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Building Sebastos: the Cyprus connection

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Introduction

Sometime before 22 BC, masterbuilders and architects from Rome arrived in King Herod's kingdom (Hohlfelder, 1985: 81; Holum & Hohlfelder, 1988: 71; Oleson, 1988: 153; Hohlfelder, 1996: 80). They had been dispatched by Augustus or by his heir apparent, Marcus Agrippa, to assist the King of the Jews in constructing a grand new Graeco–Roman city on the ruins of an earlier Hellenistic settlement known as Strato's Tower. Their task was formidable, given the erratic nature of the king; his still tenuous client relationship with the emperor, the geographical hardships of the site selected for the new maritime capital, and the urgency of their commission. Perhaps their most daunting task was the requirement to build an all-weather, artificial harbour from an exposed sandy coastline bereft of any complimentary natural features (Fig. 1). Arguably in the project was the most demanding marine engineering effort (until that time) in the classical world. It challenged the limits of existing technology and required novel solutions to problems never before encountered.

The story of the successes of these nameless builders in completing their difficult commission in a surprisingly short period of time (*c.* 22–15 BC) and in creating an engineering wonder that in many respects presages modern technology is being uncovered by marine archaeologists working beneath Caesarea's sea. The underwater features and the artefacts found associated with them reveal new heights of human ingenuity. Only a brief recapitulation is necessary here since field and preliminary reports on past and ongoing work are readily available (bibliographies in Raban *et al.*, 1989; Oleson *et al.*, 1994; Raban & Holum, 1996).

Sebastos: the harbour of Caesarea on the sea

King Herod had selected a site for his new international emporium along a section of coast in what is now the State of Israel. This new territory had recently been ceded to him by Augustus in 30 BC after the emperor had reconfirmed the Jewish king as his client ruler in Judaea following the battle of Actium in 31 BC (Josephus *BJ*, 387 CK).[1] As a gesture of loyalty to his new patron and of appreciation for the imperial vote of confidence, Herod decided to build a grand Graeco–Roman city from the sandy littoral and to honour his Roman patron by naming it Caesarea. This careful selection of appellation clearly demonstrated the king's awareness that his power and the ultimate longevity of his reign rested not in his own hands but in distant Rome. While the use of this toponym would become immediately popular in the east, Herod's decision to employ it for his city was novel and therefore even more beneficial to his regal ambitions (Roller, 1998: 89).

Obviously, Herod hoped to gain more than simple gratitude by this gesture (Holum & Hohlfelder, 1988: 73). A new

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Figure 1. Submerged ruins of Sebastos looking south-east. The entrance channel faces north. (Photograph courtesy Bill Curtsinger, National Geographic Society).

emporium in the eastern Mediterranean world of Rome also held out the promise of considerable commercial gain. Second, a new urban centre that looked west for its inspiration would demonstrate to the king's gentile subjects that he was not insensitive to their heritage and interests. The rebuilding of the Second Temple, a contemporaneous project in Jerusalem, was in part intended to manifest his concern for the traditions of his Jewish subjects and to win their support for his regime. Casesarea, on the other hand, would demonstrate a broader regal vision for his subjects whose cultural links transcended Judaism and emanated from Graeco–Roman traditions. The establishment of another international maritime emporium in the eastern Mediterranean as an alternative to Alexandria might well have provided economic opportunities for Herod. Also, an all-weather harbour that could be available to units of the Roman fleet might resound to the king's favour.[2] Certainly when Caesarea's construction began, Augustus and Marcus Agrippa had not made final arrangements for the disposition of Rome's navy.[3]

Herod also planned to build a fleet for his own purposes and for supporting the policies of Rome when called upon to do so. It needed a permanent station, and Caesarea provided that. Why and when the king decided on this unexpected venture are unknown, but by 14 BC his fledging navy sailed from Caesarea to the Black Sea to join Marcus Agrippa and a Roman fleet already engaged in military and diplomatic operations in that region (Josephus *JA* 16, 16–21). This opportunity to assist directly the heir-apparent to the imperial throne and at the same time enhance his own international standing was so well-suited to his own ambitions that one may wonder if somehow the king himself had orchestrated its unfolding.[4]

Finally, like any Hellenistic king, and that was certainly one of Herod's *personae*, he wished to be remembered by posterity for his building programmes (Josephus, *AJ* 15, 330). The pinnacle of the quest for immortality in stone was the creation of a city or cities, a royal standard created by Alexander the Great centuries before. Herod appears not to have forgotten that example. His building programme, both in his own kingdom and beyond his own borders, was impressive by the standards of any age (Roller, 1998). According to Josephus, he desired 'to leave behind to posterity still greater monuments of his reign' (*AJ* 15, 330). To that end he was successful.

Caesarea entered the world of the eastern Mediterranean in an atypical and glorious fashion. At its dedication *c.* 10 or 9 BC, it had in place or in a planning phase the public and private buildings and amenities usually associated with a major Roman city. Its architectural centrepiece, however, was its man-made harbour built out into the open sea from a shore devoid of any natural geographic features normally associated with ancient anchorages. No sheltering bay, offshore islands, or protective headland guarded the shoreline location Herod had selected for his port city. The site's appeal was not geographical, but rather political. What better place for a new city built consciously and ostentatiously to honour the king's distant patron in Rome than in territory just awarded him by the emperor? The engineering nightmares posed by his political decision were secondary considerations at best.

Building Sebastos, a sobriquet selected for Caesarea's maritime installations that also bolstered Herod's political objectives, demanded an unprecedented leap forward in the technology of harbour construction. It would be the first completely man-made harbour ever constructed and was visualised on a scale of grandeur to enhance the king's status in the eyes of his imperial patron and of the Mediterranean world at large. Practicality was hardly a regal imperative in executing this project. Finding individuals who could achieve the results envisioned by the king required looking beyond his kingdom. Judaea had no masterbuilders familiar with the unique challenges of maritime construction in the open sea. As a result of Marcus Agrippa's recent activities in Italy—creating a fleet and the supporting infrastructure to deal with Pompey and then Antony and Cleopatra—Rome at least had a nascent tradition of building in or near the sea (Reddé, 1986: 164–177, 186–197; Oleson, 1988: 149; Gianfrotta, 1996). No one, however, had ever attempted anything like Sebastos. It was *sui generis*. There seems to be little doubt that Herod appealed to Augustus, or more probably Agrippa, for technical assistance for his proposed harbour and that his request was honoured.[5]

Site problems and ingenious solutions

Sand distinguishes the seabed off the site of Caesarea. This type of ocean floor is inherently unstable and prone to shifting under any structure of great weight. The placement of two massive man-made breakwaters, the two enclosing arms that formed the protected basin of the major anchorage, posed a major challenge. Rubble breakwaters had been constructed before, but Herod wanted to go beyond the mere installation of simple moles. His plan was actually to extend the city out into the sea by building a series of warehouses and other support structures upon the breakwaters themselves. Such a building programme dramatically increased their total weight and thus their vulnerability to slumping into the sea. The challenge to the masterbuilders was to counteract or minimize the impact of less than ideal conditions below the sea so they could execute the king's desires.

Their solution to this problem was ingenious, and to the best of our knowledge to date, unique. First, they placed a foundation course or apron of rubble, cobbles and crushed stone that was wider than the planned superincumbent structures. Their intention was to reduce undercutting of the breakwaters by waves and current by the implanting of this design feature. Eventually, of course, both enclosing arms sank beneath the sea where they remain today (Fig. 1). However, evidence suggests that in some form of repair they survived functionally intact until at least the late 6th century AD (Hohlfelder, 1997, 1998, but *cf.* Raban & Holum, 1996). Their longevity confirms the success of this technological innovation.

Heavy, winter storm seas rolling in from the south-west inspired the construction of a secondary or subsidiary mole running parallel to the South Breakwater to provide a first line of defence against wave attack and spray washing over the seawall that stood on the South Breakwater. It was built just to reach the ocean surface seaward of the main structure and in a discontinuous pattern, that is with gaps in its line of construction. Its function was to receive the brunt of heavy seas, reduce spray over the seawall onto the warehouses, and to permit an easy reflux through the openings in its course.

Another experiment may have been attempted to address the perennial problem of all harbours—siltation. A least one channel (and perhaps more) may have been cut through the breakwater to allow water from the open sea to flow into the enclosed basin (Hohlfelder *et al.*, 1983: 137; Raban *et al.*, 1989). The thinking behind this feature was to enhance or induce circulation of water in the enclosed basin and thus prevent or retard the inevitable accumulation of silt. The inspiration for this design element may have been Phoenician. Perhaps the Roman master-builders saw a similar system in operation in the older harbours of Tyre and Sidon to the north of Caesarea (Beebe, 1983: 196–97). They may have visited harbour installations in the region to learn what their local predecessors had done to address the unique problems posed by the eastern Mediterranean littoral. However, unlike the other innovations there is some question about the efficacy of the sluice channels at Sebastos (Hohlfelder, 1998).

During the winter months storms rolled over the unfinished sections of the breakwater. The sand burden carried along in the waves was deposited in any temporary pocket formed by the construction in progress. When the builders could again work in the sea in the spring, they no doubt noticed this accumulation and began to wonder how this natural process that had produced it might be used to their advantage. In places on the North Breakwater, and perhaps on the inner face of the southern one as well, at points where no heavy structure would ultimately stand, they deliberately created hollows in the core of the mole itself. They arranged blocks of *kurkar*, the local calcareous sandstone widely used for construction in the region of Caesarea, or concrete (infra) on the seabed so that the faces of four blocks touched. The rectangular compartment thus formed was set to fill with sand during the following winter. The pockets already had a floor to prevent the sand from flowing out, namely the apron of rubble on the seabed already in place.

Next spring, when construction could begin again in the sea, these spaces were examined carefully. If nature had done its work, the level of sea-deposited sand was adequate to bring the level in the pocket near the surface. If not, more material could be dumped in to achieve the requisite height. The sand was then packed and capped with a layer of rubble. The in-filled hollow would sit among and be protected by the blocks of concrete or *kurkar* already placed on the sea floor as a component of a

larger structure. Pavers were added to the top of this diverse surface to provide a quay for walking or light commercial activity. The ingenuous scheme of using the sea to facilitate the construction of the breakwater disappeared from both view and memory and remained unknown prior to the underwater excavations conducted by the Caesarea Ancient Harbour Excavation Project (CAHEP) in the early 1980s. To comment on Josephus's description of the building of Sebastos: he noted in praise of Herod's success in building such a magnificent harbour in the face of many obstacles that the king had 'conquered nature' (*BJ* 1, 410); had he known about this remarkable engineering technique or cared to credit Herod's builders, he might have said that they had also 'used nature' to facilitate the construction of what would become a paradigm for future imperial harbours.

But the most important engineering advance was the widespread use of *pozzolana*, a hydraulic concrete that could be poured liquid into a marine environment to cure below the water with a hardness that equalled or exceeded a 'dry pour' on land. It was the discovery of huge concrete blocks, the largest uncovered to date was about 15·0 × 11·5 × 2·4 m, that first suggested the presence of Roman masterbuilders at Sebastos (Oleson, 1985: 172, 1988: 153). It is very unlikely that any local craftsmen would have had the necessary experience with a building material that had only hitherto been employed on a limited scale in Italy to undertake a commission of the complexity of Sebastos where its use was fundamental. While Roman builders had employed *pozzolana* before in marine environments, they had never attempted implementation on such a scale. To place massive concrete blocks at stress points where *kurkar* would not have withstood the ravages of the sea, a new delivery system, one not mentioned by Vitruvius in *De Architectura* (5, 12, 2–6) had to be invented. The builders of Sebastos constructed various types of wooden forms on shore to hold the concrete (Fig. 2), moved them into position (Fig. 3), sank them, and then filled them by tipping baskets of liquid concrete into the sea (Fig. 4). The Mediterranean world had seen nothing like that before (Oleson, 1985, 1988: 150–155; Brandon, 1996, 1997).

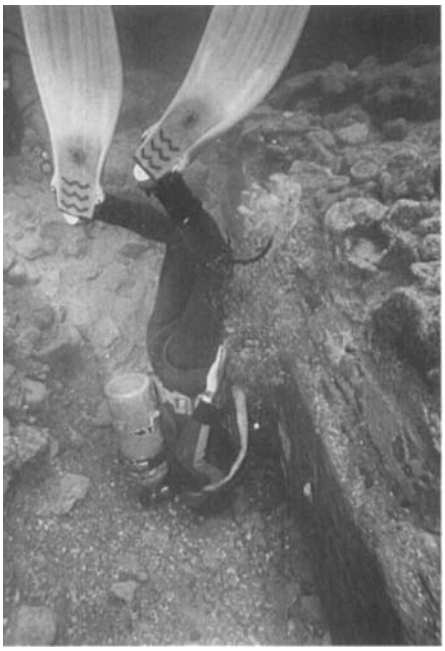

Figure 2. A section of one of the wooden barges at end of North Breakwater. Mortise joints are visible, as is the concrete fill. (Photograph: author).

Analysis of the concrete by Caesarea excavators has shown that the key ingredient—tuff either as sand or conglomerate—had been imported from the Bay of Naples itself (Gianfrotta, 1996: 75; Oleson & Branton, 1992). It is possible that, in the course of construction of the harbour installations and related shoreline structures, hundreds of tons of this material were shipped into King Herod's kingdom, perhaps as ballast in the freighters that handled grain shipments from Alexandria to Italy. These massive ships, with a cargo capacity of perhaps

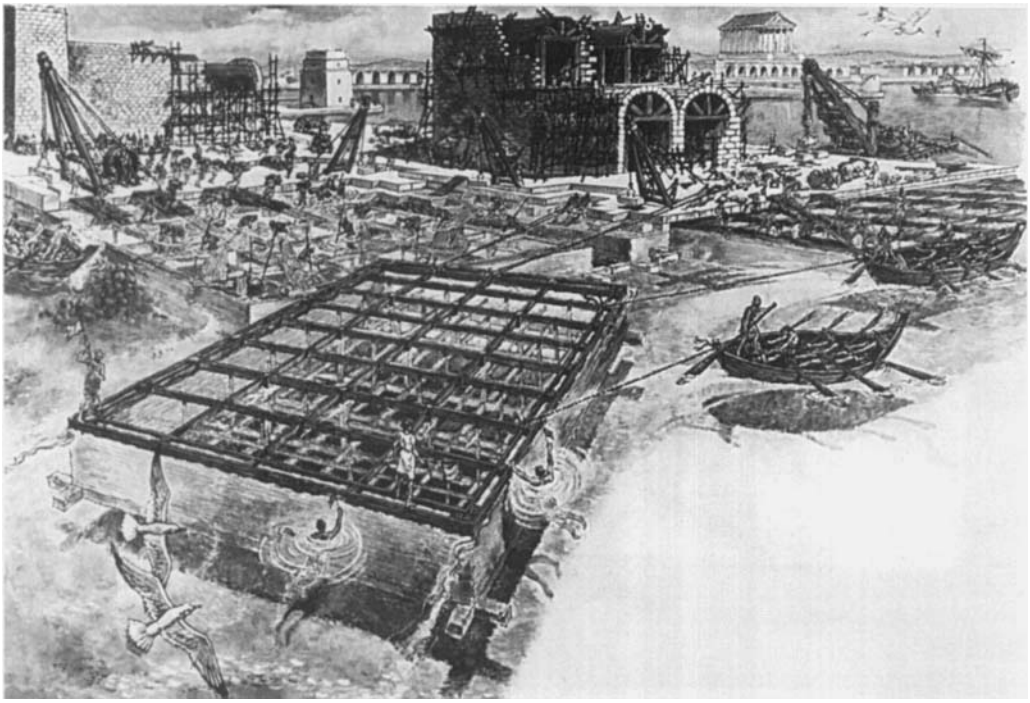

Figure 3. Hollow forms were also used to contain *pozzolana* while this substance hardened on the ocean floor. Artist's rendering of such a box being towed into position at the terminus of the North Breakwater. (J. Robert Teringo, courtesy of National Geographic Society).

1200–1500 tons, normally sailed back to Egypt without cargo and with sand as a convenient ballast, bypassing the eastern Mediterranean coast (Casson, 1971: 184–89). For a period of time while Sebastos and Caesarea were under construction, some of the fleet may have been diverted east to deliver a special cargo of tuff. The captains of these vessels would then have acquired new ballast locally for the last leg of their journey to Alexandria. Although there are no literary sources to support such a scenario, it is impossible to imagine how tuff from Naples could have otherwise arrived at Sebastos in the quantities needed or in the approximately 7 years during which the breakwaters were constructed (*c.* 22–15 BC).

The Cyprus connection

Recently the author suggested that there was an important connection between the building of Sebastos and Cyprus (Hohlfelder, 1996). The apparent repairs to the harbour of Paphos, following an earthquake in 15 BC that occasioned the intervention of Augustus himself, may have been undertaken by some of the same masterbuilders who were just completing the construction of the two main breakwaters at Caesarea. While there is no textual support for this claim, the nature of the repairs themselves at Paphos recall the design features of Sebastos. It is probable that the emperor dispatched some of his experts on maritime construction, fresh from their triumph in Herod's kingdom, to his provincial capital in Cyprus as part of his efforts to revitalize this important port city after a devastating natural disaster.

There seems also to be at least one more connection. Recent analyses of wood from one of the single-mission barges used as construction forms to transport and place

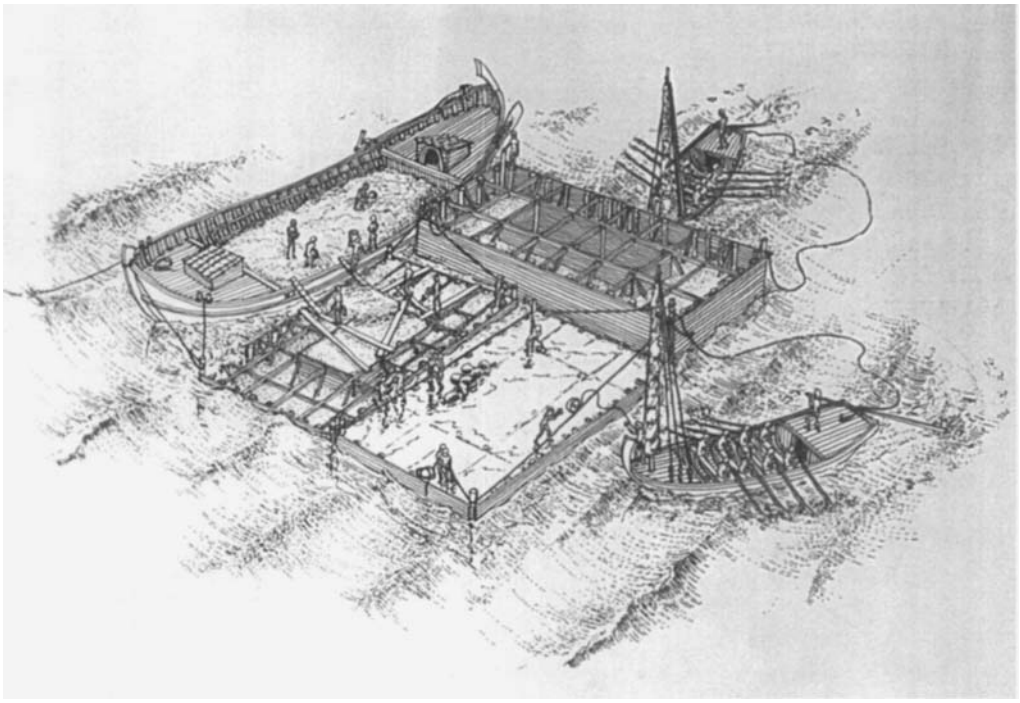

Figure 4. Single-mission barges in position at the end of the South Breakwater. A cluster of these forms, once submerged, became an artificial island where work could be continued above the sea. (Drawing: Chris Brandon).

hydraulic concrete on the seabed during the construction or repair of the terminus of the Caesarea South Breakwater appears to have come from Cyprus. Peter I. Kuniholm, director of the Malcolm and Carolyn Wiener Laboratory for Aegean and Near Eastern Dendrochronology at Cornell University, studied wood samples collected in 1990 from Area K2 (one of these barges). His analyses indicated that *Pinus brutia* or Cyprus pine had been used in the construction of the floating forms used as a delivery system for the *pozzolana* at Sebastos.[6] Another sample from one of the squared beams used in the barge construction (exact provenance unclear) was analysed. It was *Pinus brutia*. Another piece of construction timber, believed to be from much later harbour repairs during the reign of Anastasius I (*c.* AD 502), was also identified as *Pinus brutia*. Its presence in this assemblage calls to mind a comment by Ammianus Marcellinus that even in Late Antiquity Cyprus still had all the resources necessary to make ships from keel to sails (148.14). An earlier sample submitted by CAHEP excavators from a beam from a different type of frame also used to hold liquid concrete while it cured on the ocean floor (from Area G) contained *Pinus sylvestris/nigra*, another type of pine common to Cyprus in antiquity (Burnet, 1997). Regarding this sample, Kuniholm's report specifically suggests that this wood may have been imported from another region.[7]

The discovery of pine at Caesarea that was abundant on Cyprus and not available locally in antiquity does not prove conclusively the island provenance of all the samples, for other sources for all the specimens of pine thus far identified were available elsewhere in the Mediterranean (Fitzgerald, 1994: 177). A

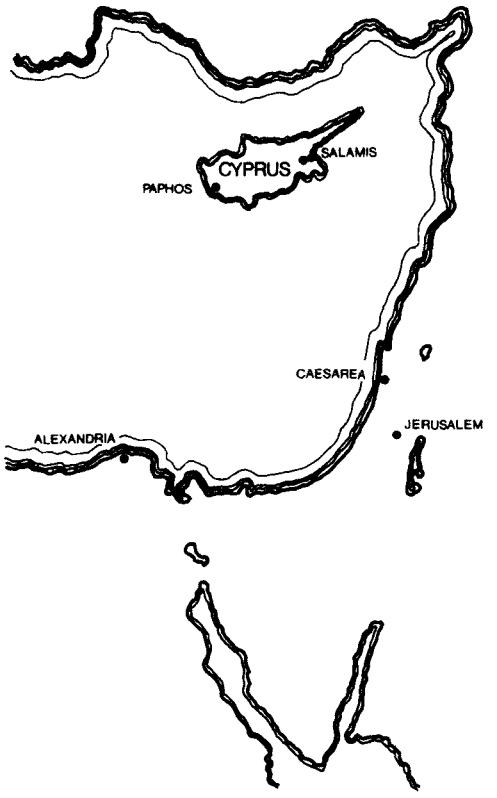

Figure 5. The normal sailing route to Caesarea from points west would have passed in the lee of Cyprus. Paphos was the major harbour during the Roman era. (Map: Kathryn H. Barth).

strong circumstantial case, however, can be made for the Cyprus connection[8]. The transport vessels bringing the Italian tuff to Caesarea would normally have sailed along the southern coast of Cyprus, and perhaps down part of the western coast, on their voyage to King Herod's kingdom. Paphos itself may have routinely been a port of call for these mariners, but even if that were not the case, a stop *en route* to pick up timber somewhere along the littoral would have been an easy diversion. Paphos, as the major port city with the most impressive harbour along the southern or western coast, would have been the likely port of call (Fig. 5).

Cyprus, of course, was famous for its timber resources in antiquity (Burnet, 1997), while Paphos itself seems to have had shipbuilding installations during the Hellenistic era and probably into Roman times as well (Hohlfelder & Leonard, 1993; Hohlfelder, 1995: 195). It is tempting to speculate that even some of the roughing-out of the timber may have been done there, perhaps to facilitate work at Sebastos where it is known construction moved along at an extraordinary pace. While it was more normal for timber to be shipped with only a modicum of trimming and shaping (Meiggs, 1982: 352), the unique situation at Caesarea may have encouraged further preparation of the timber to be shipped and perhaps even some prefabrication of the barges themselves at Paphos.

If this suggestion is correct, and some materials for the construction of Sebastos did come from Cyprus, it is further evidence of the logistical complexity behind the building of King Herod's harbour. Masterbuilders from Rome, tons of tuff from the Bay of Naples, wood from Cyprus—all are indicators of the international nature of this maritime construction and the ever-increasing cosmopolitan character of the emerging Roman Empire. These links also confirm the substance of a comment made by Josephus, writing decades after the construction of Caesarea and Sebastos. He noted that Herod 'got no material suitable for so great a work from the place itself but completed it with materials brought from outside at great expense' (*JA*, 15, 332). His observation may still be part hyperbole, but it now rings more truly than formerly.

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Notes

[1] Herod quickly acted to demonstrate his fealty to his new Roman overlord. Immediately after Actium, he had participated in the building of Augustus' victory city, Nikopolis, and had built Sebaste in his own realm (Roller, 1998: 88). While the king may have envisioned Rome as his model for many of his building projects (Roller, 1998: 90), his inspiration for Sebastos must have been Alexandria. There was nothing similar in Italy for emulation.

[2] There is no evidence for or against the use of Sebastos as a station for units of the *Classis Syriaca* or the *Classis Augusta Alexandrina*. Herod most certainly employed this harbour as the base for his fleet, for there were no other viable alternatives in his kingdom. It seems probable that an installation as large and as well designed as Caesarea's harbour would also have attracted Rome's attention. Reddé also raises this possibility (Reddé, 1986: 240–41).

[3] The friendship between Marcus Agrippa and Herod mentioned by Josephus was based on perceived mutual advantage. The political ambitions of each man profited from their personal association. Agrippa's role in the building of Sebastos is the subject of a forthcoming study.

[4] His dreams were indeed great and known to both Augustus and Caesarea. Josephus reports that they once noted that his 'realm was not equal to his magnanimity, for he desired to be King of all Syria and Egypt' (*AJ* 16, 141). His actions, including the building of Caesarea and Sebastos, should be assessed against this compelling, but unobtainable, prospect.

[5] Imperial cities routinely appealed for help from Augustus, particularly after natural disasters (e.g. Paphos in Cyprus; Hohlfelder, 1996: 92). Aid came in the form of materials; sometimes it was technical expertise, and rarer still it was money (Mitchell, 1987). Client kings probably made similar requests that were granted in similar ways or rejected at imperial discretion. In Herod's case, the dispatch of master harbour builders and perhaps other architects with specialities not readily available in Judaea and the gift of, or permission to import, *pozzolana*, timber and other materials needed for the building of Caesarea and Sebastos may have been the extent of the imperial response.

[6] The results were reported to me *per litteras* by Laura D. Steele, a research aide of Professor Kuniholm, on 18 September 1997.

[7] Paul B. Pettit, Senior Archaeologist of the Radiocarbon Accelerator Unit, Research Laboratory for Archaeology and the History of Art, Oxford University, shared the results of another test on a wood sample from the harbour of Caesarea. A small section of a knee brace from one of the single-mission barges (Brandon, 1996) was dated by C_{14} analysis to 1935 ± 70 BP. While this result allows for the barge to date from the original Herodian building programme, it favours even more its use in a later repair or renovation, perhaps late in the 1st century AD (see Hohlfelder, 1996: 90). Unfortunately, the species of wood was not identified in this test.

[8] The timber for Herod's fleet, in operation by 14 BC, may have also come from Cyprus, since the requisite material and naval stores would have been hard to access in his own kingdom. Josephus notes its existence and deployment in that year, but provides no details about its conception or construction (*AJ* 16, 16–21). It is likely that the king's warships were built at Sebastos, although Josephus does not mention a shipyard as one of the harbour's installations. Archaeologists have not found any evidence to date of its existence. There is little doubt that Sebastos was its permanent station, for no other viable alternative existed. The Inner Harbour probably served as the base for the royal fleet. Late in his reign (12 BC), Herod secured an important concession from Augustus for ownership of half of the copper mines on Cyprus and permission to manage the rest (*AJ* 16, 128). One suspects that his commercial ties with this island predate this extraordinary and lucrative commission.

References

Beebe, K., 1983, Caesarea Maritima: its strategic and political significance to Rome, *International Journal of Near Eastern Studies*, **42:** 195–207.

Brandon, C., 1996, Cements, concrete and settling barges at Sebastos: comparisons with other Roman harbour examples and the descriptions of Vitruvius. In Raban, A. & Holum, K. G., *Caesarea Maritima: a Retrospective after Two Millennia*, 25–40 Leiden.

Brandon, C., 1997, The concrete-filled barges of King Herod's harbor of Sebastos. In Swiny, S., Hohlfelder, R. L. & Swiny, H. W., *Res Maritimae—Cyprus and the Eastern Mediterranean from Prehistory to Late Antiquity*, 45–57. Atlanta.

Burnet, J. E., 1997, Sowing the four winds: targeting the Cypriot forest resource in antiquity. In Swiny, S., Hohlfelder, R. L. & Swiny, H. W., *Res Maritimae—Cyprus and the Eastern Mediterranean from Prehistory to Late Antiquity*, 59–69. Atlanta.

Casson, L., 1971, *Ships and Seamanship in the Ancient World.* Princeton.

Fitzgerald, M. A., 1994, The ship. In Oleson, J. P., *Harbour of Caesarea Maritima*, Vol. 2, 163–223.

Gianfrotta, P. A., 1996, Harbor structures of the Augustan Age in Italy. In Raban, A. & Holum, K. G., *Caesarea Maritima: a Retrospective after Two Millennia*, 65–76.

Hohlfelder, R. L., 1985, The building of the Roman harbour at Kenchreai: old technology in a new era. In Raban, A., *Harbour Archaeology*, 81–86. Oxford.

Hohlfelder, R. L., 1995, Ancient Paphos beneath the sea: a survey of the submerged structures. In Karageorghis, V. & Michaelides, D., *Cyprus and the Sea*, 191–208. Nicosia.

Hohlfelder, R. L., 1996, Caesarea's master harbor builders: lessons learned, lessons applied? In Raban, A. & Holum, K. G., *Caesarea Maritima: a Retrospective after Two Millennia*, 77–101. Leiden.

Hohlfelder, R. L., 1997, Building harbours in the Early Byzantine Era: the persistence of Roman technology. *Byzantinische Zeitschrift*, **24:** 367–380.

Hohlfelder, R. L., 1998, Romancing the mud in the harbour of Caesarea Maritima. In Hillard, T., Kearsley, R. A., Nixon, C. E. V. & Nobbs, A. M., *Ancient History in a Modern University*, **1**. Grand Rapids, Michigan.

Hohlfelder, R. L. & Leonard, J. R., 1993, Underwater explorations at Paphos, Cyprus: preliminary survey, *Annual of the American Schools of Oriental Research*, **51:** 45–62.

Hohlfelder, R. L. *et al.*, 1983, Sebastos: Herod's harbor at Caesarea Maritima. *Biblical Archaeologist*, **46:** 133–144.

Holum, K. G. & Hohlfelder, R. L. (Ed.), 1988, *King Herod's Dream, Caesarea on the Sea.* New York.

Meiggs, R., 1982, *Trees and Timber in the Ancient Mediterranean World.* Oxford.

Mitchell, S., 1987, Imperial building in the eastern Roman provinces. *Harvard Studies in Classical Philology*, **91:** 332–365.

Oleson, J. P., 1985, Herod and Vitruvius: preliminary thoughts on harbour engineering at Sebastos, the harbour of Caesarea Maritima. In Raban, A., *Harbour Archaeology*, 165–172. Oxford.

Oleson, J. P., 1988, The technology of Roman harbours, *IJNA*, **17:** 147–158.

Oleson, J. P. & Branton, G. 1992, The technology of King Herod's harbour. In Vann, R. L., *Caesarea Papers*, 49–67. Ann Arbor.

Oleson, J. P., Hohlfelder, R. L., Raban, A. & Vann, R. L., 1984, The Caesarea Ancient Harbor Excavation Project (CAHEP): preliminary report on the 1980–1983 seasons. *Journal of Field Archaeology*, **11:** 281–305.

Oleson, J. P. *et al.*, 1994, *The Harbours of Caesarea Maritima, 2: The Finds and the Ship.* Oxford.

Raban, A. & Holum, K. G., 1966, *Caesarea Maritima: a retrospective after Two Millennia.* Leiden.

Raban, A. *et al.*, 1989, *The Harbours of Caesarea Maritima, 1: The Site and the Excavations.* Oxford.

Reddé, M., 1986, *Mare Nostrum. Les Infrastructures, le Dispositif et l'Histoire de la Marine Militaire sous l'Empire Romain.* Rome.

Roller, D., 1998, *The Building Program of Herod the Great.* Berkeley.