotia:

> But if the desire for stormy seagoing seizes upon you:
> why, when the Pleiades, running to escape from Orion's grim bulk,
> duck themselves under the misty face of the water,
> at that time the blasts of the wind are blowing from every direction,
> then is no time to keep your ships on the wine-blue water.
> Think of working your land instead, as I keep telling you.
> Haul your ship up on the dry land, and make an enclosure of stones about it,
> to keep out of the force of the winds that blow wet,

 

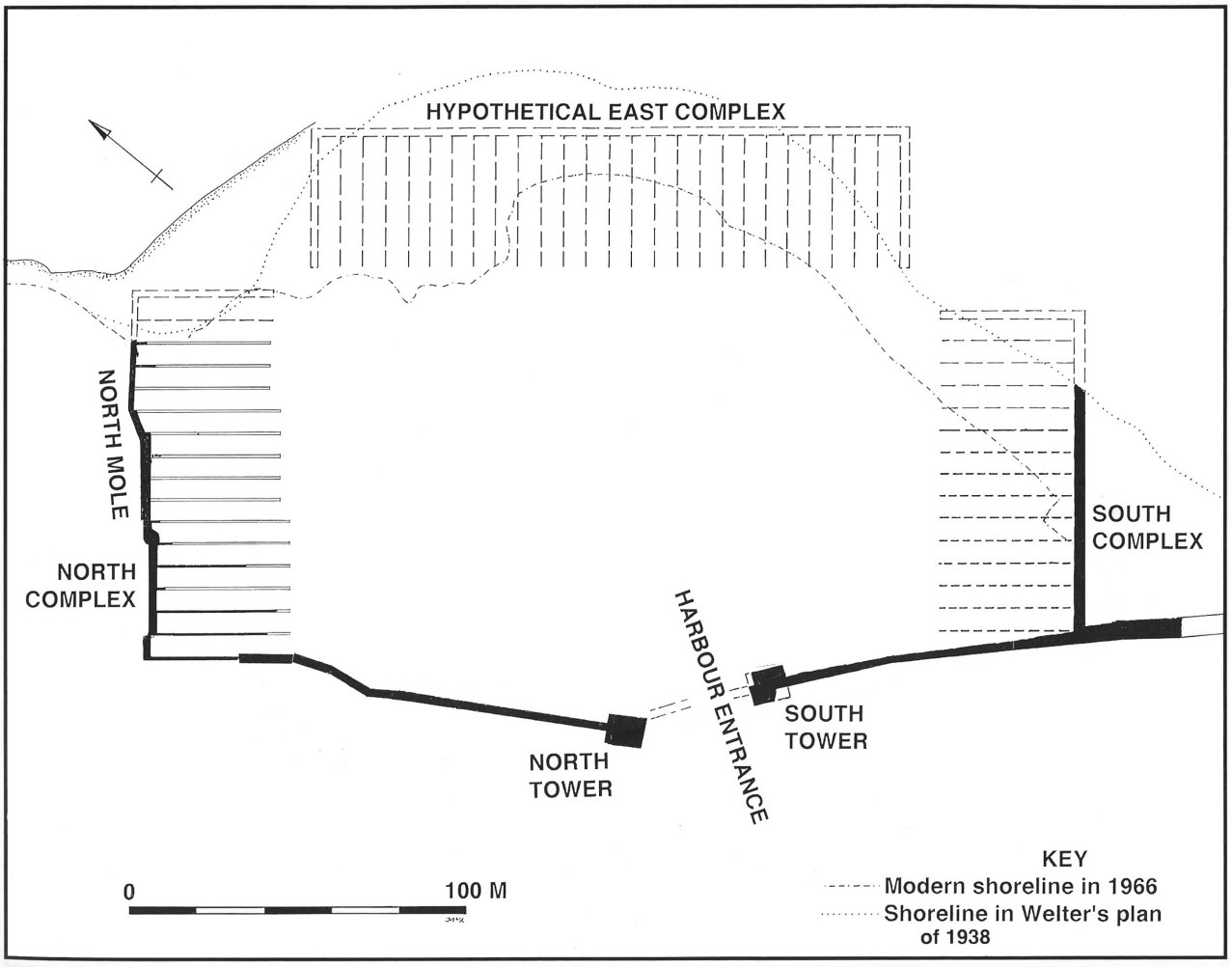


*Figure 12.* Aigina. Reconstructed plan of military harbour, showing how a maximum of 56 shipsheds could be accommodated with an interaxial width of 6.6m. (J. McKenzie, sketch plan, based on Blackman and Rankov *et al.* 2013, figs B3 2b).

> and pull the plug, so the rains of Zeus will not rot the timbers.
> Take all the tackle that's rigged to the ship, and lay it up indoors,
> neatly stowing the wings of the ship that goes over the water;
> hang the well-wrought steering-oar over the smoke of the fireplace,
> and yourself wait for the time to come when a voyage is in season.
> (Hesiod, *The Works and Days*, 618–630, trans. Lattimore, 1959)

Somewhat later at Phaleron, larger ships than the one described by Hesiod would also have been hauled up on the shore after cargo had been disembarked. Others no doubt lay at anchor offshore, whenever weather allowed (Rankov, 2013b: 103–123). Later, however, events forced a change of custom. For instance, during the period 490–479 BC the Persians' invading fleets caused chaos until they were successfully beaten off by the combined Greek forces. Also, in *c.*445 BC, the navy of the Aeginitans, from the nearby island of Aigina, attacked Athenian coastal villages as well as Phaleron and caused damage (Herodotus V: 81). Clearly, a defensive change was needed, much of the impetus to be supplied by Athenian leader Themistocles who, as early as 493 BC, urged the Athenians to transfer their centre of naval operations to a more defensible area (Bury, 1959: 263–264), namely to the large peninsular projection of Piraeus (Fig. 11), which contained three separate harbours, Munychia, Zea, and Kantharos, which all could be defended by walls built around and within them as well as around the peninsula (Thucydides I: 93. Rankov, 2013c: 420–488). At the same time parallel walls (the 'Long Walls') were built linking Athens with Piraeus in order to guarantee safety even when the city might be under siege. Also, a single long fortification wall linking Athens with Phaleron, was built to protect the large area between Phaleron and the Long Walls.

*Figure 13.* Detail of miniature fresco from the West House at Akrotiri, Thera, depicting what may be a shipshed with people on its roof and walking along the beach in front of it (from Doumas, 1992: fig. 28).

A result of the great defensive works was that the Athenians gained fame and power. While the proximity of Phaleron harbour was abandoned, and the Athens-Piraeus trip was lengthened by at least 4km, the military stability provided by the new harbour works more than made up for that inconvenience. Also, a major change for the triremes for the Athenian navy came about due to their positioning in the sheds, namely that with their bows facing the centre of the individual harbours and with the bow actually set just above the water, the trireme could be launched immediately to deal with an enemy approaching from the seaward side, as described earlier. We do not know from the ancient historians whether there were sheds for triremes at 7th-century Phaleron, a consideration also applicable to Samos (see below) at the time. Perhaps their foundations will be discovered sometime.

At Samos (Fig. 14), where tyrant Polycrates ruled *c.*538–522 BC, he made possible great works such as the aqueduct of Eupalinos of Megara, and the great pier projecting out into the natural harbour on the east (Nos 1 and 18 in Fig. 14). Also, however, Herodotus reports that there were shipsheds (*neosoikoi*) at Samos, and that after a group of Polycrates' rivals were given boats and were going into exile, but then turned back, Polycrates had their women and children confined as hostages within the shipsheds, which were to be burned, along with their inhabitants.

> Polykrates took the children and wives of the townsmen who were subject to him and shut them up in the shipsheds, with intent to burn them and the shipsheds too if their men should desert to the returned Samians. (Herodotus III: 45).[4]

If we assume that Herodotus is correct, then a search begins for the Samos site. First, Angeliki Simossi, archaeologist, made a study of underwater shore areas bordering Pythagorion, the ancient town, especially of the partially natural harbour (17–19 in our Fig. 14), where she recommended that further, deeper sections be made below later accumulation in order to find Polycrates' famous pier. She also noted:

> '… the northern harbour wall and the small southern jetty which encircles the basin of the harbour and which appear to have their foundations set on the ancient harbour works. Thus, excavation is necessary to establish the structural history.' (Simossi, 1991: 284)

Although the team searched, it did not find what is so obvious along the harbour shores at Piraeus (Fig. 11), or Aigina (Fig. 12): buildings (shipsheds) with parallel walls, about 6m apart, open on the sea side, so characteristic of the developed Greek shipshed form. But, then, where are the Samian ones? Blackman, perhaps in an afterthought, comments that they 'now probably lie under land' (Blackman, 2013b: 18).

I inquired of Blackman what he meant exactly by 'under land', and he replied that 'since Simossi looked along the south mole, and found nothing', then the shipsheds must lie elsewhere (Blackman, pers. comm. 4 February 2018). Perhaps, then, a fairly large-size stretch of shoreline, at least 300m long (for 50 shipsheds

 

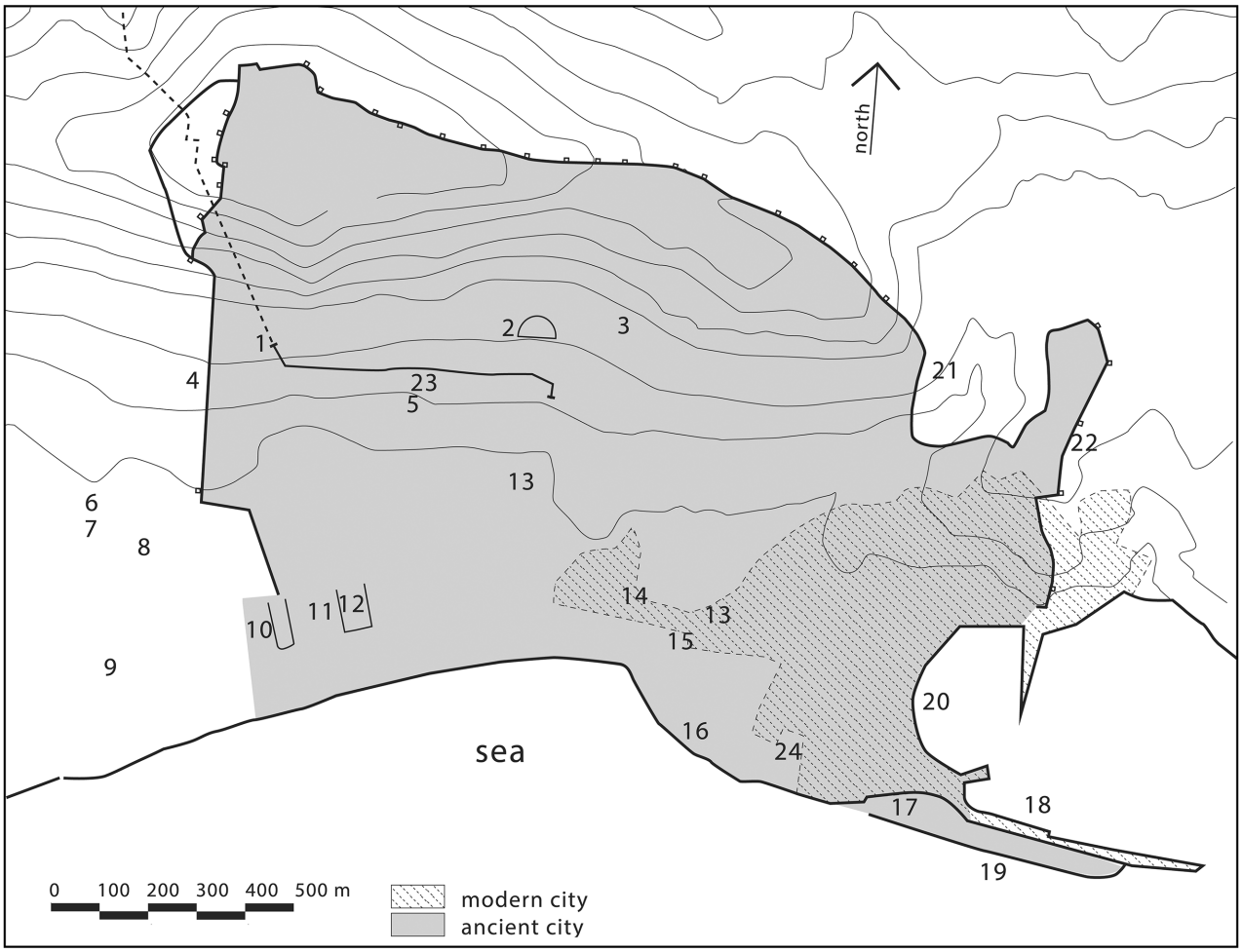


*Figure 14.* Topographical plan of the ancient city of Samos, Pythagorion. Area 19 shows the submerged ancient stone structure (breakwater) 1. Eupalinos tunnel; 2. Theatre; 3. Monastery of Spiliani: 4. Ancient wall; 5. Roman aqueduct: 6. Western necropolis; 7. Late Christian cemetery; 8. Artemission; 9. Archaic Harbour; 10. Late Christian Basilica; 11. Stadium; 12. Baths; 13. ancient city; 14. Ancient agora; 15. Temple of Venus; 16. Castle; 17. harbour wall; 18. Polycrates pier; 19. Hellenistic breakwater; 20. Harbour; 21. North-east Necropolis; 22. Kastelli; 23. and 24. Hellenistic villas (version by G. Bianco, partly after drawing by K. Tagonidou in Simossi, 1991: fig. 3).

each about 6m wide) has been buried by erosion from the land? Actually, I believe that Blackman was correct in his estimate, but that the situation is potentially different. First, if we consider what is known archaeologically of Classical shipsheds, the normal shipshed, often built together in groups (as in Figs 10 and 11), were set within sheltered harbour areas, and not those exposed to winter winds, certainly not on open beaches. On that basis, the only visible candidate in the Pythagorian area for shipsheds in Figure 14 is within small harbour 20. On the other hand, if we recall what happened at Athens, above, the Archaic harbour of Phaleron, later abandoned for those at Piraeus, could not have supported shipsheds of the type that were set into the water, for they would have been decimated by the winter waves. If there were shipsheds at Phaleron, they were more likely of a type that was built on land. Actually, from the point of view of their positioning, they could have very similar to the prehistoric shipsheds in Crete shown in our Figures 7 and 8. The presence of shipsheds at Phaleron would also have served as an incentive for the Athenians to plan a massive building of shipsheds in all three of the natural harbours at Piraeus.

Again, concerning Samos, only recently did I learn that an archaeologist working at Samos has made important contributions in his proposal that the early Archaic harbour of Samos lies buried, masked by accumulation, in Area 9 of Figure 14. With thanks to Konstantinos Tsakos, we illustrate his proposal in Figure 15, on the basis of his publications (Tsakos, 1980, 2006). Simossi, who published her article on the 1988 Samos exploration in 1991, was probably unaware of Tsakos' work, although she also proposed that the Archaic Harbour was in Area 9 (1991: fig. 3). Specifically, Tsakos proposes that:

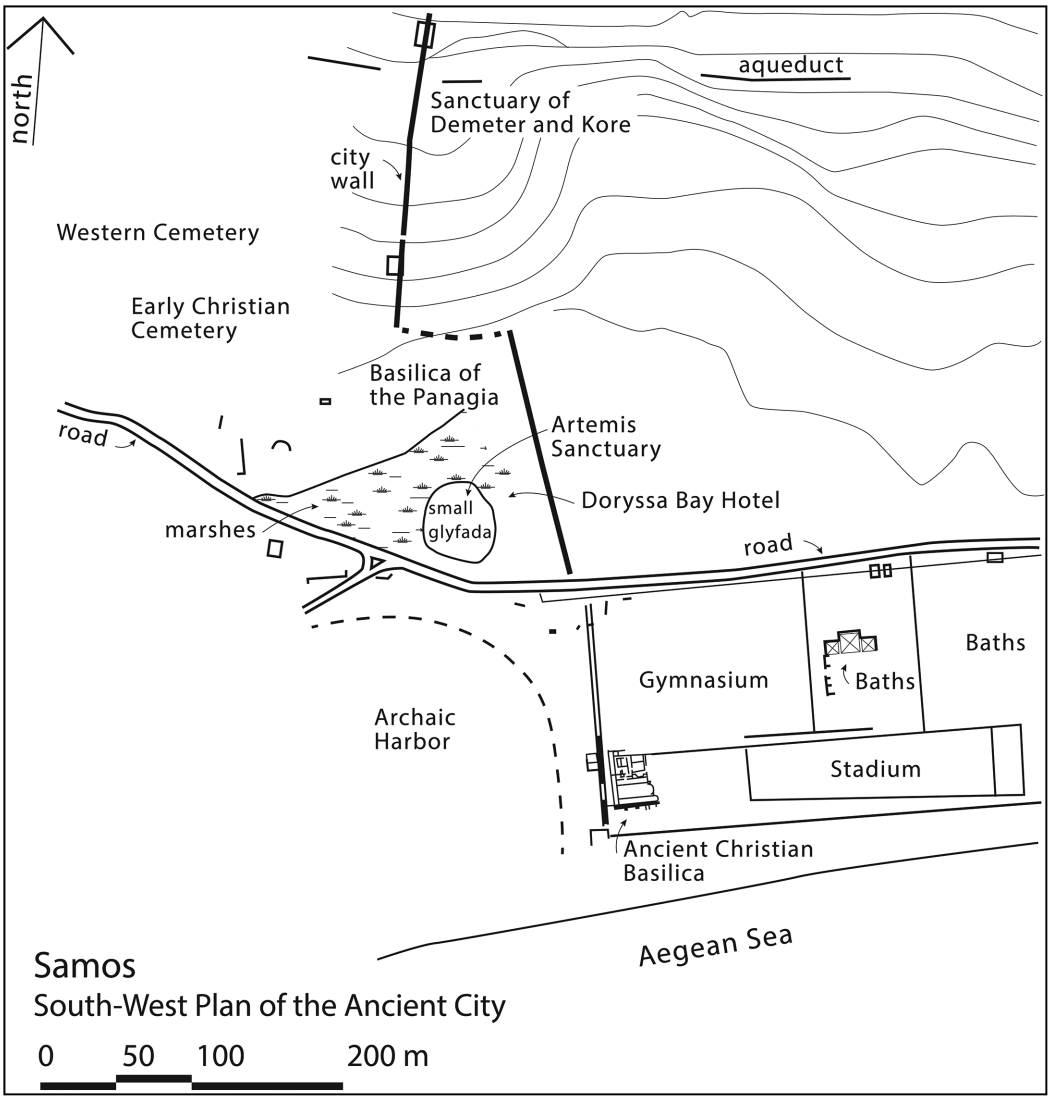


*Figure 15.* Detail of south-western area of the ancient Samos town, indicating (lower left) the area of the Archaic harbour, as proposed by Konstantinos Tsakos, (after Tsakos, 2006, fig. 1, redrawn by G. Bianco).

> The changes in the area today, with the sunken area, which begins immediately west and south of the 'Doryssa Bay' Hotel, and extends to the Pythagorion-Heraion road leading to the Heraion Sanctuary, which surely is the line of the ancient Sacred Road leading to the Heraion, make possible the hypothesis that in Antiquity a reasonably deep natural harbor occupied most of today's foreshore. (Tsakos, 1980, 314–317)

To clarify, to the left of the area in the centre of Figure 15, and marked 'small glyphada', is a salty lagoon ('*glyphada*'), about 50m in diameter. South of that, across a modern road, is the second, much larger depressed area, at least 100m in diameter, itself quite possibly remains of a lagoon, and west of the ancient Christian Basilica marked on the plan.

Tsakos advances his case with a combination of archaeological and historical inference. North-west of the small *glyfada*, for instance, he actually excavated west of the Basilica of the Panagia, a church set on the sloping hillside. There he found thousands of 6th-century-BC votives, small figurines, as well as fragmentary fine black-figure pottery with incised dedications to Artemis suggesting, reasonably, that a sanctuary of that goddess was not far away. He adds that later inspection revealed the ruins of the sanctuary in the 'Small Glyfada' (Tsakos pers. com. 2018). In that connection, he brings up the incident (Herodotus, III: 48) in which some 100 youths from Corcyra (modern Corfu), captured by Periander of Corinth (*c.*627–587 BC), were sent to become eunuchs for Alyattes, King of Lydia at Sardis. Their Corinthian ship stopped at Samos on the way to Sardis. The Samians there encouraged the youths to take sanctuary at the Temple of Artemis, which they did, and became suppliants

 

there. A festival was then founded by the Samians on their behalf. Eventually, after the Corinthians had tired of waiting and left, the boys were returned to their families in Corcyra.

Concerning harbours, Tsakos argues that since the famed mole built by Polycrates (ruled *c.*538–522 BC) was not yet built, that the Corinthian ship carrying the boys would have landed at the proposed Archaic harbour outlined in Figure 15. The harbour would have been quite close to the Sanctuary of Artemis from which came the offerings reported by Tsakos. 'The natural bay of Glyfada would have given protection to the ship,' he comments (Tsakos, 1980: 317).

Concerning the appearance of that early harbour, as we have seen, Herodotus reports that Polycrates locked up many hostages in the Samian shipsheds, but if the sheds were of the usual type we know from the later Aegean, with their lower ends open to the sea, the captives might simply have walked out. To satisfy the apparent contradiction, one can propose that shipsheds might have been arranged on a foreshore, behind the lagoons, with a closable court in front of them, (as at prehistoric Kommos, in Figs 7 and 8). One might hope for survey and excavation in the area in question, but much of the area is now overbuilt with hotels and tourist facilities, so our chances for learning directly are reduced. Probably by the time of Polycrates the 'new' shipshed type was introduced, with its sea end resting in the water. The earliest of those known presently is at the site of Abdera, not far from Thasos, dated to the end of the 6th/beginning of the 5th century BC (Baika, 2013b, 270–276), built not long after Polycrates ruled. It might suggest that an originally island type of shipshed, of Ionic inspiration, was replaced at other neighbouring seaside settlements there by a new type that ran down into the water, and that the latter was of the type that the Athenians would adopt for their new harbours in the Piraeus Peninsula during the 5th century BC. It also brings up the possibility that either at Samos or some other Ionian island site, both types could be discovered some day, clear evidence for the change in a traditional custom.

## Conclusion

During the Classical Greek period, shipsheds and accessory harbour structures are found alongside shores of harbour basins sheltered from the ravages of winter waves. From what we can tell of earlier, prehistoric, and also perhaps early Archaic practice, ships and early shipsheds were sheltered some distance back of the shoreline, on the foreshore, behind open beaches such as those at Kommos and Katsamba in Crete. Thus, in the future, archaeologists, surveyors and geologists searching for prehistoric harbour structures should first determine where the foreshore was at the time. That is particularly true for shorelines near populated inland areas such as the Plain of Argos in the Peloponnesus.

For instance, where was the harbour for Tiryns, with its known international connections during the Bronze Age? In his study of the Argolid Plain, geologist Eberhard Zangger concluded that the present shoreline of the Gulf of Argos, now about 2km from Tiryns, was actually much closer in the Mycenaean period, about 1km from the citadel and town. Also, that while there are 4m-deep deposits of alluvium north-east of the town, south of it the LM III level lies only a metre or so below the present surface, which might be explored by geophysical analysis (Zangger 1993, 80–81, fig. 43). When approached about this, Joseph Maran, Director of the Tiryns project, agreed with Zangger's estimate, but basic problems exist, such as locating the actual foreshore. Also, in order to begin, one must get reticent landowners to agree to exploration carried out on their land, which could lead to expropriation. Perhaps, like in the case of the Katsamba discovery of shipsheds in Heraklion (Fig. 9), a landowner will want to build there in the future: excavation and discovery could well result. In any case, and perhaps by chance occurrence, we will learn much as excavation and exploration continue. We will certainly be introduced further to both Bronze and Early Iron Age practice, leading to the better-known acme of Greek naval supremacy at sea.

## Acknowledgements

I am particularly indebted to David Blackman and his colleagues, whose book (2013) contains what one can say about Classical Greek shipsheds. He and Boris Rankov have made suggestions to improve my text. Also, Engineer George Poulos has provided his own perspectives, concerning the Kommos slipway. Giuliana Bianco has helped furnish some of the illustrations, as well as pointing out the eastward, paved extension of the slipway structure. I am also indebted to Joseph Maran, Director of the Tiryns excavation, and to Hermann Kienast, both of the German Institute of Archaeology in Athens. Dimitri Nakassis helped with advice about the Argolid Plain. Çemal Pulak advised on details of ship construction. Aleydis Van de Moortel's observations and suggestions were welcomed. Konstantinos Tsakos, an expert on Samos, advised on the history of his island, Nancy Bookides aided my research.

## Notes

1. Concerning Figure 4, where a ship is shown being dragged up from the sea, a reviewer has commented, 'I don't think that ships were ever hauled up bows pointing inland. The priority was fast launching and operation.' The reality is more complex, with defensibility being the governing factor. Thus, a warship moored off a beach would have its stern facing the beach, the ship ready for action (Rankov, 2013b: 103). Also, when approaching a shipshed, a ship would move toward it stern first, ready

 

to be dragged in and then to be hauled up the inclined slipway that forms the floor of the shed (Rankov, 2013: 107). Under peaceful conditions on an open beach without sheds, however, the ship would usually be run up on the beach, prow first, then could be dragged further up by means of rollers or, as in our Fig. 4, up a slipway constructed in the open air (Rankov, 2013b: 106, fig. A7.1).

2. Of some historical significance, but perhaps otherwise unconnected, during the 2nd millennium BC Egyptian ships were stored in sheds. The earliest is mentioned in a papyrus in the British Museum (BM 10056, from the time of Tuthmosis III) and concerns Peru-nefer in Lower Egypt where a large seagoing military vessel was stored. A later example (Anastasi, IV 8.4, still New Kingdom) concerns a covered shipshed for a sacred vessel at Resynu. See Glanville, 1933: 37, and Caminos, 1954: 159. We thank Professor Ronald J. Leprohon of the University of Toronto for bringing this to our attention.
3. Concerning whether more than one ship would fit into the same gallery, Van de Moortel comments that it would have raised the humidity inside the shipshed, also it would not be practical if the ships belonged to different people. In reference to Classical shipsheds, Blackman thinks that such an arrangement is implausible (Blackman and Rankin *et al.*, 2013: 459).
4. The word 'arsenal' in the Loeb translation has been changed as the Greek, *νεώσοικοι*, I am assured by David Blackman, is 'shipsheds'.

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