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Caesarea's Master Harbor Builders: Lessons Learned, Lessons Applied?

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Nearly two thousand years ago, Caesarea Maritima entered the Mediterranean commonwealth that flourished under the Roman eagle. Few urban centers had such a distinct and glorious inauguration into this community. In just over a decade (22–10/9 B.C.E.), a gleaming port arose from a desolate and barren coastline in the eastern Mediterranean to become a major international crossroads. Upon its completion, Caesarea stood as a testimony to the brilliance of the millennial tradition of urbanism in the Near East and to the level of sophistication, specialization, and opulence that characterized cities in the world of Rome.[1] Although King Herod was well known as a patron of monumental buildings, cities, and grand structures both within and beyond the boundaries of his own kingdom, he may well have viewed his new seaside capital as the capstone of his efforts to define and enhance his contemporary and historical image through an expensive and expansive building program. Much was invested in the port city that bore the name of his Roman patron, Augustus Caesar, including Herod's regal ambitions to become a more influential figure in the economic and geopolitical arena of his day.

As the supreme testimony to his dreams of international influence and immortality, the king spared no expense in the construction of Caesarea. Fortunately, we have the

[1] I would like to thank the following agencies and individuals associated with the University of Colorado for their generous support of my research at Caesarea Maritima and Paphos: the Graduate Committee on the Arts and Humanities, the Council on Research and Creative Work, Dean Charles R. Middleton of the College of Arts and Sciences, and Professor James N. Corbridge, formerly the university chancellor. At an early stage of CAHEP's fieldwork, and before Caesarea's unique archaeological richness had been fully confirmed, the National Endowment for the Humanities and the National Geographic Society took a "chance" and partially funded several seasons of underwater explorations at King Herod's port city. To a great extent, all that has happened at Caesarea since 1981 has directly evolved from their endorsement and financial assistance. I am happy to acknowledge the continuing support of the National Geographic Society for my survey work in and around the Paphos harbor. Without such benefactors, the legacy of Antiquity beneath the Mediterranean would forever remain unknown.

Much of Caesarea's story is contained in the following recent major publications, which also include the earlier and more specialized bibliography: Oleson et al., *Finds; Caesarea Papers;* Raban, *Site;* and *Herod's Dream.*

familiar passages of Flavius Josephus, written decades after Herod's floruit, that described the face of his city in considerable detail (AJ 15.331–41; BJ 1.408–14).[2]

The various archaeological missions that have probed the ruins of Herod's city since the 1950s have added significant details to our understanding of its original configuration, with the current massive archaeological effort now under way by the Israel Antiquities Authority (IAA) and the University of Haifa being of particular note.[3] While far more will be learned in the years ahead, one can now say with confidence that Josephus did not exaggerate Caesarea's elegance or grandeur. For example, his account of Sebastos, the Herodian harbor complex, was not magniloquently hyperbolic, as W. M. Thomson claimed in 1861, but was actually understated in many respects.[4]

From the moment of its birth, Caesarea was one of the finest examples of a Graeco-Roman city in the vast Mediterranean empire of Rome. And in that description, Graeco-Roman city, is the key to understanding the raison d'être of this metropolis. Herod consciously decided to create a port that would be a western enclave in the eastern Mediterranean.

Like all ports, Caesarea stood at the intersection of an extensive land and sea transportation network. People, products, and ideas could have easily moved in both directions through its harbors and gates. But the king's focus for his new gateway metropolis was in one direction. Although its geographical setting was at the overlap of two rich legacies and traditions, he decided not to recognize this cultural duality in the buildings and monuments that distinguished his city. Herod's vision for Caesarea was for it to serve as a permanent, open window to Rome and as a reflection of the majesty of the imperial world that lay beyond its harbors. Through his royal enclave, the West entered his kingdom.[5]

With such a goal in mind, it is not surprising to find the imprint of Rome in the structures and city plan of Herod's capital. It is very likely that master builders from the West may have played a critical role in the actual construction of the city and its principal public monuments.[6] Most certainly, there is compelling archaeological

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[2] A recent translation of these two passages that is sensitive to the technological nuances of the text is by J. P. Oleson, in Raban, *Site*, 51–53.

[3] The Combined Caesarea Excavations (CCE) also continues its summer fieldwork at King Herod's city in and around the excavations conducted by the IAA and the University of Haifa; see Raban et al., *Field Report* (1992). The underwater caisson excavations in the harbor, conducted in 1992 under the aegis of the CCE by the author, were inexplicably omitted from this report, although a photograph of excavations in area R3 does appear (fig. 5), along with a summary paragraph of description (pp. 4–5). For a progress report on this project, see R. L. Hohlfelder, "Romancing the Mud in the Harbor of Caesarea Maritima, Israel," forthcoming in *Ancient History in the Modern University*, ed. T. Hillard et al. (Sydney, 1995).

[4] W. W. Thomson, *The Land and the Book* (London, 1861), 495.

[5] The pottery imports reflect this orientation to the Aegean and the West. See Oleson et al., *Finds*, 156; J. A. Blakely, "Ceramics and Commerce: Amphorae from Caesarea Maritima," *BASOR* 271 (1988), 31–50; and the chapters by Jeffrey A. Blakely and by John P. Oleson et al. in this volume.

[6] Western master builders may also have worked for Herod at Jericho on his winter palace. See F.

evidence, if not direct literary testimony, to suggest that imported technology provided the underpinnings of the building program for Sebastos. The extensive use of pozzolana imported from the Bay of Naples and the use of wood, brought in from points beyond the eastern Mediterranean for use in building construction forms recently found in the sea, suggest western expertise.[7]

How these men arrived at Caesarea with their knowledge of hydraulic concrete and a fledgling tradition for using it in a marine environment can only be surmised. We know from a later period of Rome's history that the emperor Trajan (98–117 C.E.) was frequently asked by his legate and friend Pliny to dispatch technical experts to oversee major urban construction projects throughout the cities of Pontus and Bithynia in Asia Minor (Pliny *Ep.* 10.37, 39). Usually, however, Trajan rejected these requests and instructed his governor to use local resources, clearly stating that competent builders were available in his provinces (Pliny *Ep. 10.*40, 62).

One can imagine similar appeals from governors and cities flooding to Rome in an unending stream. Such was the reality of imperial hegemony, for citizens and subjects all looked to the capital. But unless the situation in Pontus and Bithynia was unique, and there is no reason to believe that it was, far more requests must have been rejected than approved.

The precise reasons why some petitions received official blessing, while most did not, are not recoverable from extant sources. The Trajan-Pliny correspondence suggests that it was most likely imperial fancy and perceived self-interest rather than fixed policy that determined which ones were honored and what form such aid took. There were no criteria for evaluating or determining which entreaties provoked imperial benefaction and which did not. The decision to intervene was personal and, if the Trajan-Pliny letters are an accurate guide, almost whimsically subjective. For those who sought imperial assistance, the whole process must have been maddeningly unpredictable, and, of course, absolutely final in its outcome. Imperial decisions were not subject to higher review.

A similar procedure for requesting imperial intervention probably began as soon as Augustus had firmly consolidated his position after the civil war with Antony had ended at Actium (31 B.C.E.). Since client kings were such an integral part of the political order of the Empire, requests for patronage and aid of all sorts probably came from these regal personages as well.

Given the grandeur of King Herod's urban project, the individual to whom it was dedicated, and the potential importance of the port city to imperial interests in the region, it seems quite likely that the king of the Jews made such a petition. As the archaeological evidence from the sea suggests, technical assistance was given for

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W. Deichmann, "Westliche Bautechnik im römischen und rhomäischen Osten," *RömMitt* 86 (1979), 474.

[7] J. P. Oleson, "Herod and Vitruvius: Preliminary Thoughts on Harbour Engineering at Sebastos, the Harbour of Caesarea Maritima," in A. Raban, ed., *Harbour Archaeology*, BAR Int. Ser. 257 (Oxford, 1985), 168, and J. P. Oleson and G. Branton, "The Technology of Herod's Harbour," in *Caesarea Papers,* 56–66.

constructing the first artificial harbor out into the open sea from a disadvantageous coastline.

Master builders with knowledge of the most advanced construction techniques were dispatched east to oversee, and perhaps participate in, the creation of sophisticated harbor installations that went well beyond the engineering traditions of the age. The project Herod had proposed for Caesarea stretched the technology of the day, for the site he had designated for his port city offered few features to encourage its selection on its own natural merits. It was especially ill-suited for the scale of the maritime project he had envisioned, but politics and economics, not nature, determined the king's decision.[8]

Since site selection was not in the purview of the master builders, they could only cope with the ramifications of the king's choice. They brought with them their technology and the tools of their trade to confront the sea at a location that they never would have chosen themselves. Their task was to implement the king's dream and to do it as quickly as possible.

Most of the Caesarea publications to date have called these western technical specialists "engineers."[9] Today this designation is invested with a thick coating of educational, methodological, and social nuances and preconceptions that most likely did not apply to their ancient counterparts. It would be far more appropriate simply to call these unknown individuals "master builders." Their approach was probably far more practical and pragmatic than theoretical. Long years of apprenticeship, rather than formal education, provided a foundation of experience to permit these men to move beyond their previous accomplishments when unique challenges presented themselves. They knew how to create new solutions for physical problems.[10] It is less likely that they always knew why things worked as they did.

The exciting story of their successes and failures is being recovered from beneath the waters of Caesarea. Several decades of underwater explorations, beginning in 1960 with Edwin A. Link and continuing today under the aegis of the Center for

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[8] But when the challenges of the exposed location of Caesarea had been successfully met, ancient harbors could then be sited anywhere politics or economics dictated, providing adequate resources and determination were available. Such was the legacy of Sebastos. In that regard, as well as in its technological features, Herod's harbor was a "modern" one.

For the king's motives for building Caesarea and its grandiose, elaborate, and expansive harbor installations, see *Herod's Dream*, 73.

[9] The use of the term in the Caesarea literature is ubiquitous. See, e.g., Raban, *Site*, 286 and passim; *Herod's Dream*, 101 and passim; Oleson and Branton, "Technology of King Herod's Harbour," 51, and in most other publications that deal with the harbor construction. I hope "master builders" will gain currency in the future for reasons suggested in the text.

[10] As Oleson points out, the only surviving Roman literary text dealing with harbor construction appears in Vitruvius, *De Architectura* (5.12.2–6). It was published before work on Sebastos had started (Oleson, "Herod and Vitruvius," 169). The master builders of Herod's harbor worked beyond what Vitruvius had summarized as the state-of-the-art instructions for using pozzolana. They were on their own to devise new solutions for the site's unique natural features and challenges.

Maritime Studies of the University of Haifa, have produced astonishing results.[11] Many publications on the wonders of the submerged portions of the harbor installations now exist, and others are in progress. This chapter discusses only three design features of Herod's innovative harbor building program that may have seen almost immediate replication elsewhere in the Mediterranean after their initial employment at Caesarea.

Early in the explorations of the Caesarea Ancient Harbour Excavation Project (CAHEP), the remains of an independent, submerged mole were discovered running parallel to a section of the main Southern Breakwater.[12] It appeared to be a discontinuous structure that merely breached the surface in Antiquity (fig. 1).

Its function was to provide a first line of defense or protection for the principal enclosing arm where it would have been particularly vulnerable to heavy storm seas running in from the southwest. Waves would have lost much of their force and kinetic energy as they rolled across this barrier. The main structure would have been spared much of the destructive power of a violent sea smashing into it. In addition, wave spray over the seawall that ran down the axis of the Southern Breakwater would have been reduced. The warehouses and magazines that Josephus tells us were built against this spinal wall would have been drier and safer for whatever cargoes might have been stored there prior to loading on merchantmen for overseas shipment or on land transport vehicles for conveyance to inland destinations.

We do not yet know how far along the course of the Southern Breakwater this freestanding secondary mole extended, what its configuration might have been beyond the sections that have been explored to date, or how successful it was. No earlier examples of such an installation in an ancient harbor are known, so it may well be that Caesarea's subsidiary breakwater was the first example of an attempt to mitigate and control the force of the sea in such a fashion. CAHEP's excavators believed that it represented one of the several experiments and design innovations intended to address the relentless natural challenges posed by the difficult siting of the port city on an unforgiving coast.

CAHEP's excavators also found the entrance of a small channel leading into the massif of the Southern Breakwater itself. It has been suggested that it was a component of a flushing system, constructed as part of the original harbor design, intended to counteract the seaborne sediments that threatened any enclosed basin constructed along the eastern Mediterranean littoral.[13] Sand-free water from wave

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[11] A. Raban, "Marine Archaeology in Israel," *Oceanus* 28 (1985), 59–65; R. L. Hohlfelder, "The First Three Decades of Marine Explorations," in *Caesarea Papers*, 291–94; and A. Raban and R. L. Hohlfelder, in Raban, *Site*, 55–98.

[12] For a preliminary discussion of this design feature, see A. Raban and R. L. Hohlfelder, "The Ancient Harbors of Caesarea Maritima," *Archaeology* 34 (1981), 59; a fuller discussion is offered by J. P. Oleson, "Area E: The Subsidiary Breakwater," in Raban, *Site*, 120–23.

[13] Early mention of this sluice channel, identified as part of a flushing system, appeared in Raban and Hohlfelder, "Ancient Harbors," 58 and 60, and in R. L. Hohlfelder et al., "Sebastos, Herod's

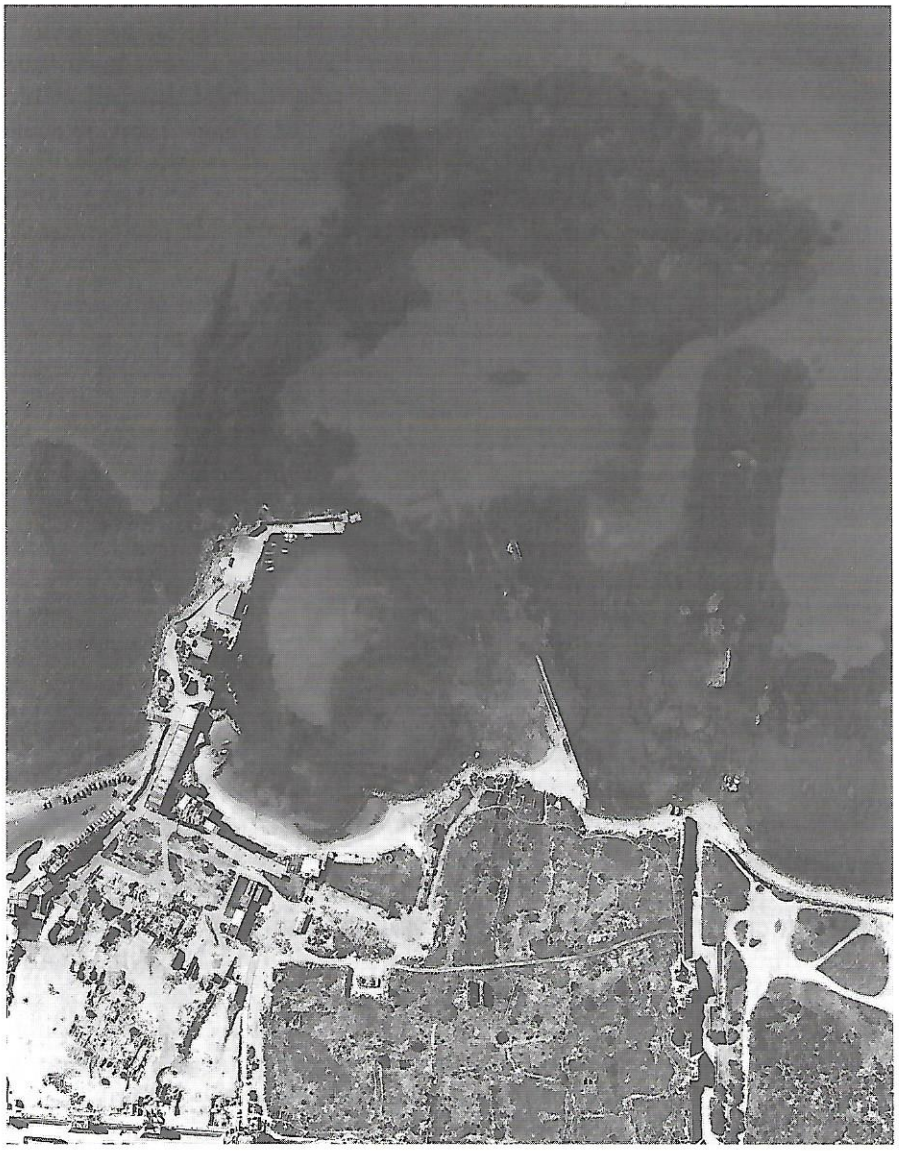

Figure 1. An aerial view of Sebastos (N to the right). A segment of the subsidiary breakwater is visible as a spit of rubble on the exterior southern face of the Southern Breakwater. Photograph by Ofek

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Harbor at Caesarea," *Biblical Archaeologist* 46 (1983), 137. See also Oleson and Branton, "Technology of King Herod's Harbour," 86.

tops flowed into the anchorage through this and other channels in some controlled manner to help create an outflowing current that would scour away sediment that had washed in through the entrance channel as well as unwanted emanations from the city's sewers or drains.

It is still unknown whether or not such a scouring current could have been manufactured by such channels or how many inlets would have been necessary to have any meaningful impact on water flow and sand deposition within the enclosed harbor. There is some evidence from recent underwater excavations that calls into question the efficacy of the alleged flushing system. The presence of mud layers throughout the harbor, dating to moments when the breakwaters were functioning as intended, hints at the nonexistence or ineffectiveness of an artificially induced countercurrent.[14] A significant outward water flow, necessary for flushing out the enclosed basin, would not have permitted the calm conditions requisite for the deposition of mud, which in some locations was almost a meter thick.

There is the very real possibility that this channel simply fed a *piscina* constructed on the breakwater itself. A parallel for such an arrangement was discovered at Kenchreai, Greece, where another Roman harbor site was under construction at the same time as Caesarea.[15] But, assuming that the channel was an original component of the Herodian installation intended to provide some amelioration of the persistent siltation, its existence provides another example of the genius of the master builders of Sebastos. They had identified a future problem before construction had begun and had incorporated a design feature into their building program to address it.

One other enigmatic element of the harbor studied by CAHEP excavators was a pair of concrete blocks uncovered west of and outside the entrance channel on an unusual axis in relation to the *termini* of both breakwaters and to the harbor entrance (figs. 1–2). These blocks have been identified as the remains of the bases of towers that supported the monumental sculpture that Josephus said adorned the gateway to Sebastos.[16]

The problem posed by these foundations is not their function but their location near the entrance channel itself. These two towers, "yoked together" in some way (to use Josephus' phrasing), would have been at the very least a hindrance to ships

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[14] For a discussion of the enigmatic mud deposits in Caesarea's harbor, see R. L. Hohlfelder, "An Experiment in Controlled Excavation beneath Caesarea Maritima's Sea 1990," *BASOR* 290–91 (1993), 95–107, and "Romancing the Mud," forthcoming, where the appearance of mud as a possible indicator of the inefficacy of the alleged de-silting system is raised.

[15] R. L. Scranton, J. W. Shaw, and L. Ibrahim, *Kenchreai Eastern Port of Corinth, Vol. 1: Topography and Architecture* (Leiden, 1978), 25–35, where a series of *piscinae* were located on the south mole. On the building of Kenchreai, see also R. L. Hohlfelder, "The Building of the Roman Harbour at Kenchreai: Old Technology in a New Era," in Raban, *Harbour Archaeology*, 81–86.

[16] For an early mention of these blocks, see R. L. Hohlfelder and J. P. Oleson, "Sebastos, the Harbor Complex of Caesarea Maritima, Israel: The Preliminary Report of the 1978 Underwater Explorations," in M. Sears and D. Merriman, eds., *Oceanography: The Past* (New York, 1980), 774; the fullest description appears in R. L. Vann, "Area K: Twin Towers West of Entrance Channel," in Raban, *Site*, 149–51.

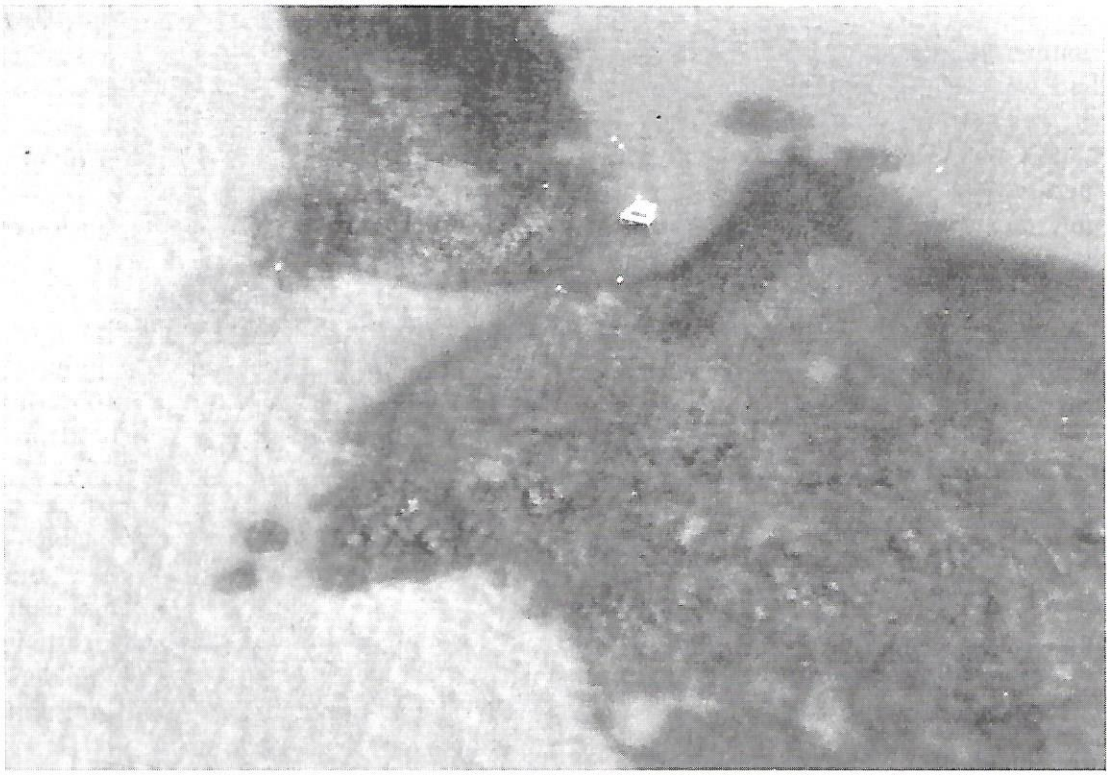

Figure 2. The ancient entrance channel at Sebastos is now blocked by rubble spill (N to the left).The remains of a large structure appears in the SW corner of the Northern Breakwater. The rubble pile at the terminus of the Southern Breakwater (area K and the "lighthouse" site) is visible, as are the two statue bases and/or pilae north and west of the harbor mouth. Photograph by Bill Curtsinger. Copyright National Geographic

entering or exiting the harbor, particularly when the sea was rough. More likely, they posed a serious hazard to the passage of larger ships into or out of the outer basin. Maneuvering something other than a small dinghy or coastal craft in or near Caesarea's channel posed sufficient obstacles and dangers, when all conditions were ideal, without adding another one that might have proved fatal when they were not. There must have been some reason why the bases were positioned where they were. But what was it?

Several possibilities are likely. The towers with sculpture surmounting them might have provided some navigational aid to incoming ships, but probably only after they had been guided to the harbor entrance by other more conspicuous markers.[17] Josephus mentioned that the great Temple of Roma and Augustus standing on the

[17] Oleson and Branton, "Technology of King Herod's Harbour," 56.

artificial podium abutting the Inner Harbor was visible to mariners far at sea. It would have been a familiar and distinct architectural signature of Sebastos.

The two large structures that stood at the *termini* of both breakwaters probably would have been sufficient points of reference for incoming mariners as well, since they clearly demarcated the harbor entrance.[18] One of these buildings has tentatively been identified as a lighthouse (figs. 3–4), possibly even the Drusion mentioned by Josephus.[19] Such a suggestion may be correct, although the lighthouse need not have been located at the harbor entrance.[20] A position on higher ground, perhaps on the one commanding outcrop of bedrock in the sea, where Straton's Tower (if there ever was such an eponymous structure at this settlement) may have stood, would have been a better location in many respects. Today it is the site of a restaurant that now delights tourists with its unparalleled view of the ruins on land and sea. In Antiquity, the locale may have served a very different function for visitors.[21]

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[18] For the concentration of blocks on the southwestern corner of the Northern Breakwater, some of which still carry lead casings for iron clamps, see A. Raban and J. P. Oleson, "Area D: Entrance Channel and Head of Northern Breakwater," in Raban, *Site*, 113–15. The blocks, with their unusual lap joints and clamps, clearly were part of a massive structure. At one time this building was identified as a tower, perhaps the Drusion mentioned by Josephus (*AJ* 15.336); see Raban and Hohlfelder, "Ancient Harbors of Caesarea," 59. It has also been identified as a possible site of a lighthouse; see Hohlfelder et al., "Herod's Harbor at Caesarea," 140.

Across the entrance channel to the west, another large concentration of blocks appears, reaching from the ocean floor to within 1.5 m. of M.S.L. It, too, has been suggested as the site of a lighthouse; see. R. L. Vann, "Underwater Excavations in Herod's Harbor at Caesarea Maritima," *Archaeology News* 16 (1991), 64, and idem, "The Drusion: A Candidate for Herod's Lighthouse at Caesarea Maritima," *IJNA* 20 (1991), 137. Both structures, whatever function they may have served, would have clearly defined the entrance channel, reducing the need or value of the proximate statue towers as navigational aids.

[19] It appears at this location in the J. Robert Teringo painting that accompanied the article on King Herod's harbor that appeared in *National Geographic;* see R. L. Hohlfelder, "Herod the Great's City on the Sea," *National Geographic* 171 (1987), 263. This painting (fig. 3) has been reproduced many times and in many places since its first publication.

In this position, the lighthouse could easily have been lined up with the Temple of Roma and Augustus by incoming mariners to mark a specific course to the harbor entrance.

[20] While lighthouses did appear on breakwaters (see Vann, "Drusion," 125, 126, and 127 for such locations at Alexandria, Portus, and Leptis Magna), they did not have to be located where they were vulnerable to the ravages of the sea (at Kenchreai, a Late Roman lighthouse may have stood on shore at the base of the north mole; see Scranton et al., *Kenchreai* 1:21). Positions on nearby heights in the harbor area would have served equally well and perhaps better.

At Paphos, the breakwaters were not of sufficient size to accommodate a large lighthouse. Such a structure, if one did exist, probably stood on the hill behind the harbor. R. L. Hohlfelder and J. A. Leonard, "Underwater Explorations at Paphos, Cyprus: The 1991 Preliminary Survey," *AASOR* 51 (1993), 57. Cf. W. Daszewski, who announced the discovery of a lighthouse base in his excavations near the House of Theseus on Oct. 19, 1994 (*Cyprus Bulletin,* Oct. 31, 1994, 3). Whether or not this tower base belonged to a lighthouse, which would have been sited in a most unlikely location in the heart of an exclusive residential area, is not yet certain. A position on a topographic prominence, such as the nearby hill where a modern lighthouse now sits, would seem to have been a more advantageous choice.

[21] See R. L. Hohlfelder, "The Caesarea Maritima Coastline before Herod: Some Preliminary Observations," *BASOR* 252 (1983), 67.

Figure 3. Painting of the main harbor installation of Sebastos by J. Robert Teringo of National Geographic, first published in 1987 to present current thoughts about the harbor. Although new data from the continuing excavations challenge some of the imagery, it remains the most dramatic and accurate visual presentation of King Herod's harbor. Courtesy of National Geographic

Wherever the lighthouse was located, it probably was in use not only at night but also by day, when it actually might have been more helpful to incoming ships. A column of billowing smoke would have extended its height and enhanced its value as a landmark and navigation point several fold. For those captains bearing in on Sebastos by day, wisps of smoke from the lighthouse may have been the first visual sign of Herod's city. The next confirmation of the port's position would have been the sight of the great temple and/or the lighthouse itself.

Although ancient ships could and did sail at night, most arriving vessels tried to make port before dusk. But for those captains who had badly timed their journeys and had failed to make landfall before losing the sun, or for those ships forced to travel at night, the lighthouse's fire beacon would have announced the location of Caesarea's safe haven. Ships that arrived after dark, however, probably would have awaited first light, standing at anchor outside the enclosed basin before attempting to

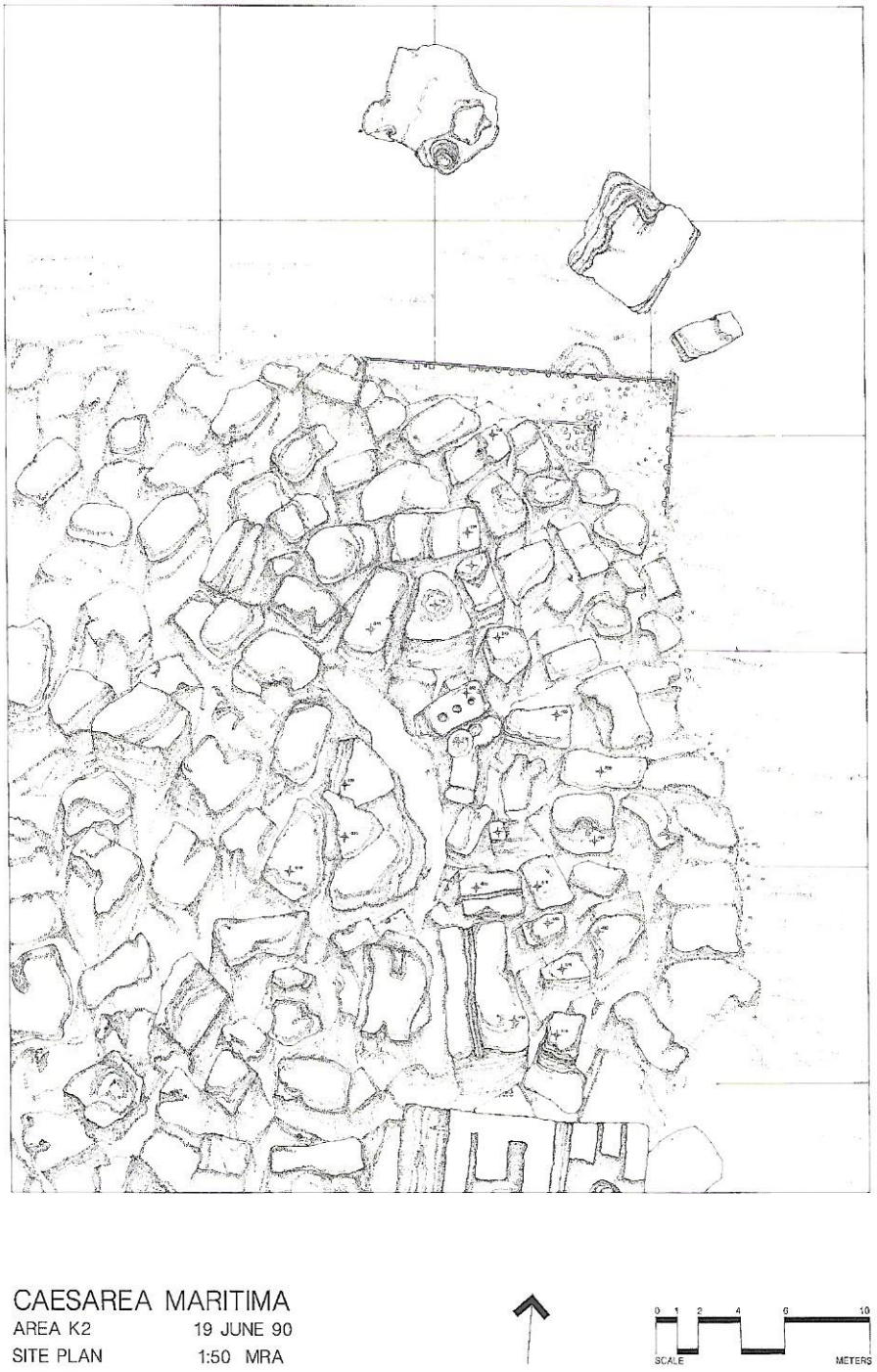

Figure 4. Drawing of "lighthouse" site made in 1990 at the outset of excavations in area K2 at Sebastos. Twin statue bases and/or pilae stand apart from the main structure. Courtesy of CAHEP

maneuver through the entrance channel. On the other hand, adverse weather conditions might have forced some captains to try a much more difficult night entry.

For ships about to enter the harbor mouth, probably under tow or haulage, the large structures on either side of the entrance channel would have clearly defined the proper and safe course. The colossal statues on their concrete foundations might have provided additional navigational guidance for marking the entrance, but this aid may have been offset by the potential danger they posed to marine traffic.

The yoked towers also might have been *pilae*, as Oleson and Branton recently suggested.[22] Above water the towers were linked to provide some type of platform for the monumental statues that distinguished and bracketed the harbor mouth. Below sea level, they were two distinct, discontinuous structures placed to provide one final measure of protection to the harbor mouth. Waves and currents rolling along the exterior face of the Southern Breakwater toward the entrance channel would have encountered one last manmade obstacle before reaching the most vital and vulnerable component of the harbor complex. Their presence might also have restricted the buildup of sandbars near the harbor mouth.

Oleson and Branton cited possible parallels at Puteoli in the Bay of Naples and elsewhere in Italy.[23] Although these *pilae* were not exactly like the Caesarea ones, the differences were in degree, not kind. As these scholars have stated, they may well have been of the same technological tradition.

There is another possibility to consider. If one looks carefully at aerial photographs of the harbor entrance, an interesting anomaly is visible (figs. 1, 2, 5). The *terminus* of the Southern Breakwater is less wide than the main structure to the south, even allowing for visible distortions of its Herodian configuration caused by the dumpage of rubble into the entrance sometime in the 690s C.E. or later.[24] It appears to lack the outer face of rubble spill, the *prokumatia* mentioned by Josephus, that baffled in-

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[22] Oleson and Branton, "Technology of King Herod's Harbour," 56.

[23] Ibid. See also the chapter by Piero Gianfrotta in this volume.

[24] The exact width of the harbor entrance to the Outer Basin is unknown. Early estimates, ca. 20–30 m., were too low (e.g., Hohlfelder et al., "Herod's Harbor at Caesarea," 139, although still supported by Raban, *Site*, 282). The western face of the channel has not yet been located, so speculation is still all that is possible. See my estimate of ca. 85 m., based on measurements from the line of concrete blocks forming areas K2, K3, K5, etc. to the pierhead of the Northern Breakwater (fig. 5).

As Oleson cautions, however, a large entrance would have facilitated easy ingress and egress from the enclosed basin of Sebastos, but would have rendered it more vulnerable to storms. See J. P. Oleson, "Area D3: Probe for West Wall of Entrance Channel," in Raban, *Site*, 119. Such a wide entrance, however, compared favorably or was a bit narrower than harbor mouths at other major Imperial ports. See Vann, "Drusion," figs. 3, 5, and 7 for the plans of Alexandria, Portus, and Leptis Magna. Roman Kenchreai's entrance was well over 100 m.; Paphos, on the other hand, was just over 40 m. See Scranton et al., *Kenchreai* 1:fig. 5; J. R. Leonard and R. L. Hohlfelder, "Paphos Harbour, Past and Present: The 1991–1992 Underwater Survey," *Report of the Department of Antiquities Cyprus* (1993), 375.

The date of the blocking of the harbor entrance and the extent to which its original size was reduced remain controversial questions. Raban would date the blockage and the complete sealing of the channel to the time of the Anastasian renovation ca. 500 (Raban et al., *Field Report* [1992], 3 and passim). I argue

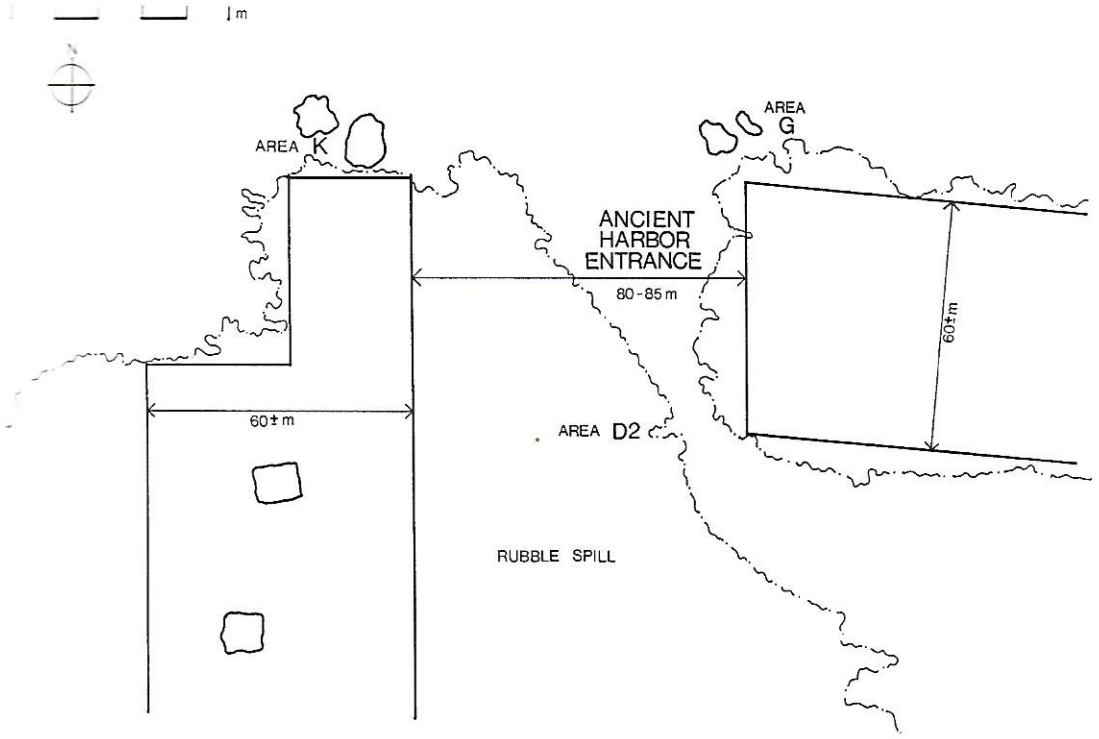

Figure 5. A hypothetical rendering of the harbor entrance to the outer basin of Sebastos. Drawing by Kathryn H. Barth

coming waves and prevented them from rolling directly against the concrete blocks with their full kinetic energy intact (figs. 1–2).

Could it be that originally the Southern Breakwater did not extend as far as what is now called area K2 by its excavators, but stopped some distance to the south, as aerial photographs may indicate?[25] If that were the case, the off-breakwater statue towers might once have played a clearer role in traffic flow into the entrance channel. Perhaps local sailing procedures or pilots for Sebastos required that entering ships

for a later partial dumping of rubble into the entrance to reduce, but not close, the harbor mouth; see "An Experiment in Controlled Excavation," 104, and R. L. Hohlfelder, "Anastasius I and the Restoration of Caesarea Maritima's Harbor: The Numismatic Evidence," in A. Biran and J. Aviram, *Biblical Archaeology Today 1990* (Jerusalem, 1993), 687–96.

[25] In the comments following the presentation of this paper, A. Raban commented that the "missing" section of the *prokumatia* had been sheared off and had disappeared beneath the sand during a very localized subsidence that did not affect the rest of area K and the Southern Breakwater. One wonders at the surgical precision of such an event and the highly selective damage it caused. I believe I offer an explanation that is at least as credible.

stay to one side of them, while departing vessels hove to the other.

At some point in the Early Roman era, an extension of the Southern Breakwater, much narrower than the main structure, could have been constructed to correct what would have been a serious design error made by the Herodian master builders.[26] Placing a relatively narrow spit of concrete blocks (each ca. 14 x 7 x 4 m.) on an approximate N-S axis to a point where the extension reached the northern limit of the other breakwater would have diminished the exposure of the entrance channel. This renovation would have insured that the Southern Breakwater overlapped the end of the northern one and protected the harbor mouth from seas running from the west or southwest.

After the concrete blocks were in place in area K, they could have provided a base for a lighthouse or a multipurpose tower to mark the western face of the harbor mouth. Considering the narrowness of the platform this line of blocks offered, it is not likely that too massive a structure ever stood there. Any lighthouse would probably have been less impressive than the one recently suggested by Robert L. Vann.[27]

Such a renovation, of course, would have changed the way ships entered and left the channel and would have brought the yoked towers much closer to the Southern Breakwater itself. Their new position would have rendered them less vital as a navigational aid and almost redundant in this regard. It is clear, however, that they were not removed. The statues they supported were not relocated to the breakwaters themselves, as Josephus clearly indicated, although such placement would have rendered them less exposed to the ravages of the sea.

This suggestion for the unusual positioning of the tower bases is offered only as one more hypothesis for the current excavators to test in their future fieldwork.[28] To date,

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[26] See Christopher Brandon's chapter in this volume for a discussion of the excavations and survey of the extraordinary single-mission barges constructed in such meticulous detail that distinguish area K. A. Raban informed me that all 20+ C-14 samples taken in and around area K provide an average date early in the first century C.E. (ca. 10 C.E.?), some years after the actual construction of the harbor. But allowing for normal deviations of C-14 dating, this cluster of somewhat later dates can only be described as interesting, not definitive. Dendrochronological dates, which will provide far more accurate chronological reference points, are not yet available for the K samples.

[27] Vann ("Drusion," 137) estimates its possible height to be ca. 40 m., but allows that a reconsideration may be necessary as fieldwork continues.

[28] See Brandon in this volume for arguments against this suggestion. Although I had a chance to hear his paper and to discuss my hypothesis with him and A. Raban before, during, and after the session at which I offered this possible reconstruction, I shall have to respond to his specific comments in another venue after I have had an opportunity to study his written text.

Another significant body of evidence relevant to this question is the pottery recovered during excavation beneath these single-mission barges, particularly from the tunnel cut in area K2. A preliminary field reading of some of these artifacts seemed to indicate first-century C.E. sherds in this assemblage.

Since the locus from which these artifacts were recovered was as close to being a sealed deposit as one is likely to find in harbor archaeology, the publication of all the ceramic material from this excavation will provide important, and perhaps definitive, data for establishing the date of construction of this segment of the Southern Breakwater.

The appearance of apparent wreckage from a ship in area K, tentatively assigned to the reign of

Oleson's contention that the towers functioned as *pilae* is the simplest explanation, although one wonders whether they would have had any meaningful impact on the dynamics of the entrance channel. But as all archaeologists have learned and relearned in the field, in simplicity there is often truth. It may well be that they represented one more experiment in deflecting current and silt from a harbor entrance. Their purported functional value may have outweighed the obvious risk factor in the minds of the master builders.

After Sebastos was functioning as the main harbor of Caesarea, sometime after 15 B.C.E. as I have argued elsewhere, what happened to the master builders from the West who had completed their special assignment for King Herod?[29] What was their next harbor project or, stated another way, where did they apply the lessons learned at Caesarea?

Although a major harbor installation was under construction at Kenchreai, Greece, the archaeological data uncovered there in the 1960s do not suggest that any of the three features discussed above or any other distinct aspect of Caesarea's construction, notably the extensive use of hydraulic concrete, was employed at Corinth's Saronic Gulf port.[30] More traditional methods of harbor construction, most likely funded by local sources and employing Greek builders, were followed there, for it is likely that Corinth constructed its eastern municipal harbor from its own resources and without imperial easement of the considerable financial burdens inherent in such an undertaking.

Kenchreai's construction over an extended period of time was far more typical of how maritime installations came to be than the sudden genesis of Sebastos backed by royal patronage. The building of Corinth's eastern harbor counters an assumption one could easily make. It would be a mistake to assume that the new technological advances embodied in Caesarea's breakwaters immediately swept away all other methods of construction or repair, for the evolution of harbor design was not rigidly linear.[31] The nature and extent of new installations or renovations of existing facilities

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Domitian, might well date from the time of the construction of the concrete spit. See A. Raban, "Area K," *C.M.S. Newsletter* 21 (1994), 3, for a brief report of this find.

[29] R. L. Hohlfelder, "The Changing Fortunes of Caesarea's Harbours in the Roman Period," in *Caesarea Papers*, 76. There I suggest that A. Raban disagrees with my dating for the completion of the harbor (n. 13). My comment was based on a reading of a draft of Raban's paper and not the final version as it appears in *Caesarea Papers*, 74; it appears that we now agree on this point. Sebastos was largely finished and functioning when M. Agrippa visited King Herod's port city in 15 B.C.E. Final work on the support structures on the breakwaters, however, could have continued for years after the harbor's ceremonial dedication.

[30] Hohlfelder, "Roman Harbour at Kenchreai," 83–85; Scranton et al., *Kenchreai*, 1:19.

[31] I follow here the observations of J. P. Oleson, who also notes: "What we can see across time is the gradual evolution of a repertoire of techniques that gave each succeeding Mediterranean culture greater flexibility in design and a better chance of success": Oleson, "The Technology of Roman Harbours," *IJNA* 17 (1988), 148. See also D. Blackman, "Bollards and Men," in I. Malkin and R. L. Hohlfelder, eds., *Mediterranean Cities: Historical Perspectives* (London, 1988), 8. Blackman slightly misinterprets my comments in "Roman Harbour at Kenchreai," 85. I did not say, nor mean to imply, that hydraulic concrete

did not depend on technology alone. Political and economic considerations were the more likely determinants. With imperial or royal support, more was possible faster. If only municipal funding was available, things moved at a slower pace, and more traditional solutions to problems were likely to have been employed. A port city's needs and its available resources determined the face of its harbor.

But it is true that Caesarea did open a new technological door for the ages that followed. Henceforth harbors could be constructed anywhere political or economic considerations dictated, providing adequate financial support existed. Of course the Caesarea experience was unique, and the technological explosion that it represented did not mean that all Mediterranean harbors constructed or repaired after 15 B.C.E. would follow or modify that model. One, however, that was also blessed with imperial patronage, may have (fig. 6).

A situation that may well have occasioned the imperial dispatch of master harbor builders, perhaps even some of those that had worked for King Herod, occurred in 15 B.C.E. An earthquake struck Paphos, the Roman capital of Cyprus, in the same year that Marcus Agrippa visited Caesarea to commemorate the completion of the harbor installations (fig. 7). It must have caused massive devastation, for Augustus himself personally provided assistance to the Paphians, no doubt in response to the appeals of those residents who had survived the crisis and to the entreaty of the provincial governor who resided there. According to Dio Cassius (54.23.7–8), the only source for this catastrophe, the emperor also permitted the city to add the honorific "Augusta" to its official titulature. At that time, as he noted, this designation had some significance, since it required a confirmation vote of the Roman Senate. By the author's day (ca. 230s C.E.), as he also asserted, cities on their own initiative adopted this title, thereby diluting its honorific importance.

Dio Cassius regrettably provided no details on the extent of the damage to the city or to the harbor, but one can assume that the disaster was of great magnitude, or the emperor would not have personally intervened. Any substantial tectonic activity would surely have damaged the breakwaters, which appear to have rested on the sandy ocean floor without the benefit of the riprap foundations found underlying the enclosing arms of Caesarea's outer basin. Liquefaction of the underlying sediments must have occurred whenever a substantial earthquake struck nearby. This momentary outflow of sand would have resulted in subsidence of portions of the breakwaters with resultant damage to any structures that stood on them. In this instance, it is

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was ever an *arcanum* (his word, not mine) per se, kept in some way from builders who may have been commissioned locally to construct or repair a municipal harbor. My argument was that the composition and means of employment of this material might have remained unfamiliar or improperly understood (= "secret" in this context) to workmen who may never before have been called upon to execute a complicated commission in a marine environment, such as the construction of breakwaters into the open sea.

The underlying issues, however, are how fast new technology spread in the Roman world and how this transfer of knowledge occurred. Blackman asks these questions as well ("Bollards and Men," 7); at this time we can only speculate.

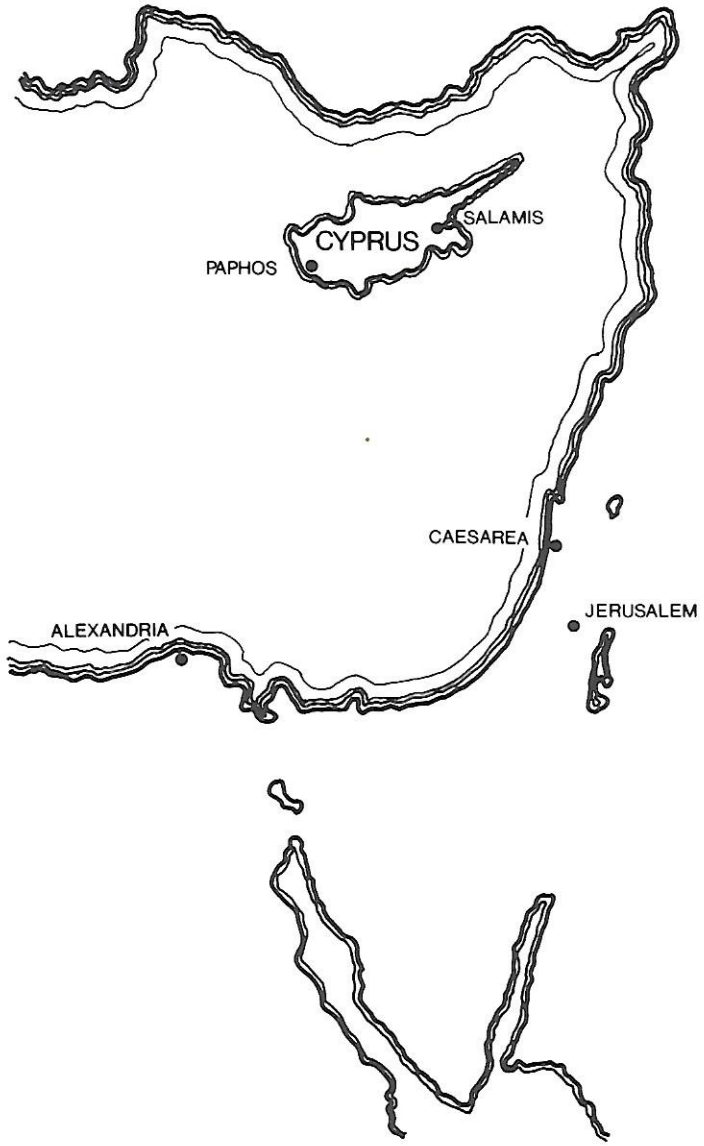

Figure 6. Paphos, the Roman provincial capital of Cyprus, stood on the major west to east sea lane in imperial times. Ships destined for Caesarea most likely stopped at this Cypriot port before commencing the last leg of their journey. Depending upon winds and sea conditions, this final segment may have taken twenty-four to thirty hours. Sketch map by Kathyrn H. Barth

Figure 7. An aerial view of the Paphos promontory and the modern harbor of the port city (looking N). The anchorage today is shielded by only one breakwater. In Antiquity, there were two. Photograph by David Rupp

hard to imagine how an earthquake of sufficient intensity to warrant imperial benefaction would not have severely wounded the harbor installations. Further, any restoration efforts in the provincial capital sponsored by Augustus would surely have embraced its harbor, for it was both the most vital and vulnerable installation in the port of Paphos and the major emporium along the entire western and southern coast of Roman Cyprus.[32]

Of course, imperial aid came in many forms.[33] There can be no certainty that

[32] There is still no archaeological evidence to confirm that the harbor was damaged at any time during one of the several earthquakes that struck Paphos during the Roman era. The eventual subsidence of the breakwaters is an incontrovertible fact, but the date and cause of this slumping remain uncertain.

[33] For example, at Caesarea Maritima there is a numismatic record of imperial assistance for repairing or renovating Portus Augusti, as Sebastos was then called, during the reign of Trajan Decius (249–251 C.E.). Cf. Hohlfelder, "Changing Fortunes," 78, and Oleson et al., *Finds*, 161. Raban, however, feels the Portus Augusti coin series was an unfulfilled plea for imperial assistance to resuscitate an installation that had slipped beneath the sea more than a century before; see "Sebastos: The Royal

master builders were actually dispatched to Paphos to repair what nature had damaged. Money might have been the extent of the Augustan intervention. But relief in some form was extremely likely, since the emperor himself had decided to help his Cypriot capital recover and went so far as to allow the restored capital to add his name to its own official nomenclature. Skilled master builders who had just finished, or were finishing, their assignments at Caesarea might have been candidates for this new commission. The extent of the disaster and the nature of the structural damage to the Cypriot capital would have determined what competencies were required. No texts exist that make this connection, but under the sea, the technological signature of the builders of Sebastos seems visible in the extant remains of the ancient Paphian harbor.

To date, only underwater survey has been conducted in the harbor of Paphos by two teams of scholars, one headed by W. Daszewski in 1965 and the most extensive one by the author in 1991 and 1992.[34] There was also an amateur effort by British military engineers and sappers between 1959 and 1961 and an informal investigation by Avner Raban in the early 1970s. No excavation, however, has yet been undertaken by any archaeological mission, although recent dredging in the basin of the harbor and in the modern entrance has uncovered numerous artifacts and provided incidental information about the ancient facility.

In the absence of any systematic and extensive underwater excavation, the following observations about the function and date of the extant underwater structures can only be preliminary. West of the entrance of the ancient harbor, a rubble spur projected from the outer face of the western breakwater for a distance of at least 50 m. (figs. 8 9). Today it is mostly obscured by modern spill dumped into the sea during harbor renovations in the 1980s, but it was far more apparent in 1965 when Daszewski explored this area. In Antiquity this structure, which might have been gapped in its design, had been constructed to afford protection to the harbor mouth

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Harbour at Caesarea Maritima A Short-lived Giant," *IJNA* 21 (1992), 111. Such a petition would have been unusual (perhaps unique?) in Roman civic coinage. Reverse types normally commemorated actual events, traditions, or real benefactions that loomed large in a city's self-identification and civic pride. They were not normally used to recall municipal structures long out of service.

At Caesarea in the mid-third century C.E. or at Kenchreai, where a harbor coin of Antoninus Pius may have commemorated some imperial gift to the port (R. L. Hohlfelder, "Pausanias II, 2, 3: A Collation of Archaeological and Numismatic Evidence," *Hesperia* 39 [1970], 328), we cannot be sure what form any imperial aid may have taken (e.g., a donative, tax relief, or authorization for a special levy on transshipment trade, etc.). Certainly at Caesarea, the geopolitical circumstances in Palestine and the eastern Mediterranean were not the same ca. 250 C.E. as they had been ca. 22 B.C.E. It is not likely that master harbor builders from the West were dispatched by Trajan Decius. It would have been left to local authorities to use best whatever financial assistance they had received from Rome.

[34] For the literature on the port city of Paphos and the harbor installations specifically, see Hohlfelder and Leonard, "Underwater Explorations at Paphos;" Leonard and Hohlfelder, "Paphos Harbour, Past and Present," 365 80; and R. L. Hohlfelder, "Ancient Paphos beneath the Sea: A Survey of the Submerged Structures," forthcoming in *Cyprus and the Sea*, ed. V. Karageorghis (Nicosia, 1995). These articles also explain in some detail the extant structural features of the harbor.

Figure 8. Renovations to the western breakwater at Paphos in the 1980s, namely, the addition of a ca. 23 m. wide rubble baffle, allowed the port authorities to remove a seawall that had once formed the main defensive line against storms. Ruins in the sea south of the remains of the Frankish Fort mark the line of the ancient spur. Photograph by R. L. Hohlfelder (looking E)

from storms from the west. It baffled incoming waves and diverted them from rolling across or through the entrance with all their kinetic energy intact. At the same time, it deflected or diverted sediments from entering the main basin. It was a design feature intended to control harbor siltation (fig. 10).

Such a spur might have dated from the original *limen kleistos* constructed by Ptolemy I late in the fourth century B.C.E. or from sometime later in Paphos' Hellenistic history, but an Early Roman date seems more likely. Its sophisticated double function of deflecting waves and deterring sediments from entering the harbor installation speaks more of Roman technology than that of earlier eras.

In its intent, it is not unlike the purported *pilae* near Caesarea's harbor mouth or even the line of concrete blocks of area K currently under exploration (if my contention stated above is correct), but this deflector may have been more effective at achieving the purposes for which it had been constructed. Its mass, length, and angle in relation to prevailing wave patterns and current would have rendered it more

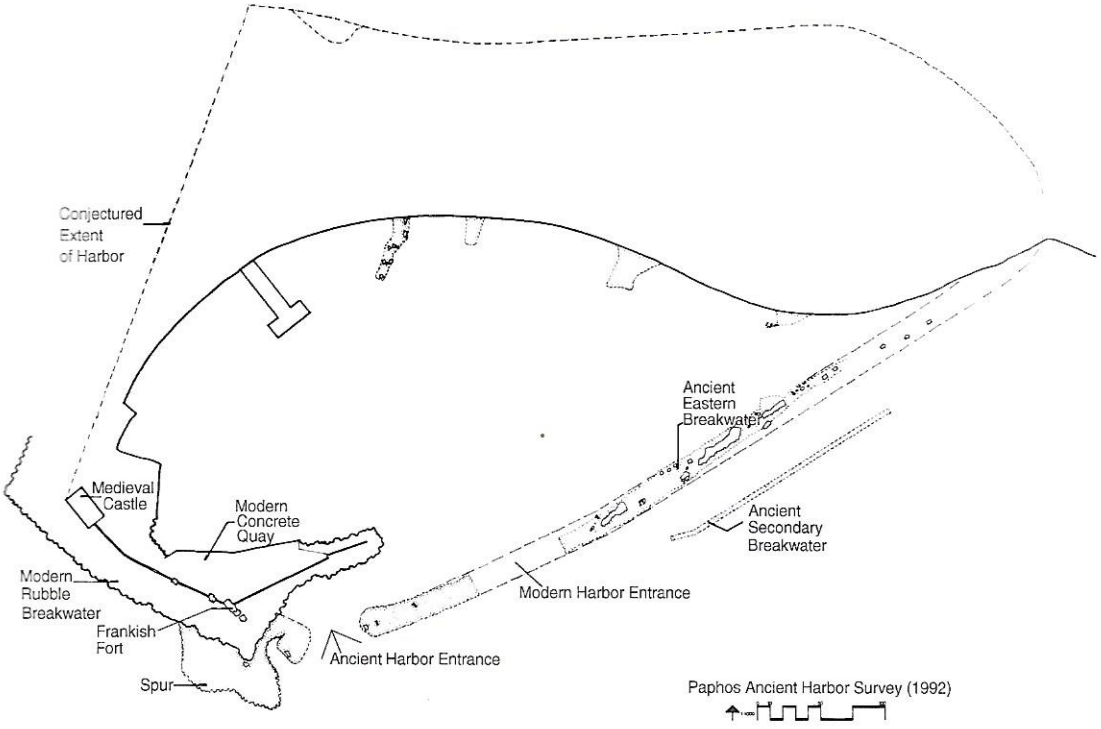

Figure 9. Extent of the closed basin of the Paphos harbor. Drawing by Kathryn H. Barth

efficient in protecting the Paphos entrance channel from the perennial banes of waves and sand. Could this installation have been added during repairs to the Paphos harbor following the catastrophe of 15 B.C.E.? Could it have been constructed by master builders who had faced a similar situation elsewhere, specifically at King Herod's city on the sea, and subsequently had modified their earlier efforts to fit the needs of a new site and to accommodate their previous experience? No certain answers to these questions are possible in the absence of underwater excavations, but this scenario provides a likely starting point for future fieldwork at Paphos.

Two other structures have striking similarities to alleged design features in Herodian Sebastos. The eastern breakwater of the Paphian harbor now lies in ruins, the victim of earthquake damage over the past two millennia, centuries of neglect, and the demise of the city's status as an international emporium on the major sea-lanes of the eastern Mediterranean (fig. 11). Seaward of this structure, just below mean sea level (M.S.L.), is a secondary or subsidiary breakwater that runs parallel to the course of the main one for ca. 100 m. of its length (fig. 12). It appears to shield at least two large channels (ca. 4 m. in width) that were cut through the main massif of the eastern breakwater at some time in its long existence.

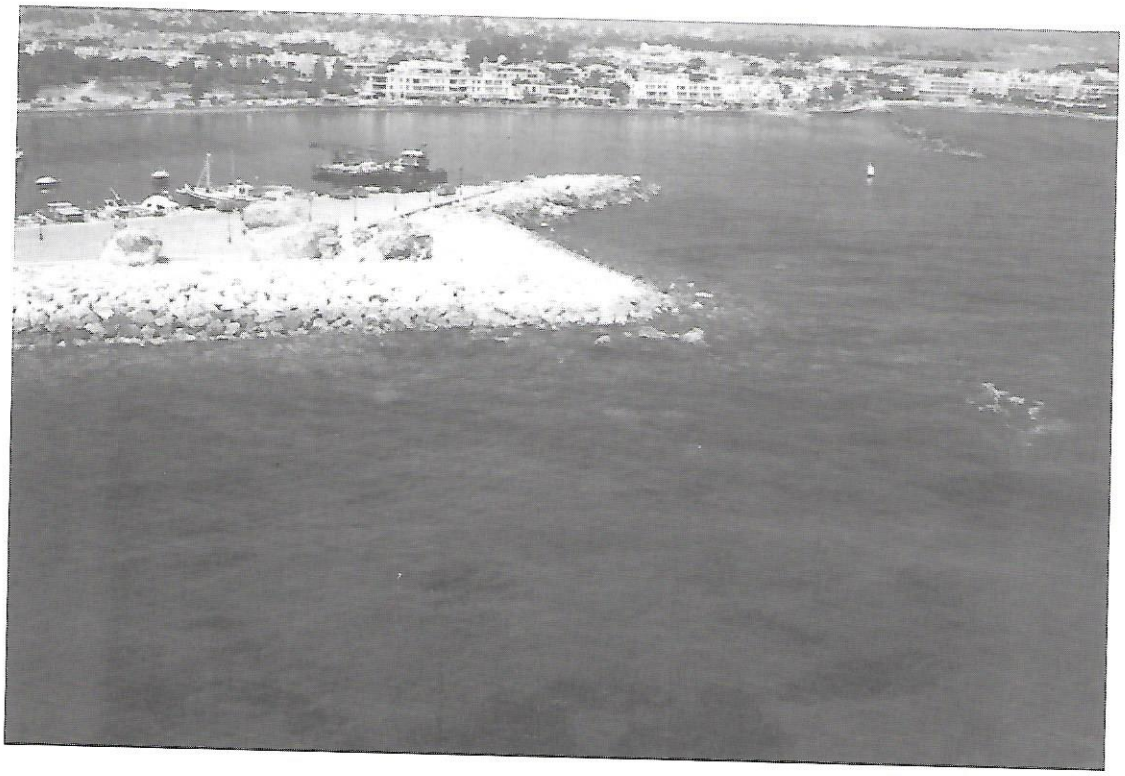

Figure 10. The remains of the spur at Paphos are visible underwater extending from the southern point of the modern rubble breakwater face. Photograph by R. L. Hohlfelder (looking NE)

Although the purpose of the second parallel breakwater is not yet known for certain, one is struck by its position vis-à-vis the main structure and the breach channels it shielded. As at Caesarea, it may have been constructed to afford a first line of defense to the eastern breakwater and/or to protect the manmade breaches from incoming storms that might have ripped into the enclosed basin if it had not existed.

In this case, the channels probably were cut to attempt to provide exits for the silt-bearing current that would have entered the harbor mouth and circulated clockwise. Without such outlets to the sea, sediments would have begun to clog the eastern portion of the harbor, quickly rendering it useless without extensive dredging. By changing the basic design of the eastern breakwater and physically embedding in it a structural solution to the siltation problem, the builders or renovators manifested a most advanced knowledge of using harbor design to combat natural forces. What is unknown, of course, is whether such features actually functioned as intended.

As stated before with regard to the deflecting spur, the purpose of these features

Figure 11. The remains of the eastern breakwater at Paphos and the subsidiary structure running parallel to it. Photograph courtesy of the Department of Antiquities, Republic of Cyprus

cannot yet be ascertained definitively nor can their date. They might have been original elements, but it seems unlikely that breach channels would have been in place when the city walls ran down the spine of the eastern breakwater all the way to the harbor entrance. Any passageways beneath the fortification system could have compromised the city's defenses by providing entry points for determined enemy soldiers. Since it is likely the fortifications of the city were maintained in some fashion or another until Rome had dealt with the Cilician pirate menace in the early 60s B.C.E. and had absorbed Cyprus into its empire in 58 B.C.E., the channels were probably of later date. Once again, 15 B.C.E. or the years immediately following could have been a time when both the breach channels and the subsidiary breakwater designed to protect them, while still permitting the egress of silt to the open sea, were constructed. By then a *limen kleistos* would have been a military anachronism during the Roman quiescence that had descended on the island.

One can note again that both features in slightly different forms seem to have been part of the design of King Herod's harbor. There, as noted above, excavators have

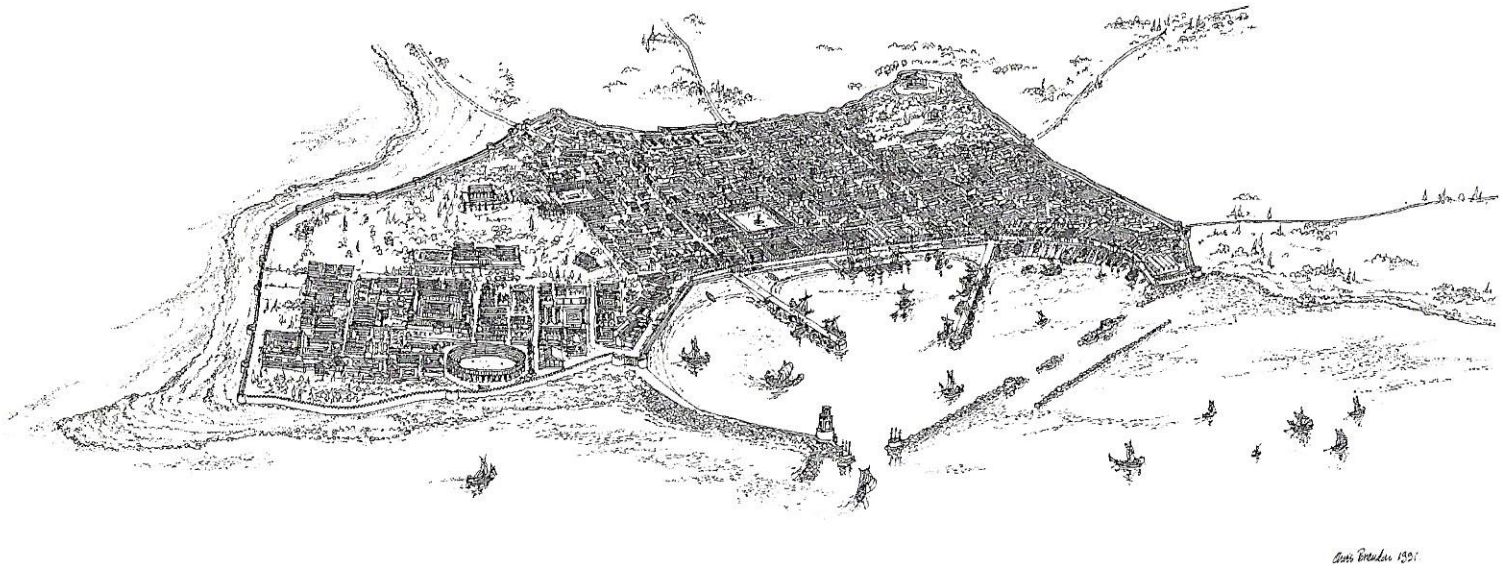

Figure 12. An artist's sketch of the Roman harbor of Paphos, after the earthquake of 15 B.C.E. It incorporates literary evidence, survey data, and considerable creative imagery. Drawing by Christopher Brandon

found a secondary mole designed to protect the Southern Breakwater and at least one, and possibly more, channels cut through the massif of this structure. At Caesarea the channel(s) was seen as part of a sluicing or flushing system intended to permit water to enter the harbor; at Paphos their purpose was exactly the reverse. But both functions would have addressed the same underlying problem – the deposition of sediments in an enclosed basin.

Perhaps there were Caesarea antecedents for the Paphos harbor repairs. If so, the lessons learned at King Herod's harbor were quickly applied at another important eastern Mediterranean provincial capital and international port city. Imperial interest, involvement, and investment might well explain the rapid deployment of the new technological advances. At this moment, however, given the absence of underwater archaeological data from Paphos, this is only speculation offered as a working hypothesis. Future fieldwork beneath the sea at Aphrodite's city will confirm or refute it.[35]

[35] No excavation beneath the sea has yet been undertaken, but underwater survey on reefs and in bays near the Paphos promontory continues; see R. L. Hohlfelder, "The Cave of the Amphoras," *Biblical Archaeologist* 58 (1995), 49–51.