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РЕДАКТОРИ
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ТРАКИЯ ПОНТИКА СЕРИЯ I

ДОКЛАДИ ОТ МЕЖДУНАРОДНИЯ СИМПОЗИУМ

ЦЕНТРАЛНА БАЗА ЗА ПОДВОДНИ АРХЕОЛОГИЧЕСКИ ПРОУЧВАНИЯ

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Maritsa, ancient Hebros, comes into consideration as a trade route already because of the position of the city close to the river bed, on its terraces. That is why the ruins of the ancient city are now covered by thick layers of deposits carried down by seasonal flooding. Even Nestos marked the way from the mother city of Pistyros.

Regarding Central Europe we may consider two parallels from Roman times, describing military outposts far away from the imperial Roman territory out in the *barbaricum*. They may help throw light on the particular position of Pistiros. The Roman fort of Marktbreit (Pietsch et al. 1991) was founded on the Main (Mayence) and in Mediaeval times there still was an important river port on the spot. The Roman outpost at Mušov in Moravia lies deep in *barbaricum*, but it was also on the Dyje river which was navigable for small boats in Mediaeval Times and until the last century (Friesinger and Tejral forthcoming; Bouzek et al. 1994 forthcoming), so that even building materials, such as tiles and bricks, could easily be brought to both places from the Roman territory proper.

Small objects could be transported by pack animals, but this is impracticable for brittle pottery and impossible for heavy wine amphorae and their contents. The distribution maps of wine amphorae in particular show clearly that throughout the whole Black Sea region (Lazarov 1975; 1986; Bouzek 1990, 100-101) (as well as in southern France) the main transport routes for larger quantities of wine with their clay containers from the sea ports must have been the rivers. Even when the rivers were only navigable for small boats carrying a rather modest cargo, they undoubtedly formed the main axes of the trade. Rivers connect the sea with the mainland: they nourish the sea by their waters and also enable men and animals to penetrate the hinterland. This is the easiest way for both the cargo to be transported and for men to find their way in a country without proper roads and overgrown with forests and bushes, as was the case in large parts of the Thracian hinterland in antiquity. The trading posts on rivers, like our Pistiros, were also inland harbours, rather modest compared with those on the coast, but with direct access to the local hinterland markets. This trade was certainly one of the main reasons for the foundation of Pistiros and for the flourishing of its economy, attested by the monumental architecture of its houses and fortifications, which are both comparable to that of the coastal Greek towns.

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WOODEN CAISSONS FOR HYDRAULIC CONCRETE AT THE HARBOUR OF CAESAREA

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Caesarea is located today half way between Tel Aviv and Haifa on Israel's Mediterranean coast (Fig. 1). It was here that Herod the Great built the city of Caesarea Maritima with Sebastos its huge harbour complex. Although Herod chose the then ruinous town of Stratos Tower as the nucleus for his new city and port, it had no natural features that made it suited to the formation of a large harbour, a fact vividly recorded by Flavius Josephus.[1] He noted the absence of any suitable anchorage along the coastline of the region from Dor to Jaffa and how even in mild weather conditions the sea was always rough. The problems associated with the site did not impede Herod or his engineers and he created an almost entirely 'man made' harbour using mostly imported skill; material; and probably labour within an incredibly short time.

There can be little doubt that Roman specialists were called in to assist Herod on this project, for in order to build this harbour of over 200,000 m2 in little over a decade (c21-10 BC) all the ingenuity of Roman engineering techniques were employed including the extensive use of hydraulic concrete made with pozzolana.

To be able to meet the timescales imposed by Herod it was necessary to work on many fronts at the same time. It has been suggested by Professor Avner Raban that 'construction islands' were set up at the outset of the project at key points around the planned outline of the harbour from which the infill sections could be extended.[2]

[1] Josephus describes the sea and coast conditions of this part of the coastline in both of his texts on the city (Thackeray 1927, 192-194; Marcus 1963, 160-162; Oleson 1989).

[2] Raban proposes that the first feature the engineers built was an artificial island, situated where eventually the top of the main mole would be, some 500m N-NW of the top of the southern promontory and about 350m due west of the stem of the northern one. Another one was installed half way along the curved line of the main mole at the turn

Concrete platforms formed the bases of these 'islands' and different techniques were evolved in the building of them, the variations in design being mainly due to site constraints although evolution of design could also be a contributing factor.

In 1982, in area G (Figs 2 + 3), evidence of the original timber formwork for several large rectangular concrete blocks on the end of the northern breakwater provided details on how one version of these bases were constructed (Oleson 1989, chapter III. F., 127-130). The wooden forms or caissons were 15m x 11.5m on plan and 2m high, and consisted of a double wall of planking with a 23cm gap between mounted onto a 29 x 29cm sleeper beam. The interior of the form was strengthened by timber ties and struts but there was no bottom or floor to the caisson itself. The double wall provided the required floatation to move it from the shoreline out to the site. It could then be sunk into place when filled with a pozzolana based concrete. The solidified concreted walls then provided a permanent containment for the fill of hydraulic concrete that comprise blocks that still largely remain in situ. These caissons are a combination and adaptation of techniques described by Vitruvius.[3]

This paper will concentrate, however, on the particular design of a concrete filled timber caisson that was found in area K at the end of the main southern breakwater. Evidence of these structures was found initially in 1990 and studied over the following seasons under the direction of Prof. Avner Raban of the Centre for Maritime Studies of the University of Haifa. This is a summary of the findings to

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of its course from the west to a northerly direction, and also one at the tip of the northern breakwater (Raban 1992a).

[3]Oleson believes that the caisson design at area G is a conflation of two major types of formwork described by Vitruvius, in an adaptation of the basic principles involved to a third type of situation. "The engineer knew from the start that he was working with a hydraulic concrete that could be poured directly in the sea water, but the character of the sandy sea bed and rubble breakwater foundation made it difficult to fix prefabricated forms in place by means of pilings. In consequence, bottomless, double-walled wooden forms were constructed on shore and floated out to their final destination. Once the footings had been cleared and levelled by divers, mortar was poured into the hollow sections of the double-wall, until the buoyancy was overcome and the form settled onto the prepared sea bed. While the inundated form was being filled with cement and aggregate, rubble was also dumped around the periphery to prevent shifting of the formwork prior to the curing of the concrete, or undermining of the final block. Although Vitruvius' single-walled forms were prefabricated, pounding their uprights into the harbour floor would have been a difficult and time consuming process." (Oleson 1988).

date rather than a definitive statement as the excavations and investigations are still continuing.

Early on in the 1990 season a straight edge feature was noticed in area K (Figs 2 + 3). This feature had become apparent due to the unusually low level of the sand cover that year.

Area K, which is at the northern end of the main southern breakwater, consists of a chaotic pile of enormous tumbled concrete blocks with an average size of 3.5 x 4.5 x 1.5m, many still retaining the impressions of timber formwork into which the concrete had been poured, together with large kurkar blocks.[4] This mound is spread across the site and rises from the current seabed depth of between 7-8m to within 2m of the surface. It has been assumed that this was the collapsed remains of the lighthouse structure or Drusion described by Josephus as being the tallest and most magnificent tower of a series built at intervals along the stone wall that encircled the harbour.[5] The location being at the mouth of the harbour made this a likely candidate for a lighthouse site (Vann 1991).

Excavations during the 1990 season and over the following years have revealed details of a series of concrete filled timber caissons approximately 14m x 7m on plan and over 3.5m high. The caissons are set out in a 'header' fashion (Figs. 4 + 5) although not in a straight line or uniform depth (the depths of the bottom planking vary between 9m to 7m below MSL).

Excavation techniques had to suit the terrain which was covered in massive concrete and stone blocks. The first caisson to be excavated, K2 , was the most straight forward as it was not completely buried beneath the mass of collapsed structure. However, to reveal the detail of the timber elements that comprised the original formwork, it was necessary to dig down through consolidated concrete by as much as 1.5m.

This was not possible at K3 due to the extent of the overlaying concrete and tumbled masonry which was in excess of 4m thick. Although some parts were in a somewhat fragmented state marine growth had reconcreted it together. Consequently,

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[4]Kurkar, the local building stone, is a relatively soft and porous carbonate-cemented quartz eolianite sandstone (Oleson and Branton 1992, 58-63).

[5]The towers at the entrance were described by Josephus in the first century: "At the harbour entrance there were colossal statues, three on either side, set up on columns. A massively built tower supported the columns on the port and two upright blocks of stone yoked together, higher than the tower on the other side." (Thackery 1927, translated by J. P. Oleson).

in order to investigate the nature of the structure of K3 and examine its bottom planking and to be able to compare its construction details with that of K2, a vertical shaft was constructed against the edge of the caisson (Fig. 6) and a tunnel was driven underneath it for a distance of over 4m. (Fig. 7).

In the other areas to the south of K2 and K3 the extent of the collapsed structure severely limited the sites where probes could be made. However, due to an erosion layer existing just above the floor timbers on K5 it was possible, after the removal of some large blocks, to enter a labyrinth of tunnels which ran under the tumbled structure. With only a minimal amount of further excavation it was possible to uncover a large area of the caisson floor, although unfortunately erosion had obliterated all visible evidence of vertical structure.

K8 was very badly broken up and there is evidence that this may have started in antiquity as excavations around the displaced fragments of the K8 caisson have uncovered a wreck site dating back to the 1st century AD (Raban unpublished notes), and it could only have got to where it did by sinking on top of it.

There is no apparent timber formwork remaining of K9, however, the concrete block does substantially remain, although split in half, and lies within the 14m x 7m footprint and has an overall height of approximately 4m.

Each block was originally 14 x 7 m on plan and approximately 4m high. These concrete blocks were cast within a different design of shuttering to that found at area G. The wooden formwork, of which substantial parts still remain below the current seabed, consists of a single watertight skin built with a floor in the same manner as shell-first ship construction. All the timber planks were edge fixed with tenons let into mortises and transfixed with treenails. The interior was then stiffened with floor beams, stringers, ties and raking struts. The resultant rectangular 'barge' could be floated out to the site in a similar manner to the caissons found at area G.

The development of this alternative design was the direct result of specific site and timescale related problems. The early completion of the main southern breakwater would have been crucial to the success of the development, making the northern breakwater and internal jetties much easier to build within its lee. The site at the terminus of this main breakwater would obviously be a crucial point to establish a 'construction' base at the outset of the project. However, it presented the designers with particular problems in working at the extremities of the area and being subjected to difficult sea conditions of large swells and strong long shore currents. The designers chose a rectangular barge which could weather the sea conditions and

enable them to ship to site a quantity of concrete within it. Being rectangular they could be sunk side by side to form a solid foundation for the overlaying structure. The open bottomed caissons would not have been suitable for the open sea as the double walled floatation section would have been susceptible to being swamped and flooded from swells and breaking seas and would easily founder, and were consequently restricted to protected areas such as the northern breakwater.

There are only minor variations in the construction of the three caissons that have been studied, which could be due to evolutionary improvements in design or simply due to the fact that they were built by different shipwrights. These barges were rectangular, flat-bottomed craft 14m long with a beam of 7m and a height of approximately 4m, and one at least had an inner central compartment 2.5m wide and 6.5m long (Fig 8).

They were built with planking, edge fastened with mortises and tenons which were transfixed with treenails in the same manner as traditional shell first ship construction. The pine boarding ranges in size between 19cm to 26cm deep by 8cm thick on the sides of the caisson and 19cm to 26cm by 5.5cm on the bottom and also on the walls to the inner compartment. No end joints in the planking have been seen and therefore it is not possible to say if they were scarfed, as would be expected in this method of construction.

The tenons, which are made from a hardwood, are on average 8 x 10cm and spaced at 20cm centres, although the upper boards on K5 have tenon spacing of 30cm. The tenons are secured with 11mm diameter treenails, and are arranged so that they are staggered from board to board. The planks were built up one by one rather than prefabricated and this is confirmed by the way the ends of the individual boards have been cut where let into the corner posts in sequence. There is no evidence of any caulking material between the boards, although there is the remains of a lime based cement slurry which has seeped out through the joint between the chine beam and the first plank and solidified, thus effectively sealing the gap.

A 26cm x 20cm chine beam forms the junction between the side walls and the floor (Figs 9 + 10). The planking on the sides is fixed to the chine beam with mortise and tenon joints secured with treenails. This also applies to the floor planking which runs parallel to the chine. However, the ends of the bottom boards are set into the chine beam at bow and stern. This section is rebated along its length and in the case of K2 has mortises cut to take the projecting tenons which were cut into the ends of the boards (Fig. 12), whereas K3 has a different design where the ends of the planks have been rounded on section and let into a similar rebate on the side of the chine (Fig.13).

The floor frames comprise 20 to 25cm by 20cm rough hewn pine sections, some still having bark adhering to them indicating that these were not secondary use timbers, set with an irregular spacing between each varying from 30cm to 70cm (Fig.9). The frames are fixed to the bottom planking with at least one treenail per board. The ends of the frames are set into the chine beam with a tenon which protrudes from the lower half of the frame (Fig. 11). It is therefore apparent that the frames were fitted before the chine beam was offered up and fixed to the sides.

The inner face of the chine beam at the bow and stern, which projects down below the level of the bottom planking, has a firring piece set against it to protect it from damage when the structure was launched (Figs 13 + 14). This detail does not appear on the underside of the side chine beams, clearly indicating the direction and method by which the caissons were launched.

The chine beam on the bow and stern projects out from the sides of the caisson by between 20cm and 30cm, and the complicated joint between the junction of the chine beams and the side wall planking is capped with a 4cm x 5cm quadrant section of timber which has been mitred and fixed around the chine beam (Fig. 17).

Stringers of approximately 25cm diameter, with bark still adhering, were nibbed over the frames and transfixed to them with treenails (Fig. 10).

Timber knee sections provided stiffness to the junction of the side planking, chine beam and bottom planking and were fixed in place with treenails and iron pins (Figs. 10).

Diagonal bracing or raking members provided rigidity between the inner compartment and the outer side wall planking. These raking props were braced off the frames, stringers or knees and secured at their heads by beams or directly onto the side frames.

Beams positioned between the inner compartment and the outer side frames were set at approximately 2m above the floor frames and projected through the side wall planking (Fig. 9). This was above the water line of the 'barge' when floating with an initial fill of approximately 0.5m of concrete.

The inner cell, of which evidence remains in K2 but not in K5, is formed directly off the bottom planking and the floor frames are discontinuous either side of it. The function of the inner cell, which is built in the same watertight construction as the main part, can only be surmised. It could well have served as a central stabilising

chamber to allow the barge to be loaded and sunk in a controlled manner. Within the compartment, the floor frames are similar to those that are outside it but are set into protruding edge beams onto which the corner posts and stringer are also fixed. A stringer runs on axis (approximately) and is nibbed onto the floor frames and fixed to them and to the edge beam of the inner compartment with treenails. The corner posts are formed from pine trunks into which rebates are cut to take the side planking. The posts are set onto the edge beam with a tenon which is wedged in place (Fig. 15).

The exterior "corner posts" are of a similar design to those found in the inner cell. The ends of the boards are let into the rebates running on either side of the "post" and are fixed in place with a combination of metal pins and treenails (Figs 16 + 17). This cutaway post, however, leaves a weak nib which was broken off most of the corners that were excavated, and it is likely that this damage occurred in antiquity.

The side frames range in size, shape and spacing, being either rectangular, square, semi-circular or quadrant shaped posts approximately 18 to 20cm by 18cm, and are fixed to the side planking with both treenails and metal pins. These side frames are notched into and over the chine beams where they project into the caisson. There is also evidence that not all the frames extended over the whole height of the sides and some did not reach the chine.

Based on the evidence of the surviving structure hypothetical reconstruction proposals can be suggested.

There is no doubt that the bottom planking was constructed first, and was probably set out on a raised "trestle" to enable the treenails to be trimmed as each board was fixed in place (Fig.18.1). A possible site for the "ship yard" is on the foreshore beside what is now Kibbutz Sdot Yam to the south of the ancient harbour where jetty like structures have been found (Galili, Dahari and Sharvit 1993). From there the barges could be towed with the long shore current to their destination around the harbour enclosure (Figs 19 + 20).

Onto the bottom planking the floor frames would next be fitted and the chine beams offered up to the sides and fitted over the tenons on the frames (Fig. 18.2).

The bow and stern chines were then added and the stringers let in on top of the frames and fixed into the bow and stern chine beams (Figs 18.3 + 18.4).

The external corner posts were then erected and propped in place whilst the side planking was built up board by board and cut to fit inbetween the corner posts (Fig. 18.5).

Once the side walls had been completed and the side frames, diagonal props and cross beams added (Figs 18.6 + 18.7 + 18.8), the barge was then launched probably on log rollers, bow or stern first (Fig.18.9). (This is confirmed by the evidence from the underside of the chine beam where a triangular closing fillet protects the downstanding edge of the chine beam and only appeared on the bow or stern.) The estimated weight of the empty barge is 70 metric tons and it would have floated with a draught of approximately 0.5m.

The barges were then partially filled with a pozzolana based concrete, to a depth of approximately 0.5m, at which point they would float with a draught of about 1.5m, which was allowed to set before being taken out to the site. The use of hydraulic concrete both in this lower portion indicates that the caisson was not entirely waterproof. The concrete both provided ballast and helped to seal the joints particularly around the bottom edges. Once the concrete had hardened the barge was towed to its pre-determined destination and moored in place whilst lighters transferred a lime mortar into it, and placed by hand lumps of tufa and limestone aggregate (Fig.18.10). This lime mortar concrete was loaded in until the caisson settled onto the seabed which had previously been prepared with a rubble layer of concrete, tufa and stone. At this point the freeboard was minimal and a pozzolana rich mix was used to complete the fill.[6] It required only a further fill of 1.0m of mortar and aggregate for it to sink onto the bottom. The upper layer of hydraulic material was used to seal in the non-hydraulic layer and protect it from the seas which would obviously break across it until such time as the rubble breakwater was added and the overlaying structure built ontop of it.

Although there are examples from other Roman harbours of the use of mortise and tenon joints tied in with treenails in the construction of formwork, particularly from North Africa, they do not show the ship construction detailing that is prevalent in the 'K' type caissons.[7] There is no evidence of the use of comparable bespoke built barges in either contemporary texts or from other excavated sites. The caisson at

[6]Preliminary results from samples of concrete taken from K5 in 1994, which were tested by Technotrade Ltd Harpenden, show that the top and bottom layers of concrete contain high proportions of pozzolana and low lime, whereas the middle layer has a high lime and low pozzolana content. It was noticeable that in the samples from the middle layer there were particles of burnt lime in the lime bound mix which had not re-hydrated.

[7]Yorke and Davidson describe examples of mortise and tenon jointed forms for inundated concrete structures along the North African coastline. However, none appear to comprise a barge like structure (Yorke and Davidson 1985)

Laurons although purpose built, was more closely related to terrestrial carpentry/ joinery technology than shipbuilding and was filled with rubble rather than concrete.[8] Later the architects/engineers who built the harbour at Portus outside Rome used redundant hulls of ships as permanent shuttering in the breakwater and also for the foundation to the lighthouse which is the closest comparison. There are, however, no examples of concrete moles which have similar layering properties, where the block was made with a non hydraulic core.

The likelihood is that the engineers were faced at the outset with material delivery problems. It would have taken some time to ship in all the necessary pozzolana from the Bay of Naples area in Italy to Caesarea, and with the pressures of the programme decisions could well have been made deliberately to use a non-hydraulic lime mortar as a means of reducing the amount of imported material being used in the construction of the harbour.

Unfortunately, this method of construction was inherently defective. The weak layer in the middle of the blocks became exposed due to seismic movements. Being effectively mass concrete with little or no structural reinforcement, it had no tensile strength, so any sagging or hogging action would have caused it to crack, allowing currents to wash through and erode the soluble centres undermining the overlaying structures. This partly explains why the harbour so quickly fell into disrepair and why it would have been very difficult to put right (Raban 1992b).

The remains of the caissons now lie at varying depths which generally slope down from a depth of 7m on the south to over 9m at the north end. It is suggested that this variation in depth is due to a number of reasons, the principal ones being tectonic movement and variations in load along its length and the location of the fault lines.

Now, as more of the lime rich mortar in the central area of the blocks is exposed, and sand levels vary on the sea-bed in different seasons, further erosion takes place causing the existing remains to fracture and become more jumbled as they are shifted in severe storms.

As we find out more about the design of these concreted forms and their likely purpose within the harbour enclosure the picture becomes more complex. This paper should be considered as no more than an interim report on findings to date. A lot more site work, analysis and research is necessary before a comprehensive paper can ever begin to be written on this subject.

[8]Ximenes and Moerman 1985. Contains the description of a 22.9m long by 2.2m wide wooden caisson which was rubble filled.

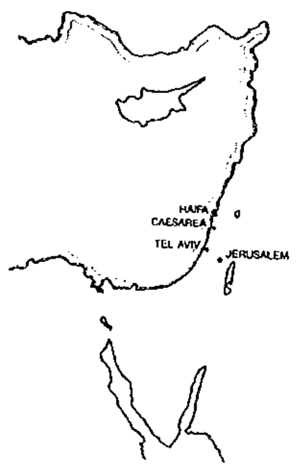


FIGURE 1

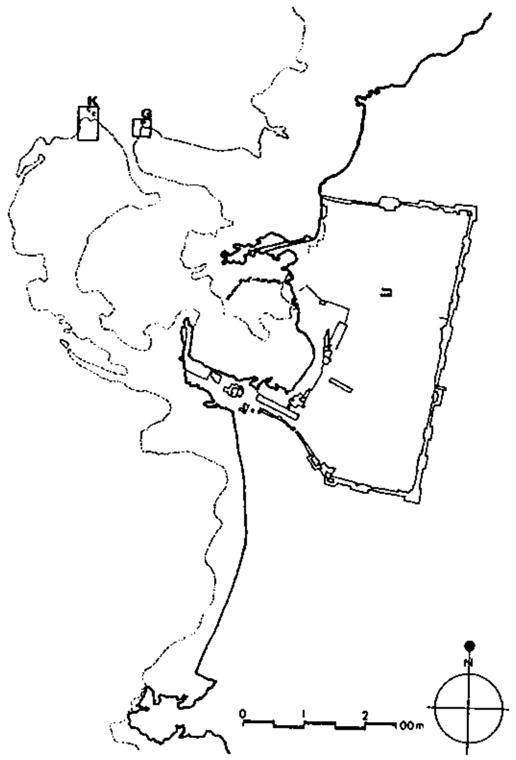


FIGURE 2

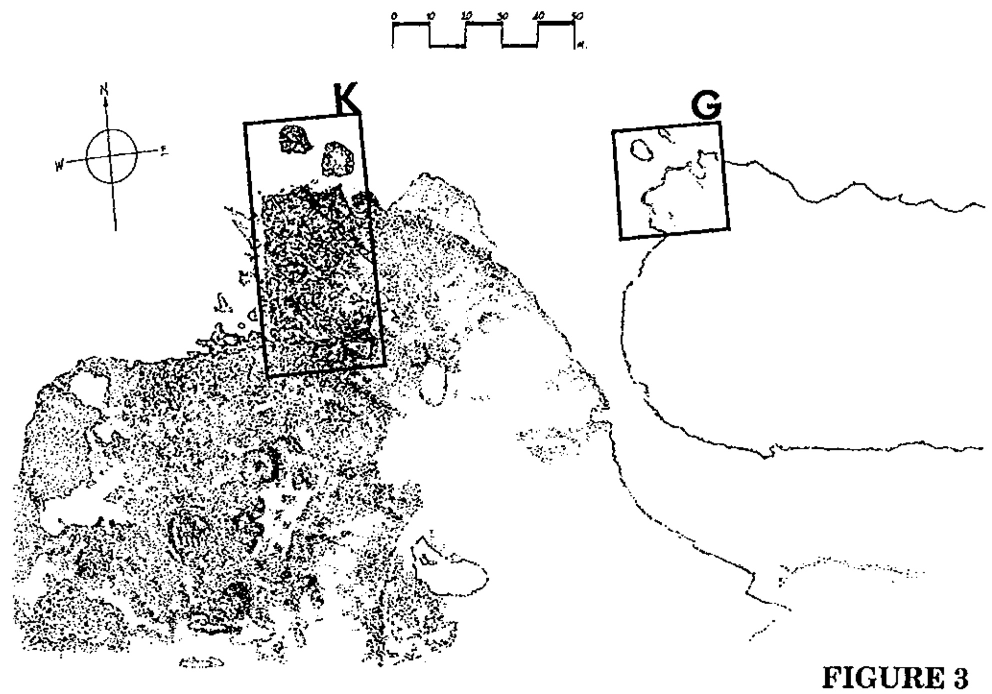


FIGURE 3

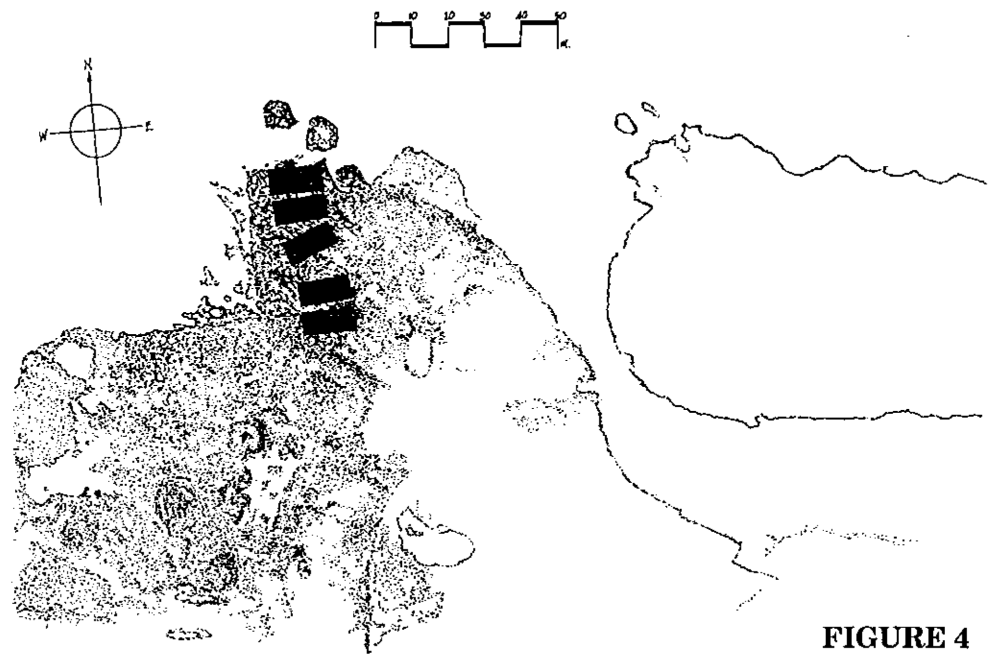


FIGURE 4

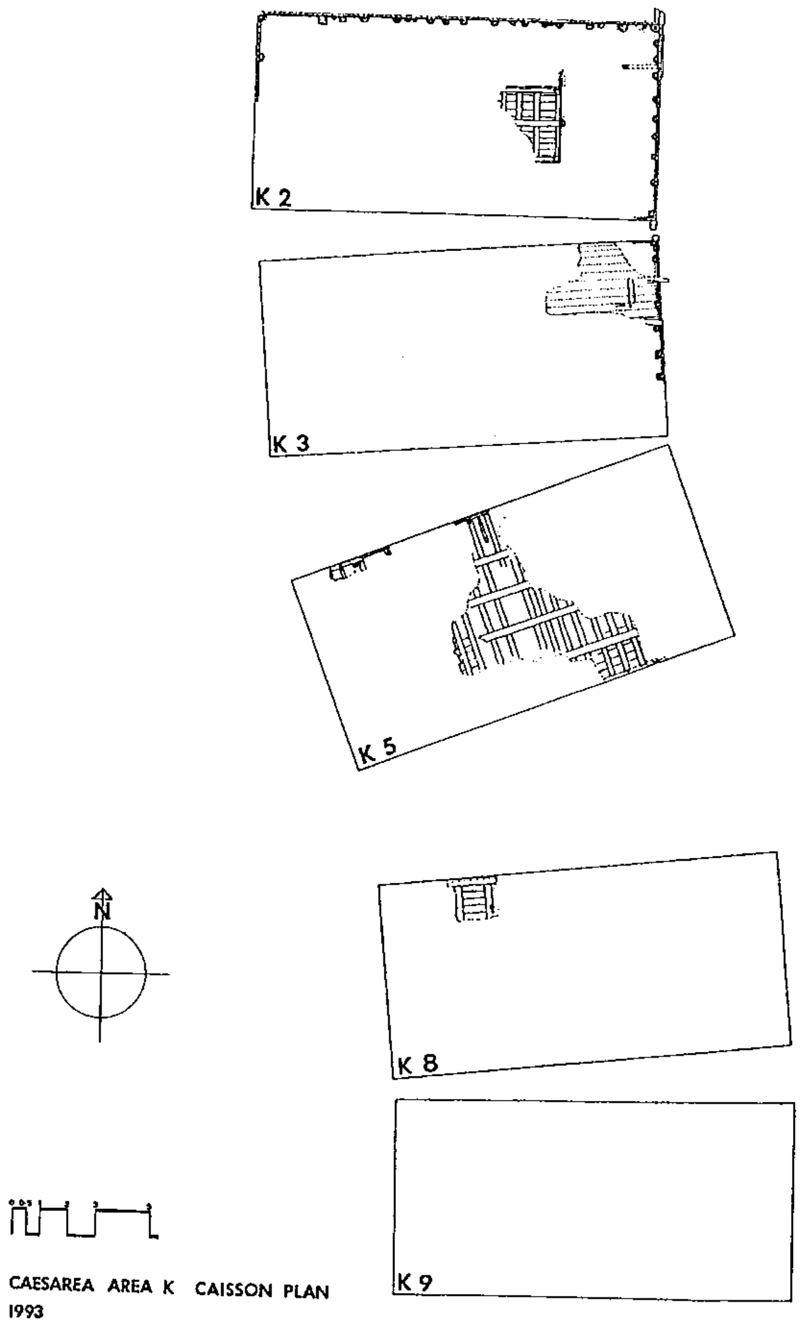


FIGURE 5

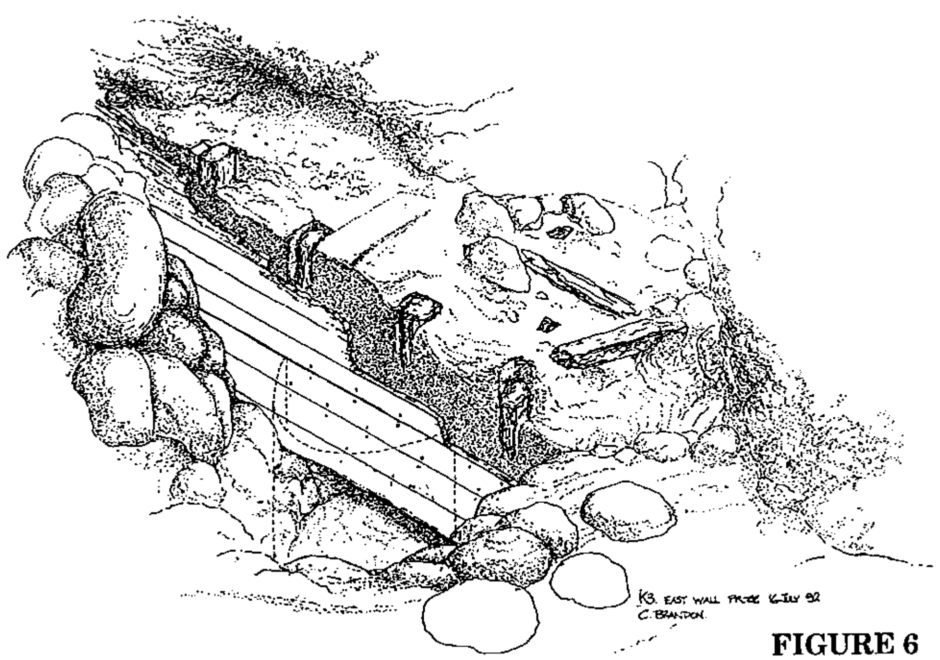


FIGURE 6

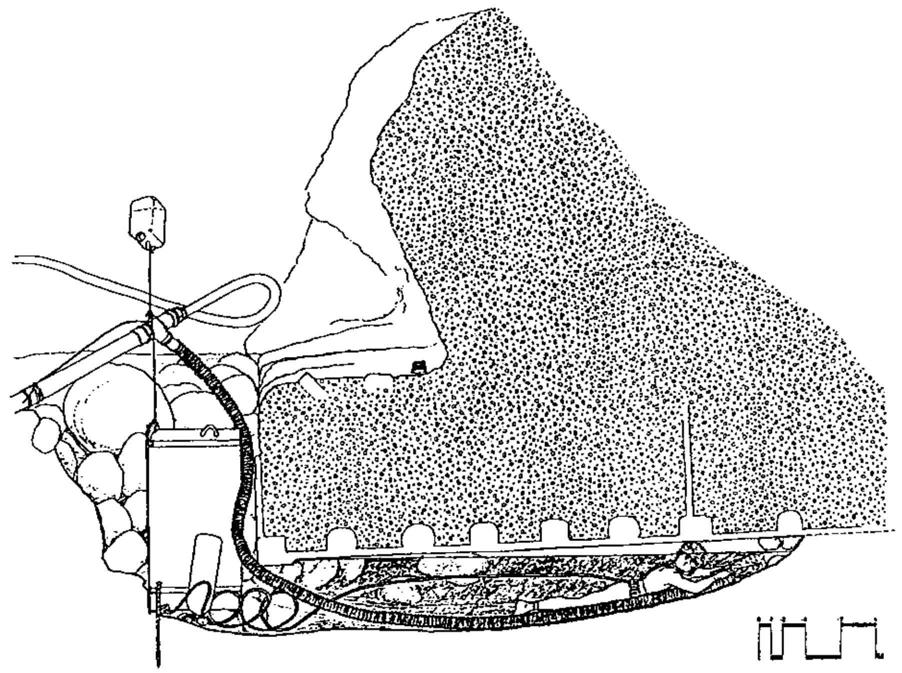


FIGURE 7

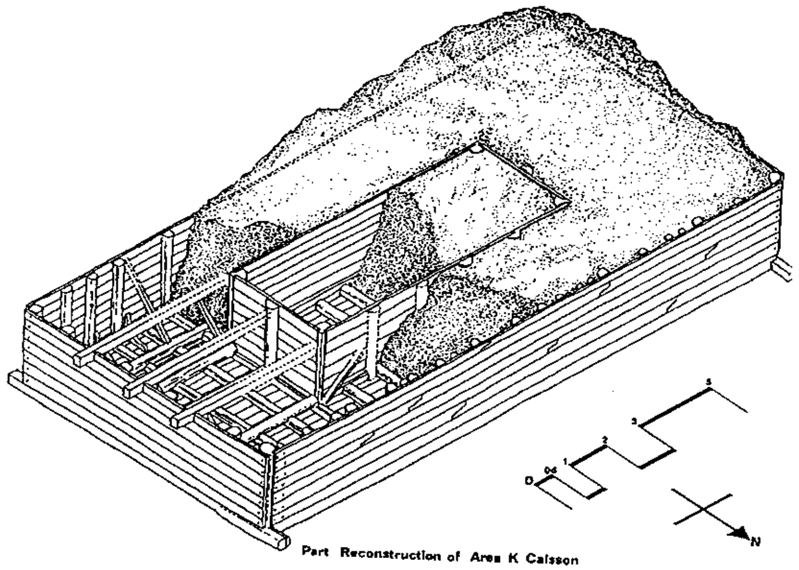
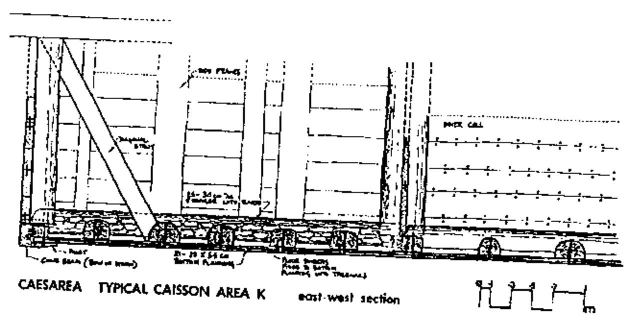


FIGURE 8



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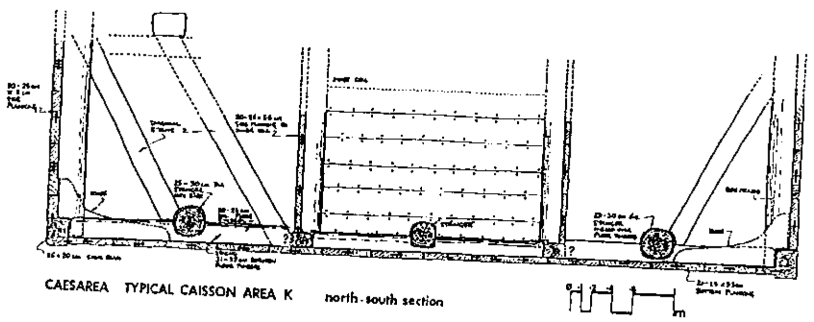
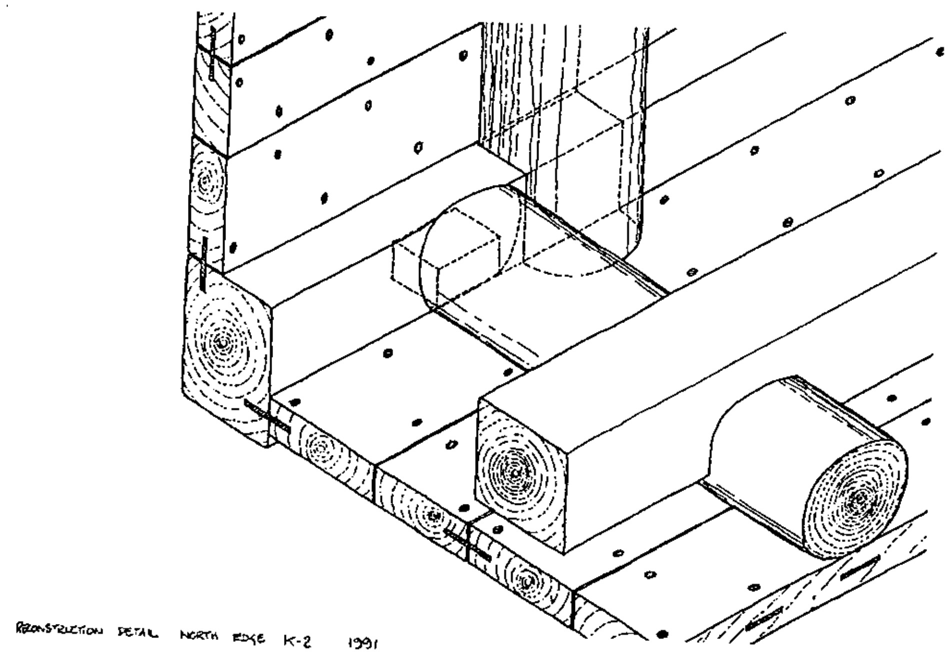


FIGURE 10



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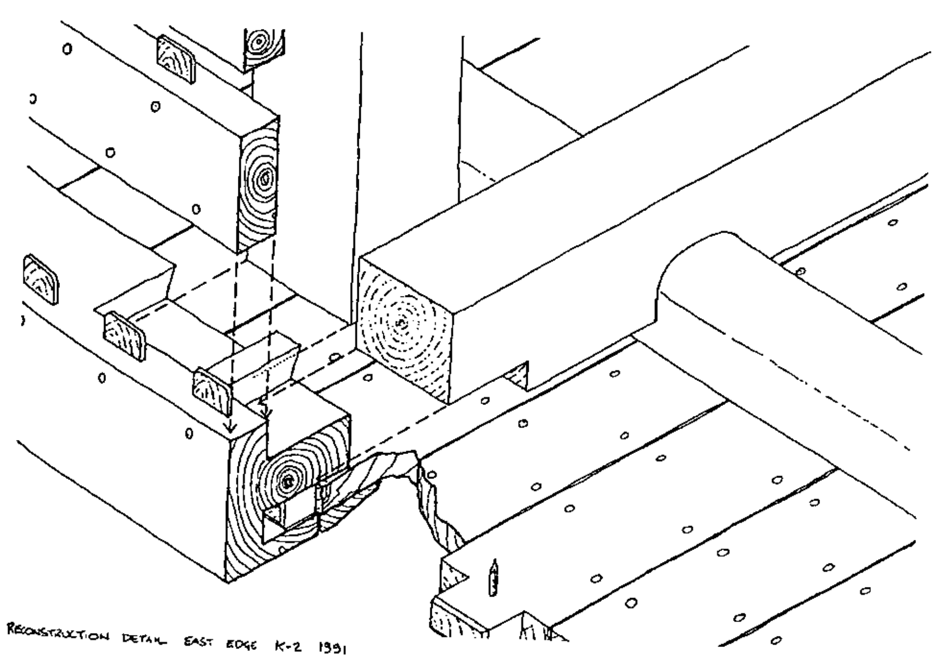

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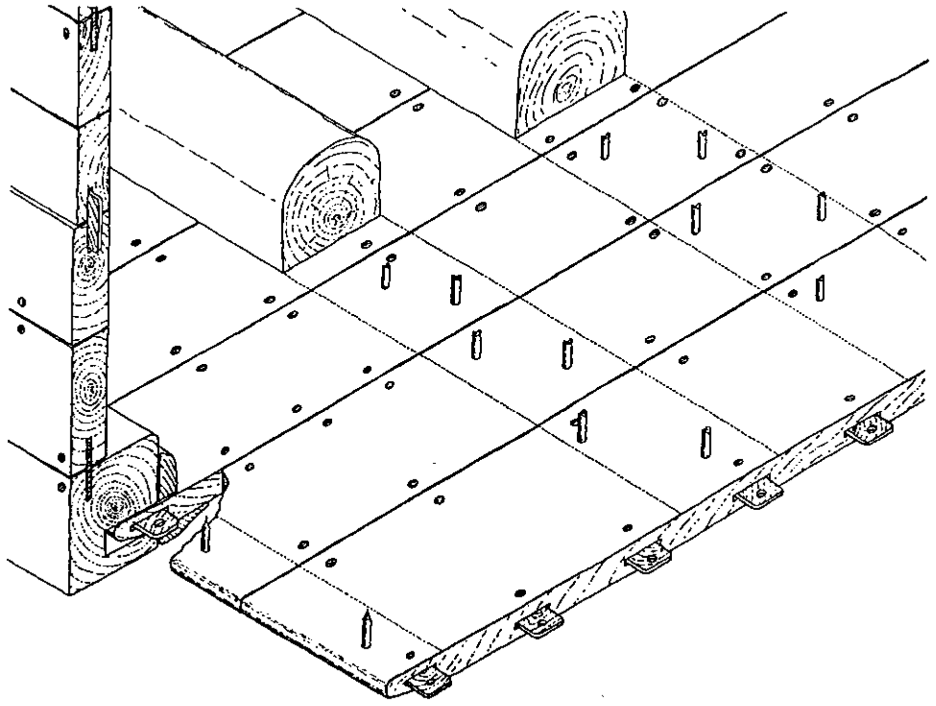


FIGURE 13

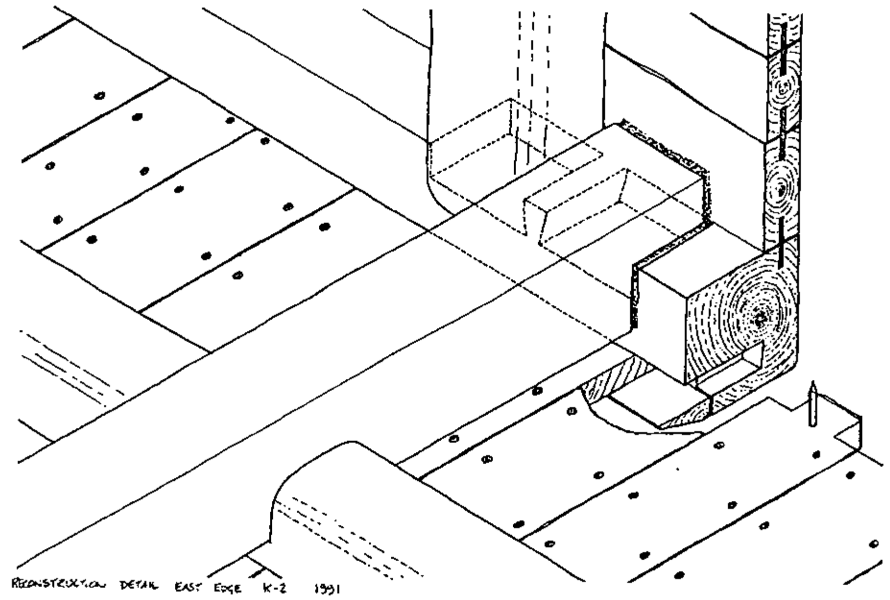


FIGURE 14

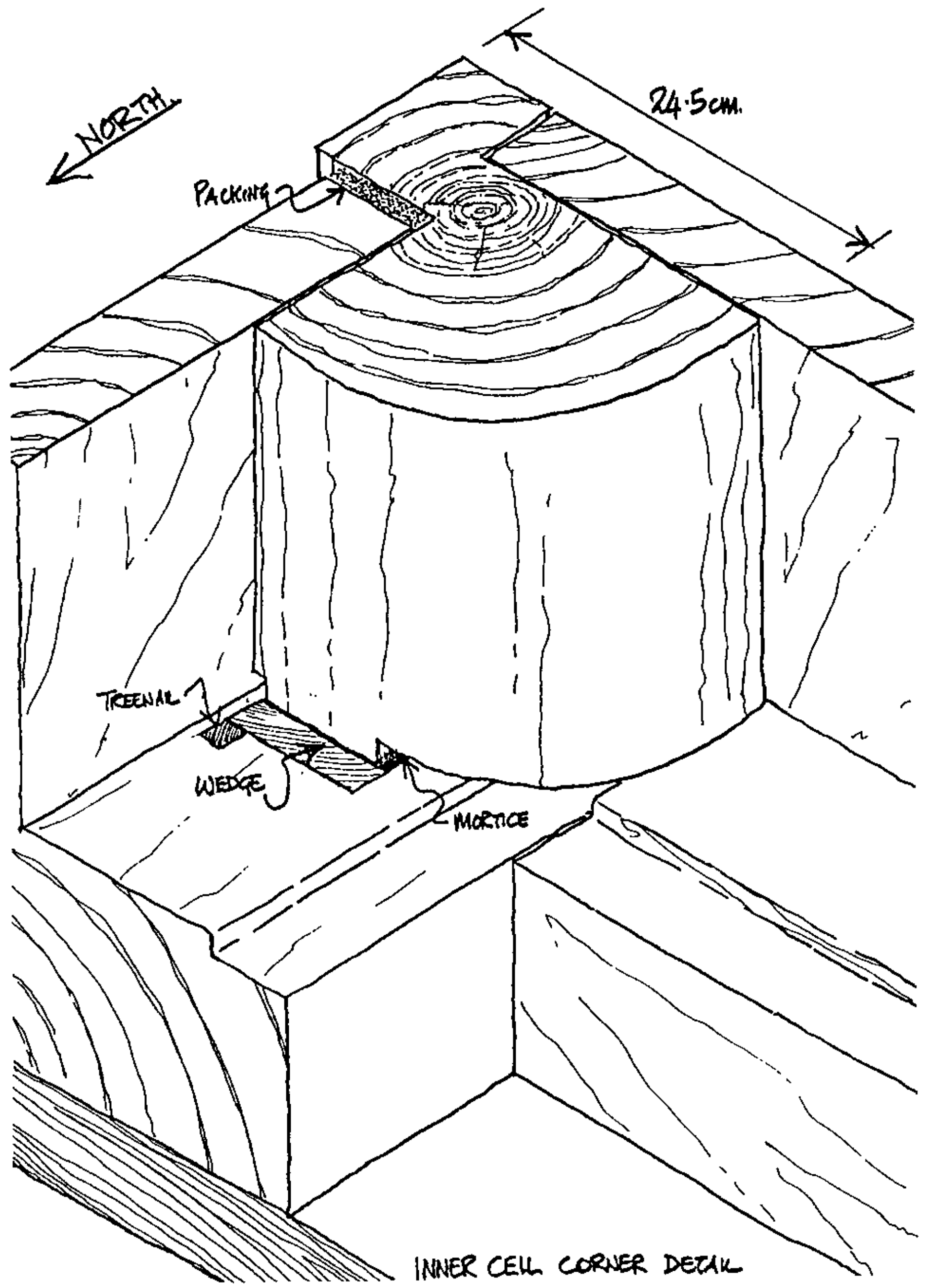


FIGURE 15

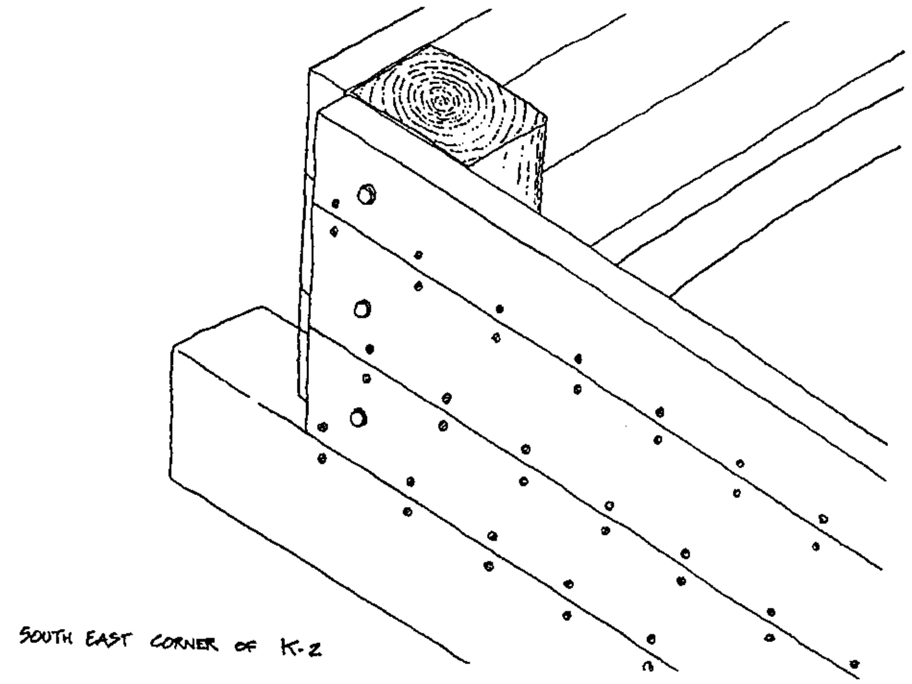
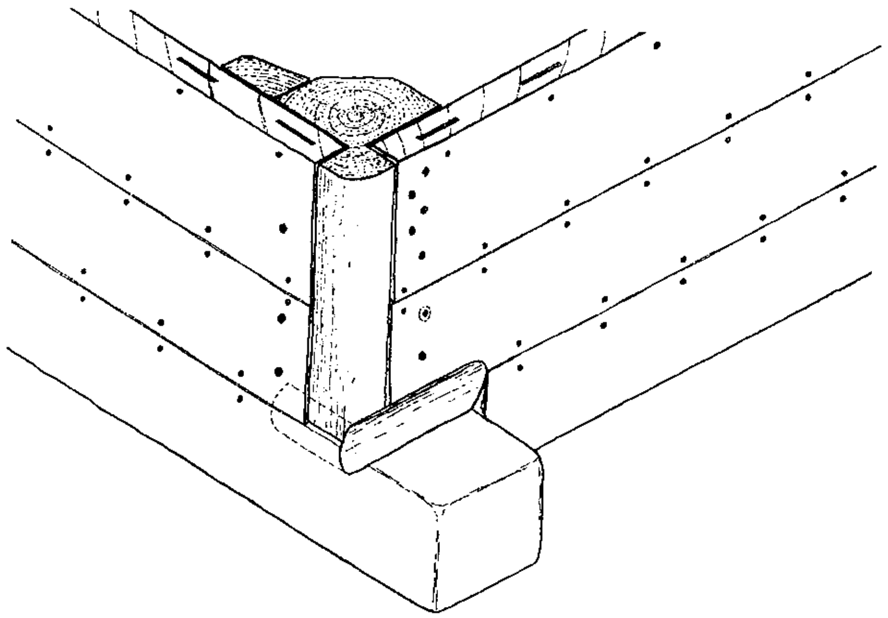


FIGURE 16



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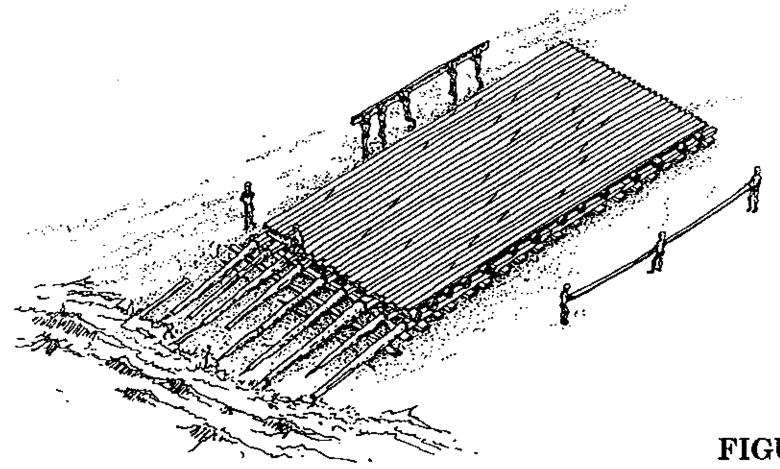


FIGURE 18.1

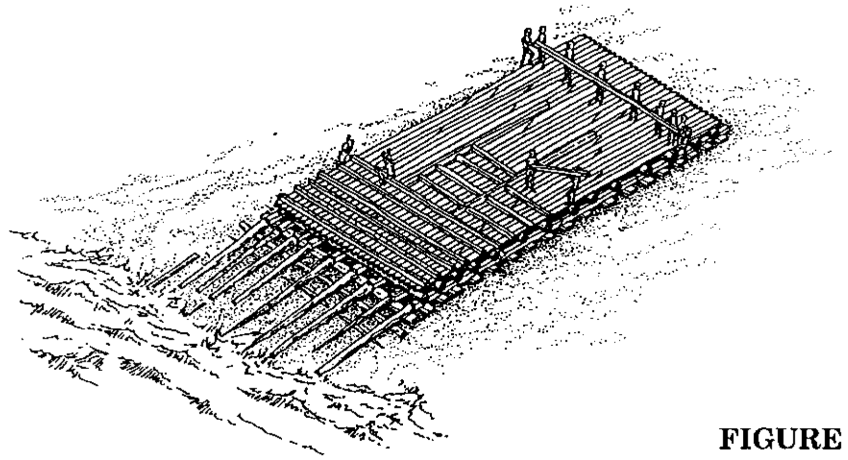


FIGURE 18.2

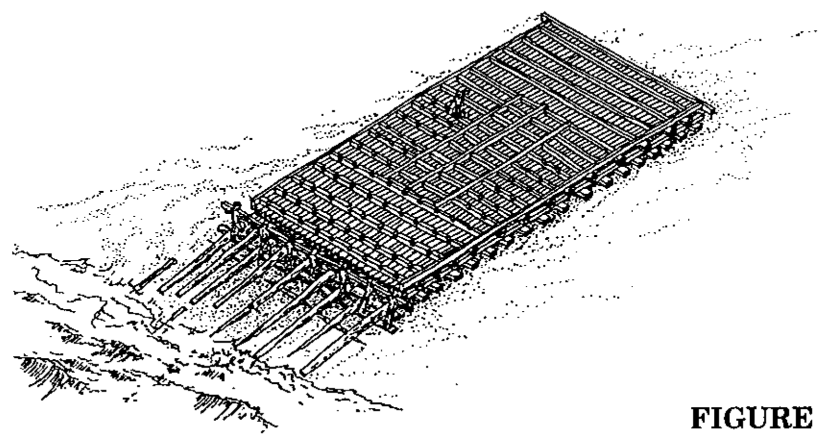
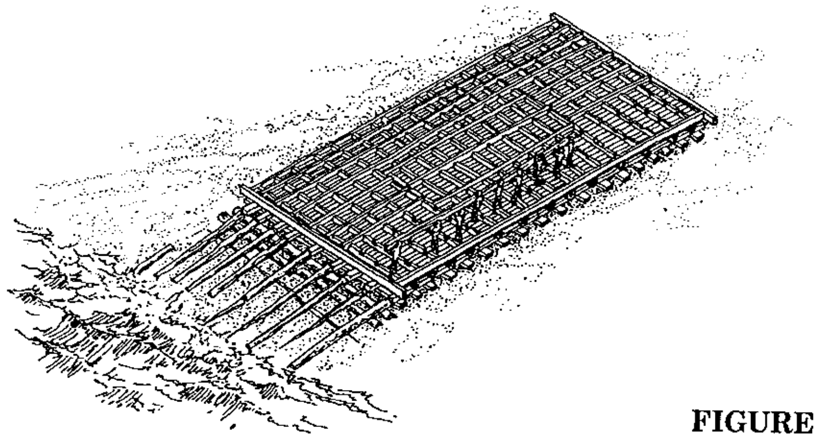


FIGURE 18.3



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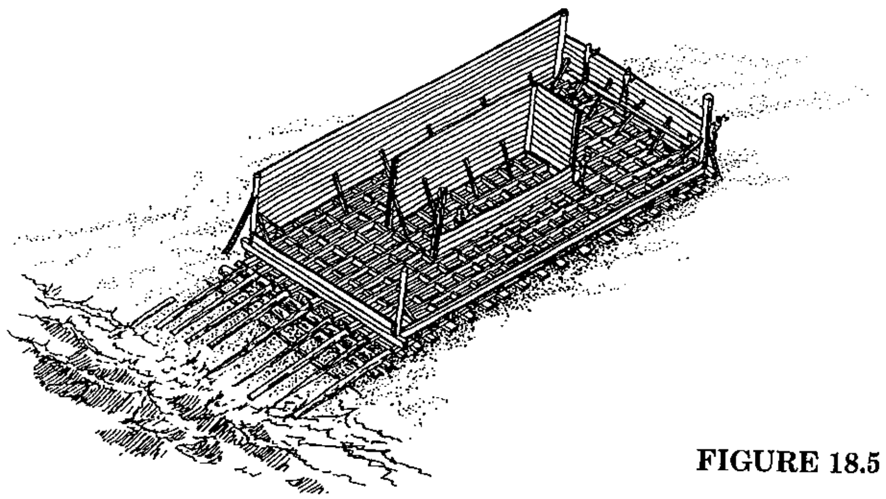

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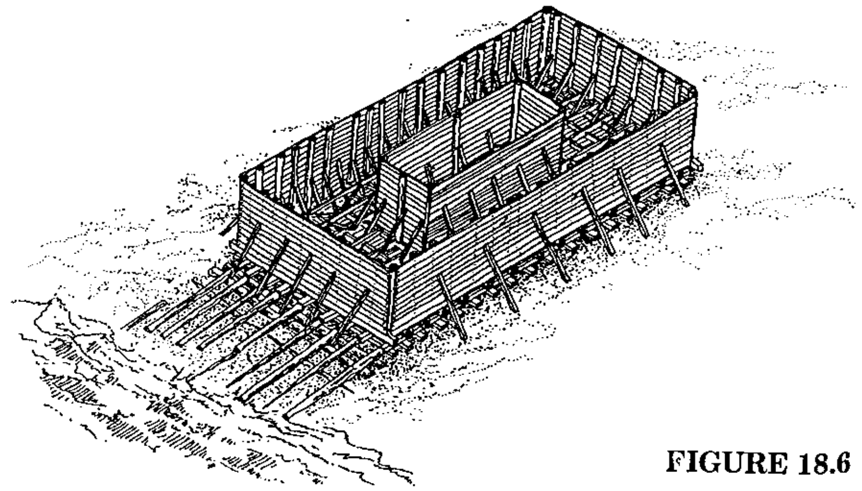

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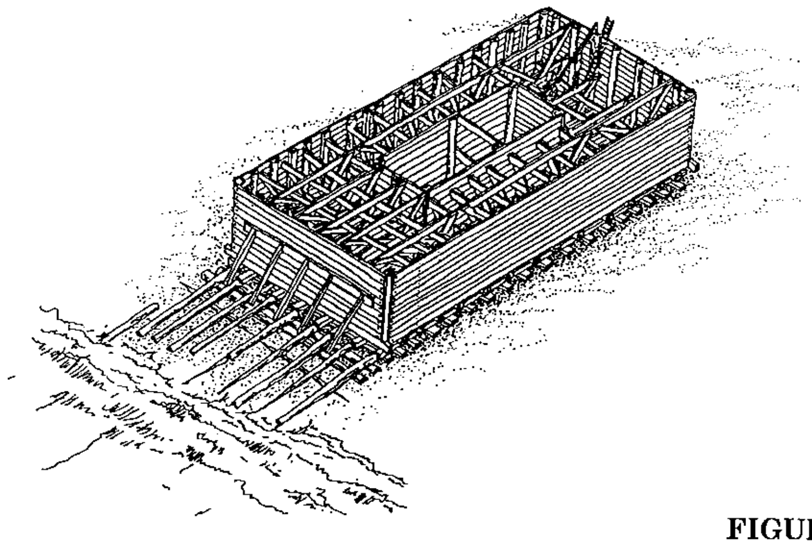

FIGURE 18.7

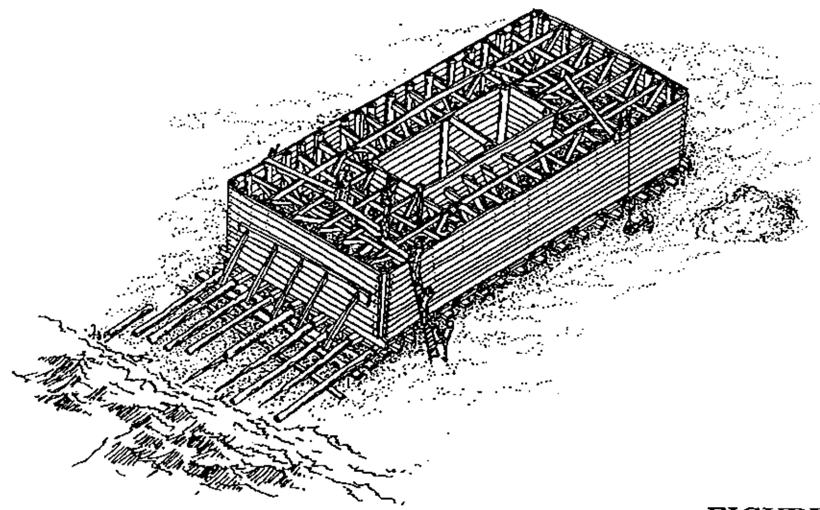

FIGURE 18.8

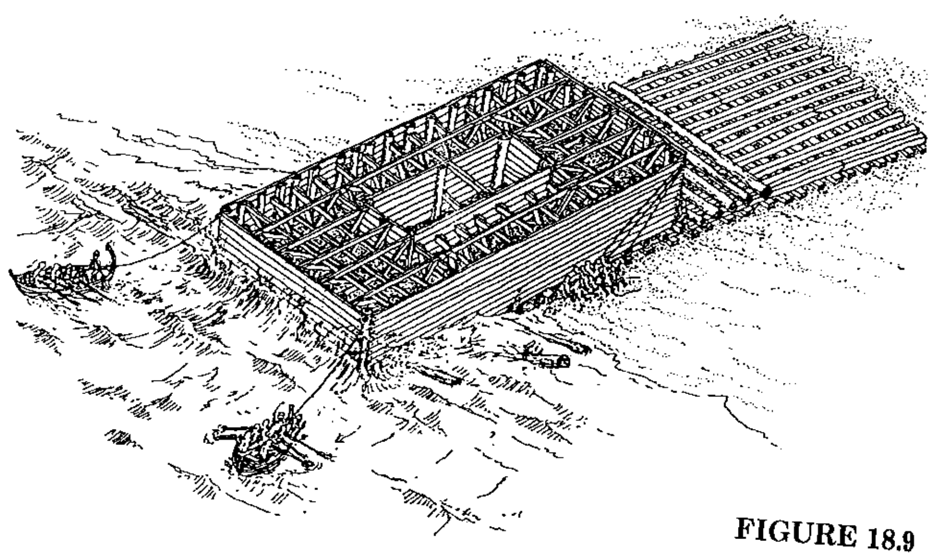

FIGURE 18.9

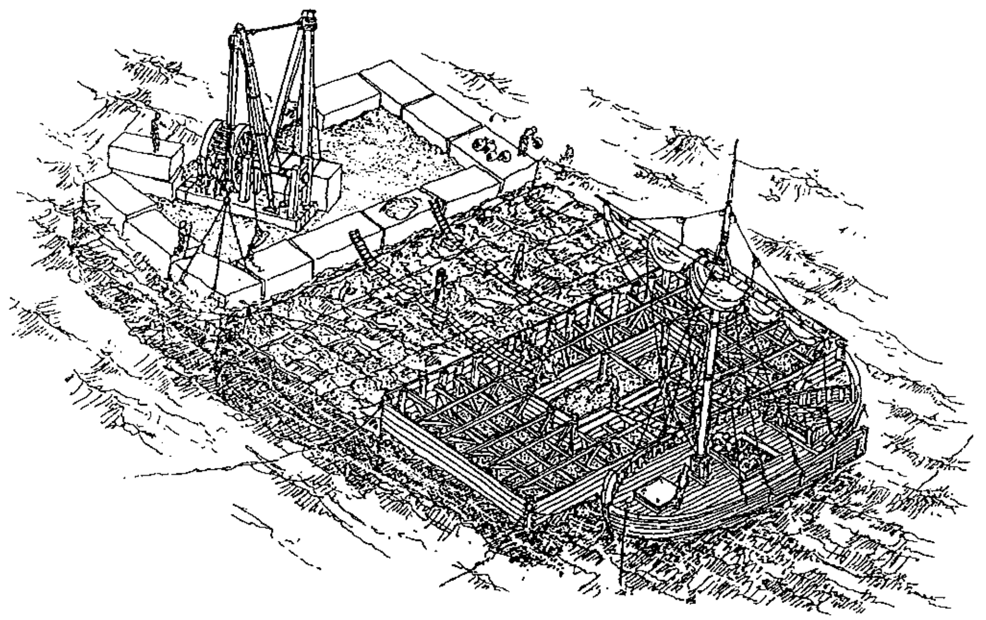

FIGURE 18.10

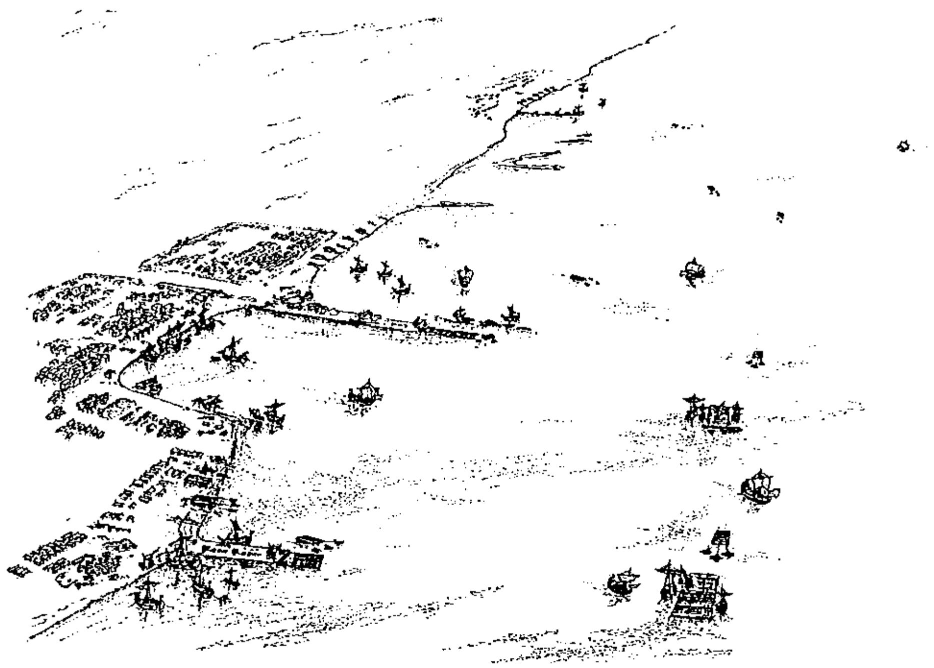

FIGURE 19

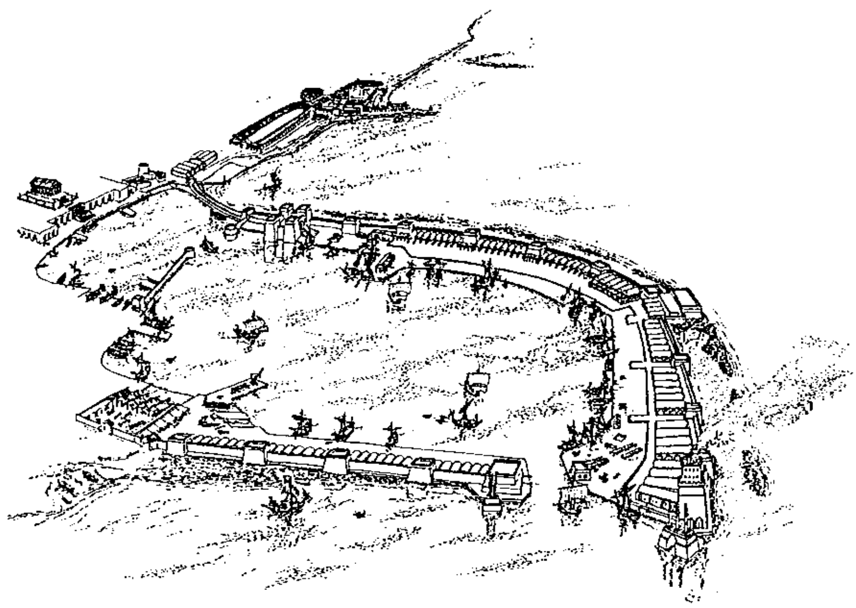

FIGURE 20

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THE DIFFERENT TYPES OF RITUAL PITS IN DURANKULAK AND THEIR CONTENTS

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The excavation of the Hellenistic remains in Durankulak concentrated in the last years on the rock-cut sanctuary on the islands and on the ritual pits in the area of the Neolithic necropolis, ca. 600 m to the south of the island (Burow 1993, *AA*, p.333 sqq.). Here on the slope of a low hill, approximately 3 m higher than the level of the mentioned necropolis around 70 pits have been found, and most of them can be dated after the ceramic evidence in early Hellenistic time. Some belong to the Middle Age - they are to be seen most probably in connection with the tombs from this time in the area of the pits (Burow 1993, *AA*, p.342, fig.18, nos.32-37), and a few are completely without finds and therefore can't be dated.

The Hellenistic pits can roughly be divided into 5 types:

1. The most common one is pear-shaped, 2 m to 2.50 m deep and with a diameter of 1.5 m or little more (Fig.1:1). Of course there are smaller and bigger examples of this type, two pits are nearly 4 m deep. The profile shows different layers of earth, more or less mixed with ashes, some stones, ceramic fragments, bones and smaller finds. The ground is sometimes covered with stones or stone-slabs, and in many cases there is a thin layer of black ash on the ground, perhaps from a ritual purifying before filling the pit. Several times fragments of the same vessel have been found in the different layers of the pits, and this assures that all the material was filled in at the same time. On top of these pits were big stones or stone-slabs, sloping to the centre and filled with smaller stones. This guarantees that the pits are undisturbed.

2. The same type as no.1 but with two big slab-stones in the centre, put gablelike together, and underneath concentrated ashes - always without any remains of human beings (Fig.1:2). A variation of this type shows stones in the centre put next to each other with ashes on top, most probably secondary sacrifice within the pit. (Fig.1:3).

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THE INNER HARBOUR BASIN OF CAESAREA: ARCHAEOLOGICAL EVIDENCE FOR ITS GRADUAL DEMISE

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FOREWORD: The very existence of an inner basin within the harbour complex of Sebastos, might be historically surmised only from indirect passages in Josephus, referring to "subsidiary anchorages within it [the Sebastos]" - ἐν τε τοῖς μυχοῖς αὐτοῦ βαθεῖς ὅρμους ἑτέρους (Bell, J. 1.410); δευτέρους ὑπόρμους (Ant J. 15.331). The archaeological evidence for that basin were attested by us already in 1976 (Raban et al. 1976; 1989b, 80-81), when we followed the earlier data of A. Negev's excavations of 1960 (Negev 1967, 27-30). Later studies enabled us to conclude that this basin had been built already during the Hellenistic period, though its conjectural size and shape were wrong (Raban 1989a, 131-138; 271-275; Vann 1992, 68-74, figs.2,3; Holum et al. 1988, figs.11,24,50,86,89). During the present phase of our research we have managed to expose the original size and circumference of that basin, which was found to be three times larger than formerly suggested (Raban et al. 1993, 11-14, fig.13). During the last three years a score of additional archaeological and sedimentological data have been collected and processed, which enabled us to reconstruct in a rather detailed manner the history of that basin from its initial phase to the time it finally went out of use, becoming a terrestrial part of the built-up urban unit. Yet, the implications of our reconstruction are heavily contested by our colleague scholars who would question our suggested original time of construction (Roller 1992, 23-25; Oleson et al. 1994, p.158) and the various phases of its demise (Horath forthcoming; 1993b). Still being under study with excavations continuing and data being processed, these issues will not be argued below. The following will therefore be merely a summery of data gathered by us up to the end of 1994.

I. The Original Topography

We are still shy of knowing exactly when the coastal low ridge of *karkur*, aeolinite sandstone had been occupied for the first time by human settlers. Few Iron Age sherds and more of the Persian Period (5th-4th c. B.C.E.) were found at the vicinity and within the Herodian fills next to the area of the Inner Basin. Yet no significant architectural features that might be attested to these early phases have been traces so far. Much is also true for the following, Hellenistic period, though much more pottery of that time has been found - both within the Inner Basin and at the top of the rocky outcrops east of it, at the alleged site of the later Herodian temple for

Rome and Augustus (Berlin 1992, 112-124). In any case, it seems that prior to human intervention the topography of that site was characterized by a well-eroded long shore low ridge of kurkar, with its western, seaward side being segmented and partly inundated by the sea. Of that part some residual in-shore reefs and rocky islets remained well above the waves. The most prominent of these was the presently under the so-called Harbour Citadel (Fig. 1). Underwater survey of the sea floor just south of that outcrop proved that some time in the past there was a very extensive abrasive shelf adjacent to it, at a time the relative sea level was about 2.4 m lower than the present one. Yet, recent drills and probes at its lee have traced the topography of the bedrock to be at a depth of as much as 6m below the present MSL, indicating that the south bay was originally connected to the area of the Inner Basin. No sand depositions have been traced at these probes to suggest that there was a stable perennial Tombolo there to bridge the gap[1].

2. The First Inner Basin

The exact time when the water passage, between the rocky islet of the Harbour Citadel and the shore to the east, had been closed and bridged over by a man-made sea wall is still under debate. So far no direct archaeological and architectural data have been found of that alleged structure. Yet, many scholars would suggest that the Harbour Citadel was the original site of Straton's Tower (Guérin 1875, p.225; Schumacher 1888, 134-141, fig.1; Levin 1973, 75-88; Roller 1983, 61-66). The most intriguing architectural feature in that context is the Round Tower which was discovered in 1978 and has been studied ever since (Raban 1989a, 177-181; 1987, 71-88; Holum et al.). The ashlar headers components of its structure and the close resemblance of its shape and size to the twin towers at the Early North Wall are in complete disaccord with the formed mixture of rubble and *Pozzolana* that characterizes the quay of the Inner Basin; and yet - corresponds quite nicely with the style of the Pre-Herodian quay at the north bay and other Phoenician harbour works at Athlit and Akko (Raban 1987, 71-88; 1985, 30-44).

The proposed date for that tower, the other two at the North Wall and the basic issue of the whereabouts of Straton's Tower have been discussed by us and by other elsewhere (Raban 1987, 71-88; 1992b, 7-22; Blakely 1992, 26-41; Hillard 1992, 42-48), but it is important to consider Josephus' entries referring to that Pre-Herodian town, from which one must deduce that it was fortified during the time of Zoilos, had a harbour (very probably closed within the confinement of the city walls in the best Hellenistic tradition of "*Limen Kleistos*") and the size of which had been larger than contemporary Dor (80 acres) (Raban 1992c, 21-22). With all these circumstantial data in mind one would consider the round tower and some fragmentary Pre-Herodian ashlar structures parallel to the eastern quay of the Inner Basin, on its lee (*CCE* 1992,

[1] The probes were made in April 1994, by professional team with commercial equipment standard for a building substantiating survey. Their logs and cores were made available to us by the "Caesarea Touristic Site Project" and the data are processed by Mr. Ron Toueg, as part of his M. A. research thesis.

37-41, figs.77(WO78), 78, 81-83, 88) as components of what might be considered as the "Hormos", or "Hyphormos" of Zoilos' Straton's Tower (Figs. 2, 3, 4). The very location of the round tower does not fit any reasonable layout other than that of a protecting feature at the entrance to a close basin (*Limen Kleistos*). As such it would not fit the overall layout of Sebastos, as it had been described by Josephus, or any later harbour (and for that - see below). An intriguing issue is the absence of any significant remains of a sea wall which should have connected this tower to the north shore, encompassing the town of Straton's Tower along its western side.

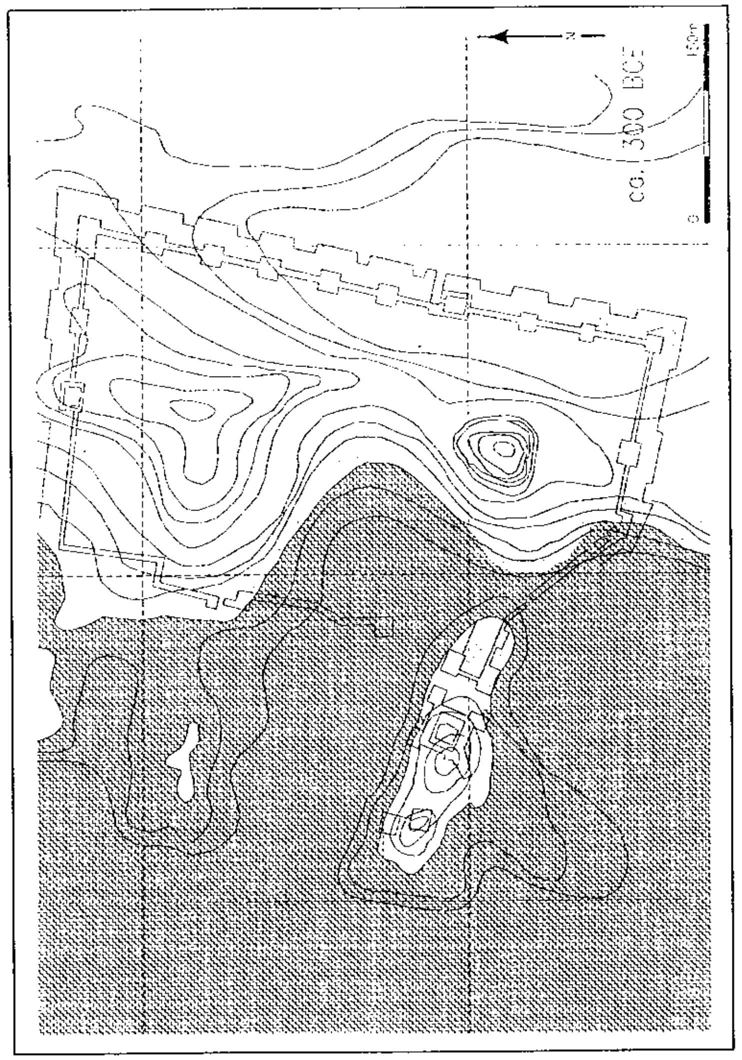

Figure 1. Sketch plan of the central area of Caesarea before Straton's tower had been established.

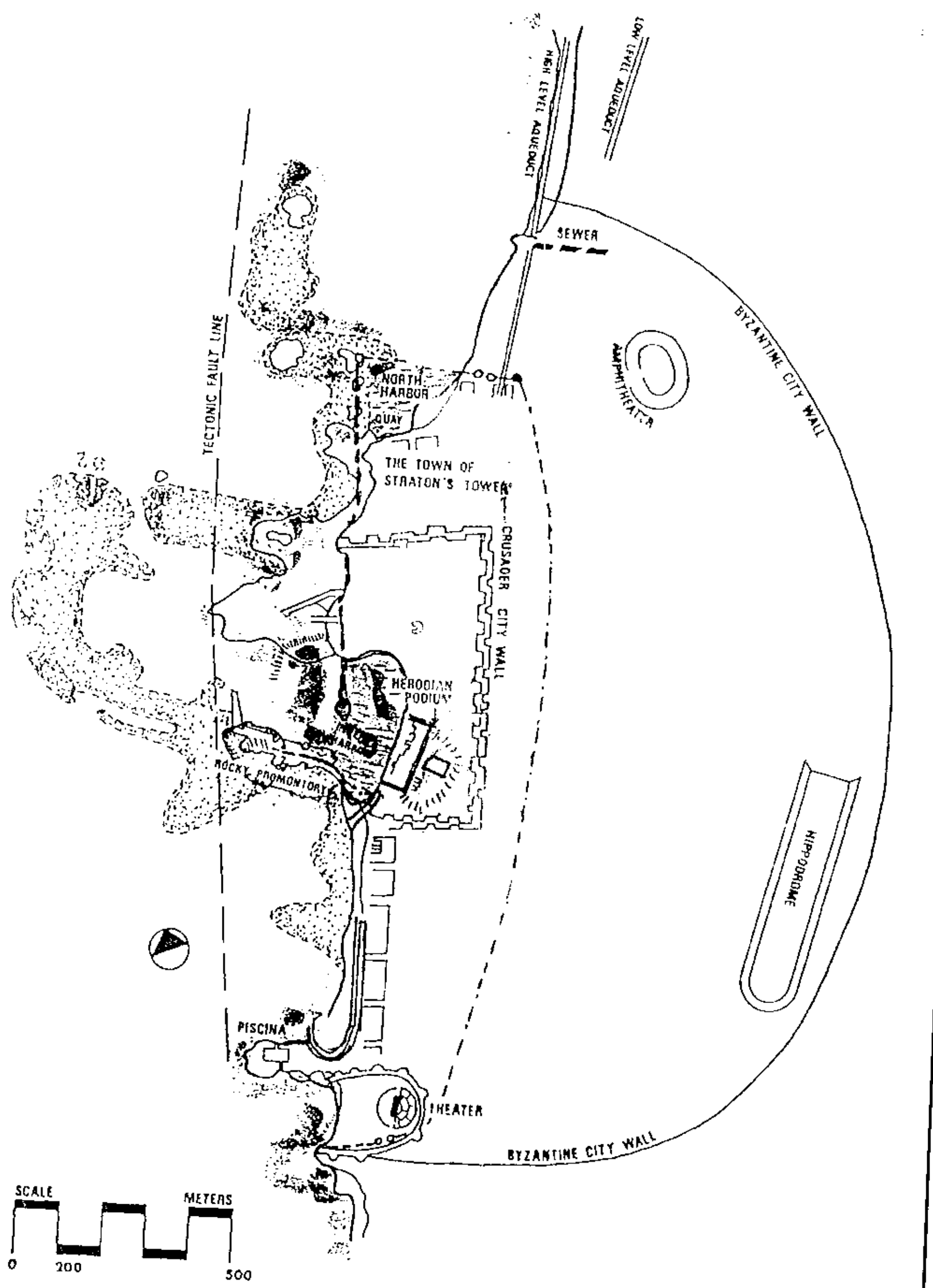

Figure 2. Sketch of tentative plan of Straton's Tower in Zoilos' era.

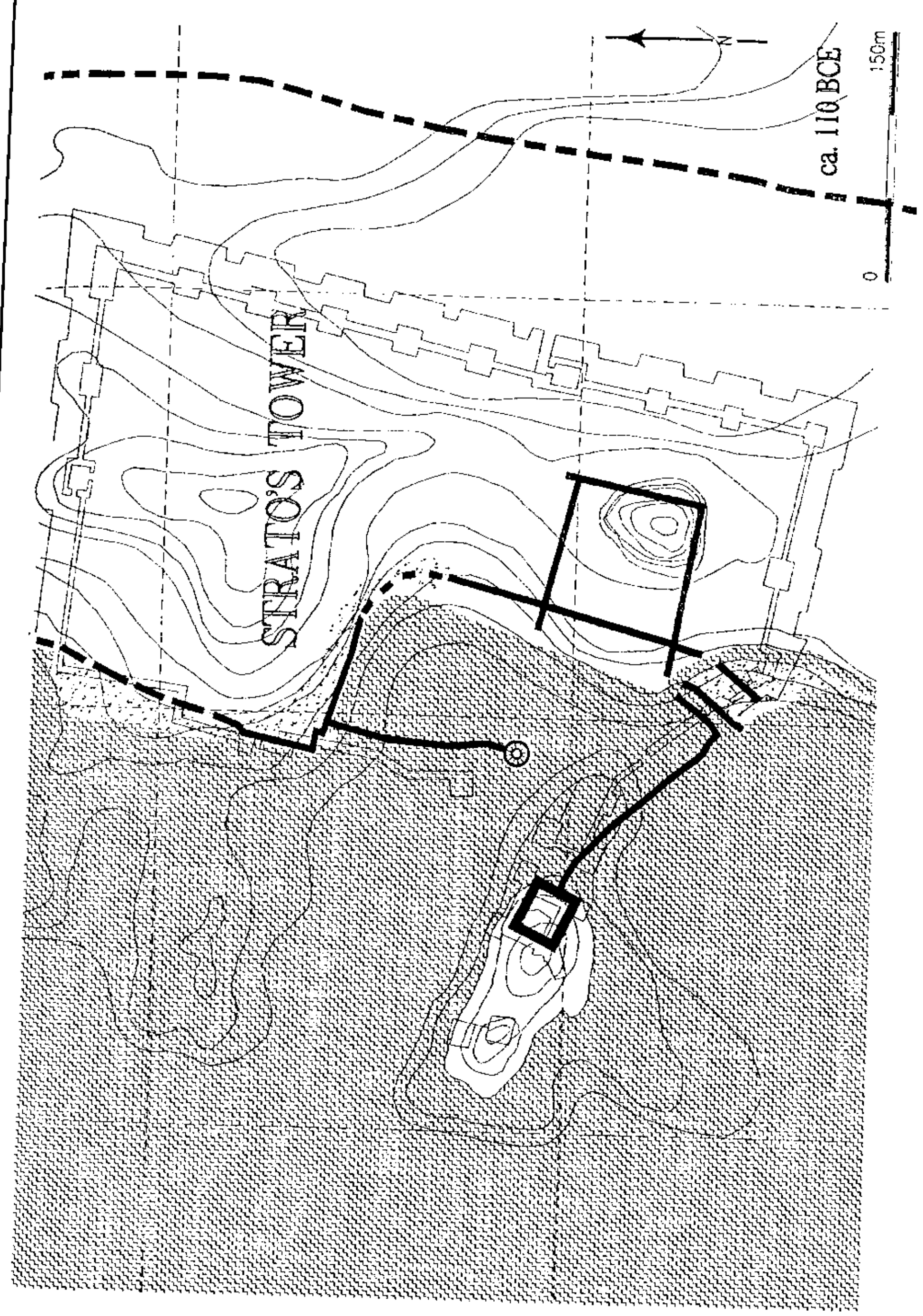

Figure 3. Sketch plan of the Inner Basin c. 110 B.C.E.

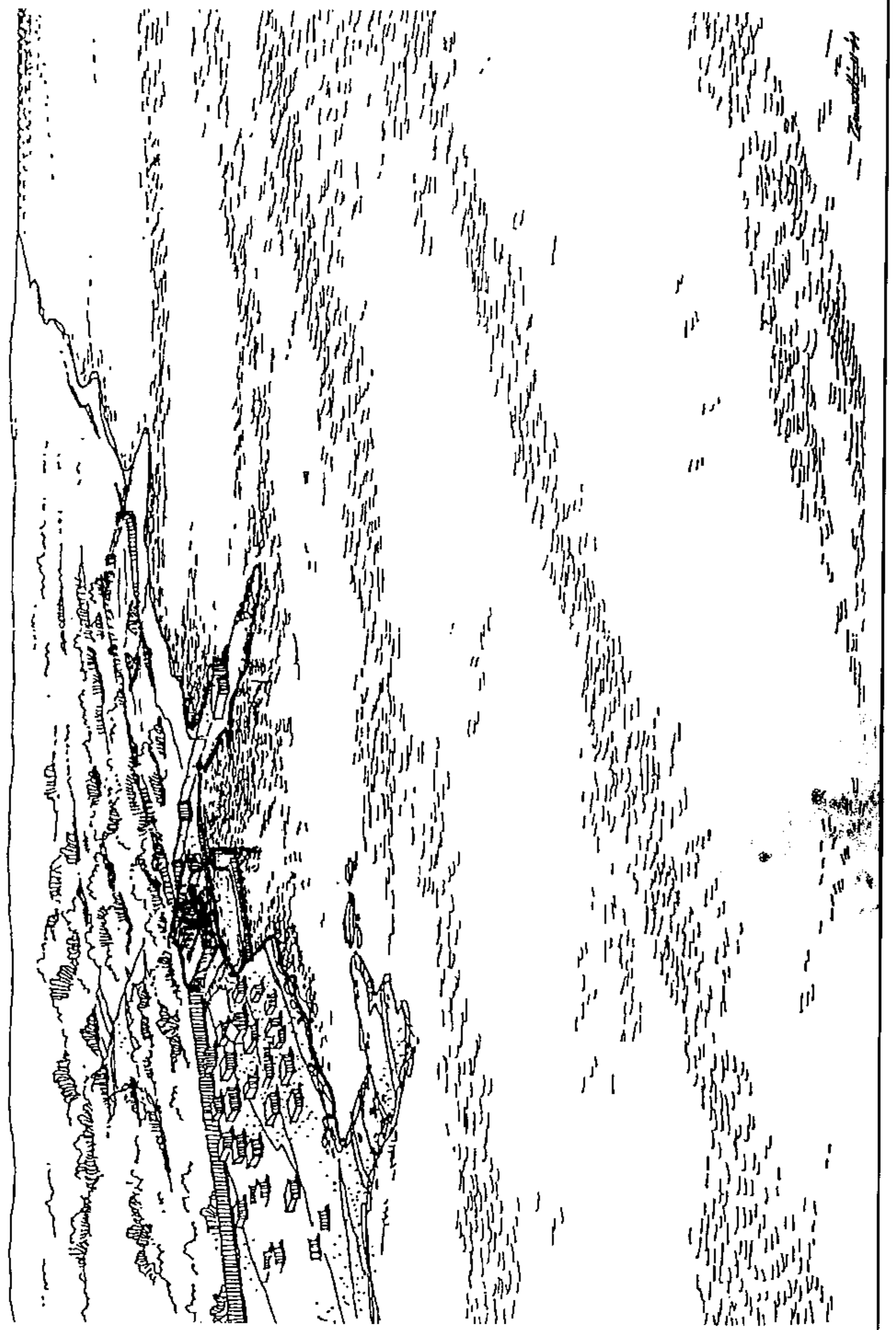

Figure 4. Artistic rendering of the southern half of Straton's Tower (S. Gianetti).

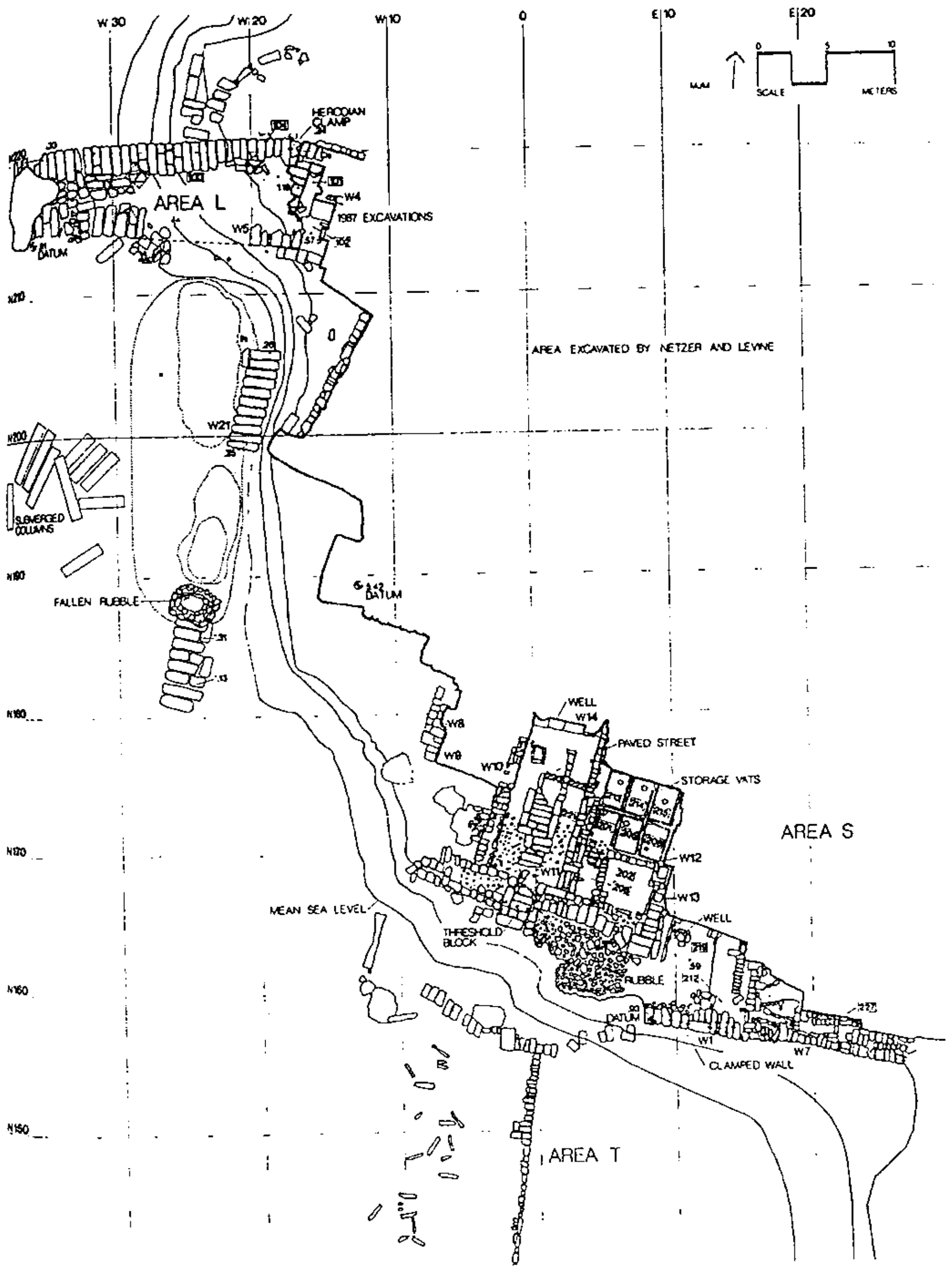

Figure 5. Top plan of CAHEP's Area L and Area S after 1986 season.

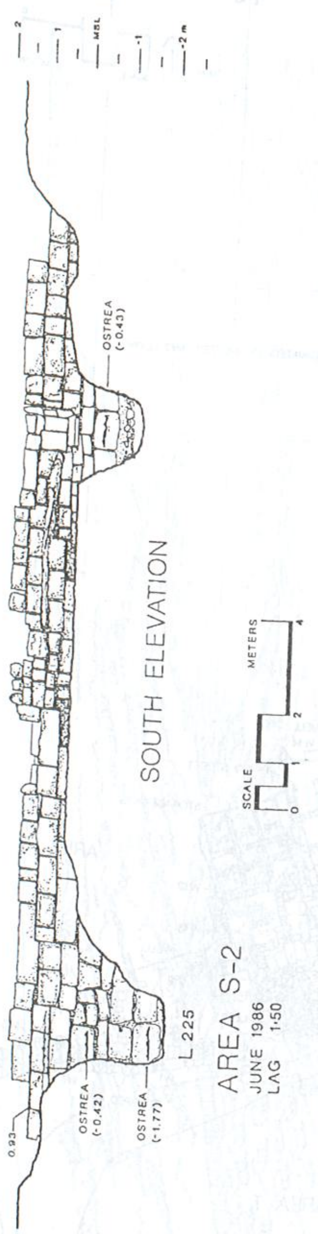

Figure 6. South elevation of W1 at Area S after 1986 season.

The relatively large quantities of 3d-2nd c. B.C.E. sherds within the thin layer of fine mud that covers the rocky floor, in the Inner Basin next to its eastern quay, at CAHEP's Area I1, illustrate a situation when there was a still body of sea water (attested by the multitude of *Ostreae* shells) in that period (Holum et al., 89-93). The conjectural conclusion must therefore be that the area of the Inner Basin was devoid of any wave energy, with no supply of sand and eroded sherds prior to Herod's time. Yet, the earliest quays around that basin studied so far are all of the molded mixture of rubble and *pozzolana* - a building compound not known to the Hellenistic Levant before the last century B.C.E. (and see below).

There is, though, one exception, at the very NW end of that basin, at CAHEP's Area S2 (Fig. 5). The quay there (W1) was exposed during the 1986 season in two places, some 10 m apart. In both places it was found to be built of ashlar blocks with no binding matrix, and in both places *ostreae* were found along the south face to –0.42 cm below MSL (Raban 1989a, 173-177; Stieglitz 1987, p. 188). The western probe went down to almost 2 m below MSL, with bedrock being reached at about –2.7 m, by water jet probe (Locus 225, and see Fig. 6). This quay, and maybe also the headers paved passage NW of it (Fig. 5, 220), might have built earlier than the Sebastos, for the harbour of Straton's Tower, at a time when the relative sea level was lower by as much as 0.4 m. Such data would better fit the Hellenistic era rather than the Herodian one (Raban 1989a, 293-295). A related issue might be the original date for the Phoenician style, ashlar headers jetty and its adjacent quay at the nearby Area S1 (CAHEP's former Area L)[2], but this is not part of the Inner Basin and to be discussed elsewhere.

[2] Recently we have cleared the fill next to the quay (WO21), to the west, and found that it lays on the bedrock at –0.6 m below MSL (Raban 1989a, 151-154).

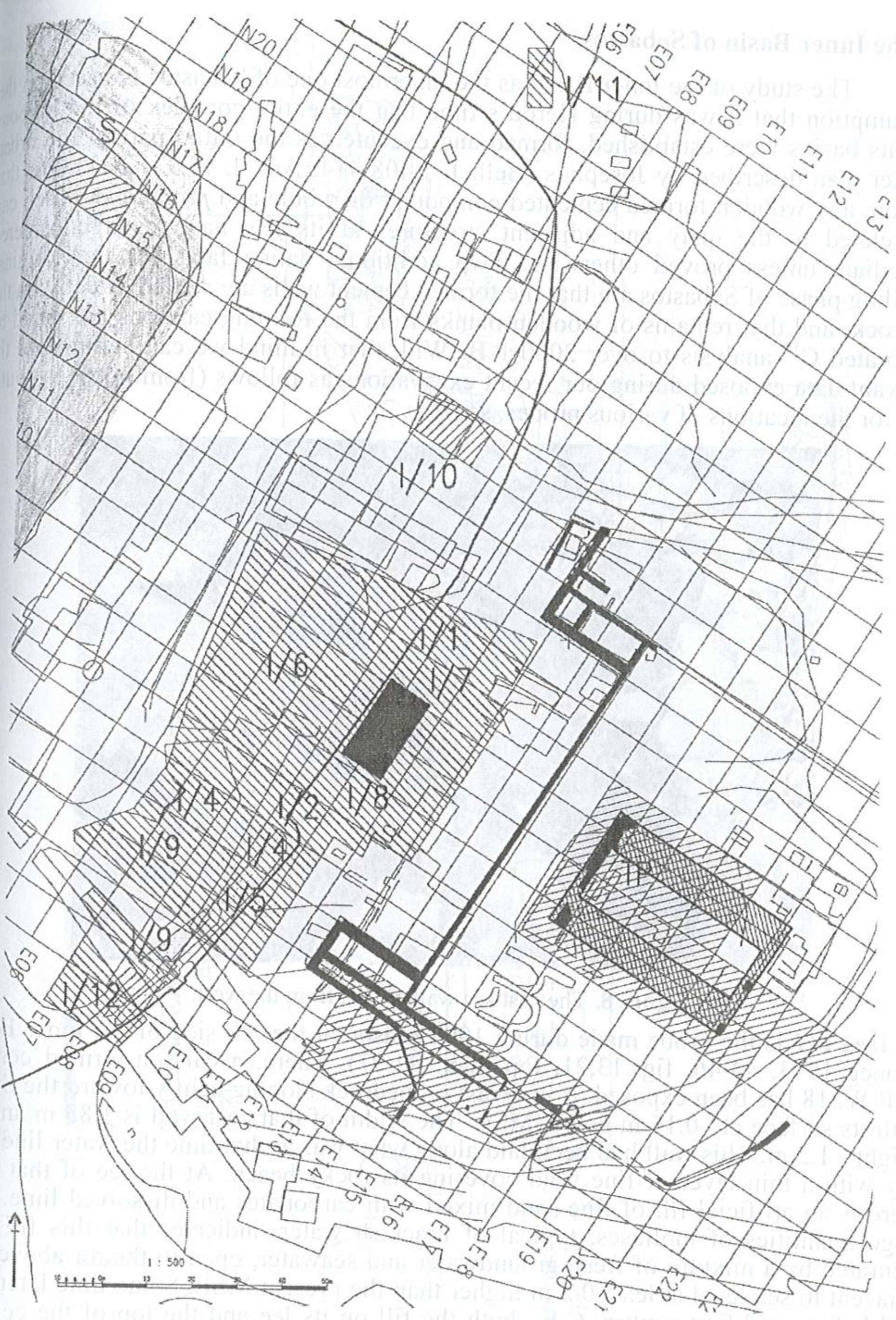

Figure 7. Sketch plan of the area of the Inner Harbour and its surroundings at the end of 1994 season, with the various probes marked.

3. The Inner Basin of Sebastos.

The study of the Inner Basin as the innermost one of Sebastos is based on the presumption that it was during Herod's time that the entire complex of the harbour and its basins were established, formed and executed as the initial part of the urban master plan described by Josephus (Bell. J. 1.408-414; Ant. J. 15.331-341). For that reason, any wooden formed cemented compound of rubble and *pozzolana* which can be related to the quay and adjacent structures at its lee, have been considered Herodian, unless proved otherwise. Two additional dating facts for that original building phase of Sebastos are that the formed cement walls are settled directly on the bedrock; and that remains of wooden planks from the forming caissons are dated by calibrated C^{14} analysis to over 2000 P.B. With that in mind we can summarize the relevant data exposed during our recent excavations as follows (from north to south, and for the locations of various probes, see Fig. 7):

Figure 8. The cast sea wall at I11, from the west.

a. ***Area I11*** is the probe made during 1992 season at the NE side of the Inner Basin (Toneg 1993, 44-46, figs.13,21, top plan: 94-97). There, a caisson-formed cement wall W518 has been exposed. It was cast on bedrock sloping gently toward the SSW, with its surface at –0.16 m below MSL. The width of that cast wall is 1.85 m and its height - 1.2 m. This wall had been laid along what was at that time the water line of a bay with a thin layer of fine sand covering its rocky beach. At the lee of that wall there is an artificial fill of fine sand mixed with carbonates and dissolved lime. The large quantities of molluscs, typical of brackish water, indicates that this fill was saturated by a mixture of fresh groundwater and seawater, open to the air above and adjacent to sea level at least 0.2 m higher than the present MSL. Some time later, but still before mid-first century C.E., both the fill on its lee and the top of the cement wall were covered by a concrete floor (F511) about 0.2 m thick and very coherent. On top of that floor there were sherds of the Herodian era (Fig. 8).

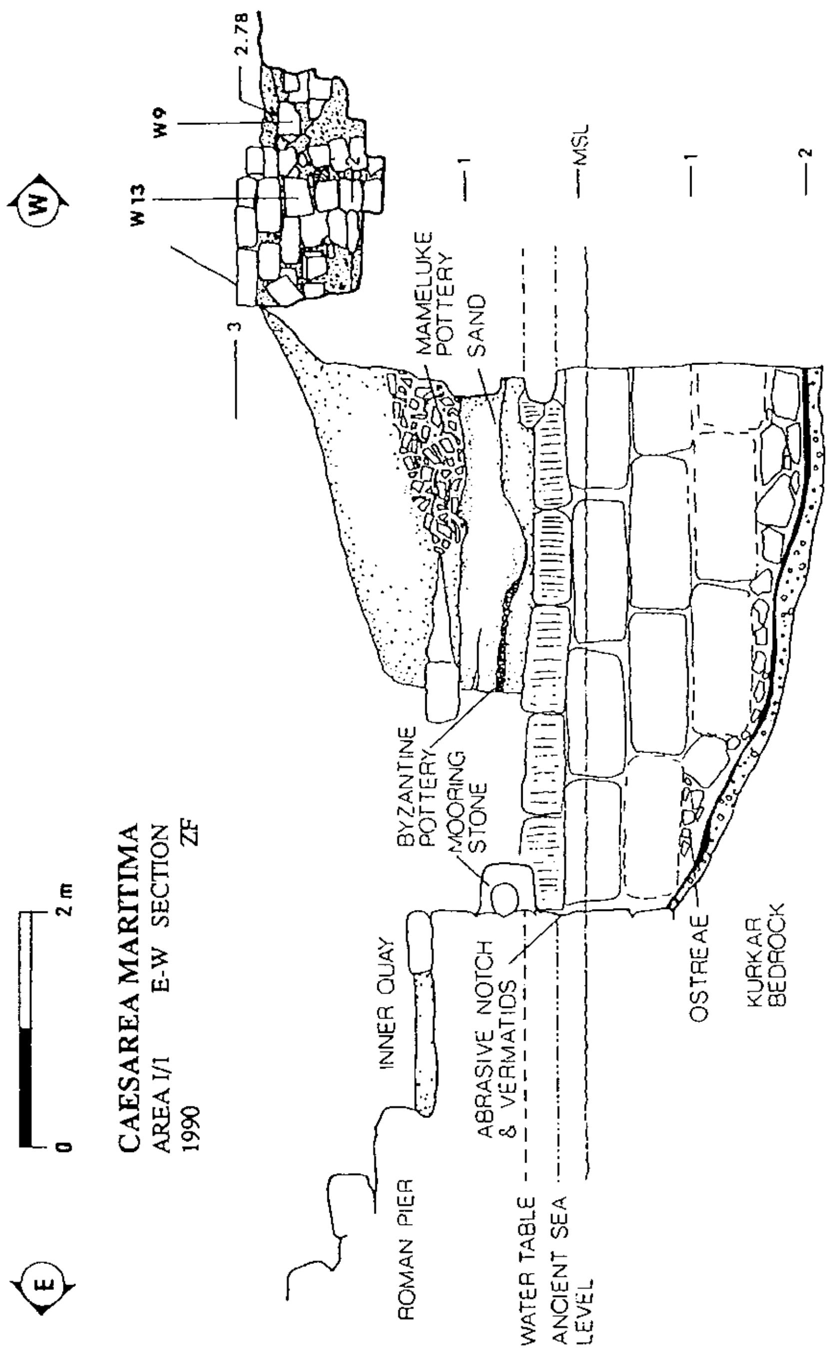

Figure 9. Section at the eastern quay in area I1.

b. *Area I1*, at the midsection of the eastern quay, west of the NW corner of the Temple Platform (Fig. 7), is the one that has been under study since 1976 (Raban 1989a, 80-81, 132-137; 1993, 15-22). The more it is studied, the more complicated the data are. Yet, its original phase, though covered in many places by later renovations and additional structures, is of a clearly discerned character: a vertical sea wall, of which only the western face is exposed, had been installed on a leveled edge of rather crumbling *kurkar*, at –0.85 m below MSL. Within its upper part a pierced stone slab was incorporated, with the centre of its horizontal hole for mooring at 0.7 m above MSL (about 0.4 m above the ancient one). The formed mixture of rubble and hydraulic concrete *(pozzolana)* was topped by a single course of ashlar headers to a height of 1.65 above the present MSL (Fig. 9). The highest elevation of *ostreae* shells on the face of this wall indicates that sea level was about 0.3 m higher than the present MSL when seawater reached that wall , probably in the 2nd, or early 3d c. C.E. (and see below).

c. *Area I2*, just south of I1. There the line of the eastern quay has been exposed below the floor of one of the Fatimid bins (1295) (*CCE* 1992, figs.27,48), at 1.16 m above MSL, built of ashlar slabs. Yet, in another bin of that group, which later turned out to be used as a well (Loci 1212, 1255) the mosaic floor of the bin seems to have been laid over concrete that extends west of the line of the eastern quay (*CCE* 1992, 22-24, fig.41). The same type of concrete has been exposed at 1.17 m above MSL, even farther to the west, during the 1993 season, at L. 951, under an 8th c. C.E. floor. So, it is probable that there was some kind of projecting cast jetty at that area, which is still hidden under later structure.

d. *Areas I4,5*, two adjacent probes along the eastern quay. In both the original structure was partly dismantled and rebuilt with topping courses of very large ashlar blocks. **I4** is a probe attempted already during the 1989 season. The quay there was found to be 2.6 wide and laid on levelled bedrock at 0.3 above MSL on its lee and –1.05 m below MSL, on its western side (*Report 1989-1990*, 89-90, figs. 16-18). Farther north along the eastern quay (L.1271) the entire height of the seawall seems to be a later replacement of the original Herodian one, and so is the case of the adjacent area at its lee, which was disturbed and penetrated by various early Islamic cisterns and wells (Fig. 10). There, the very northern surviving segment of a flushing channel has been exposed. It is a plastered structure that was molded in hydraulic concrete with its 0.8 m wide floor at 0.89 m above MSL (*CCE* 1992, 27-31, figs.50-52).

A similar situation has been found at **I5**, but at that farther southern segment of the quay, there were two crushed *kurkar* floors, of which the lower one (359), at 1.21 m above the MSL, was based on a fill of crushed *kurkar*, mixed with some shreds that would date it to the Herodian era (*CCE* 1992, figs.49, 54, 58). Beyond that floor, some 6 m at the lee of the quay, there is that Byzantine square wall (342), that pierced through another, better preserved, segment of the flushing channel (360). That channel was found to be deliberately filled with a mixture of fine, dark clay, in which many *ostreae* and sherds are incorporated (Fig. 11). Careful reading of every significant sherd and any readable coin enabled us to suggest that this fill had been dredged from the bottom of the inner basin early, in the 3rd c. C. E. (a coin of the Roman Emperor Septimius Severus, 193-211 C. E., is the latest datable item found in that context so far).

e. *Area I9* is next to the base of the southern medieval city wall, just east of the gatehouse of "Jaffa Gate" (Porath forthcoming; 1993b). There the eastern quay was found to be crossing underneath the foundation of the Early Islamic wall, and to be topped by three courses of ashlar slabs that are incorporated with a floor of beaten soil. That floor and the fill that substantiated it cover two channels (Fig. 12). The western one resembles, by form, size and elevation, the flushing channel exposed in I4 and **I5**, though its floor is somewhat higher (0.95 m above MSL). The original quay incorporates three courses of cut stones, the upper one is of headers of considerable size and its base is well abraded by the sea. The *ostreae* shells were found up to its base (Fig. 13) at 0.3 m above MSL. The lower course of cut stones is imbedded in the cast mixture of rubble and *pozzolana*, which had been laid on bedrock at –1.4 m below MSL.

f. *Area I12* is the southeastern corner of the Inner Basin. Here, the excavations have followed the course of the eastern quay toward the south bay and exposed its curved turn toward the west (Fig. 14). In that area the original quay has survived to a maximum height of only 0.6 m above the MSL, topped by later added blocks. The only surviving course of well-eroded headers had been originally incorporated with molded concrete, composed of rubble and *pozzolana*, much like in **I9**. The probe made next to it went through a very disturbed mixture of shell, sherds and wave-deposited coarse sand. The rate of abrasion on the surface of the quay indicates that it was exposed to extensive water energy for a rather long period. The cast quay was found to be laid directly over a gently sloping surface of beachrock, at –0.9 m below MSL. Below the beachrock there is sand with no sherds, or any other human-made artifacts. At the lee of the quay, to the east, a wide and rather shallow flushing channel was found, in continuation of that in **I4**, **5** and **9**. The floor of the channel in **I12** is over 1.4 m wide and it gets wider, shallower and at lower elevation toward the south[3].

It seems as if that flushing channel had been fed from the wash of the waves over the rocky beach of the nearby South Bay (even today there is no deposition of sand at that place). The incoming water would rush into the ascending channel to a point somewhere between **I9** and **I5**, where we assume there was a settling basin, with sluice gates and threshold at just over 1 m above MSL. From that alleged basin the flushing water would run down through the channel and would flow into the back of the Inner Basin, at Area **I4**. Unfortunately that part of the quay went through a series of modifications in a later period, so the exact whereabouts of the turn of the course have not survived. Based on the data summarized above, the following drawings represent the reconstruction of the Inner Harbour as it was incorporated by Herod's engineers within the overall complex of Sebastos (Figs. 15, 16).

[3] We are grateful for the oral information given to us by Dr. Porath, who excavated the "Land Site" at I9 and I12 (Porath forthcoming; 1993b).

Figure 10. The flushing channel at the lee of the eastern quay in Area 14, looking south.

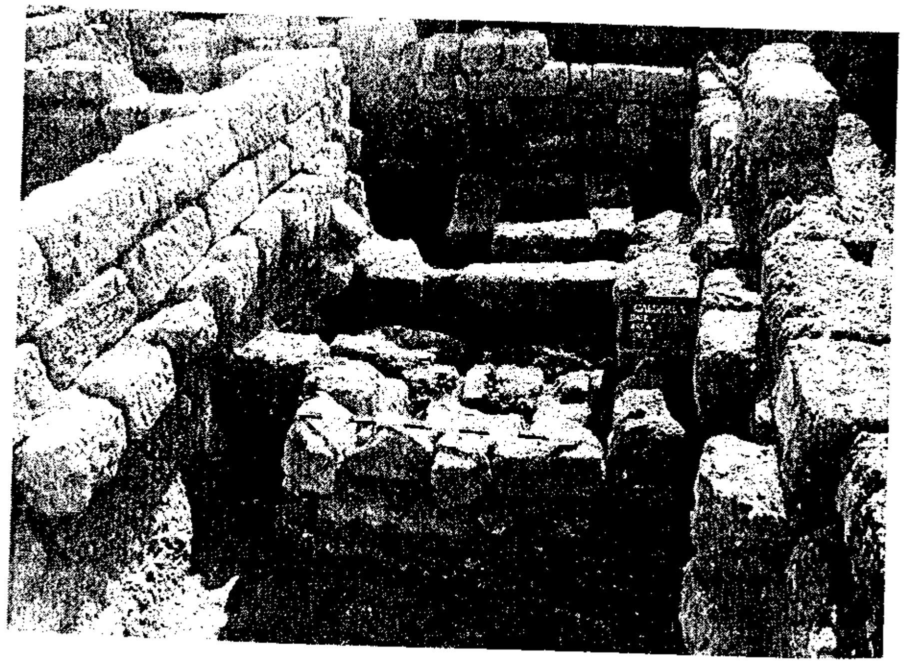

Figure 11. Area 15 from SW, well 342 within channel 360 are at the top right hand side.

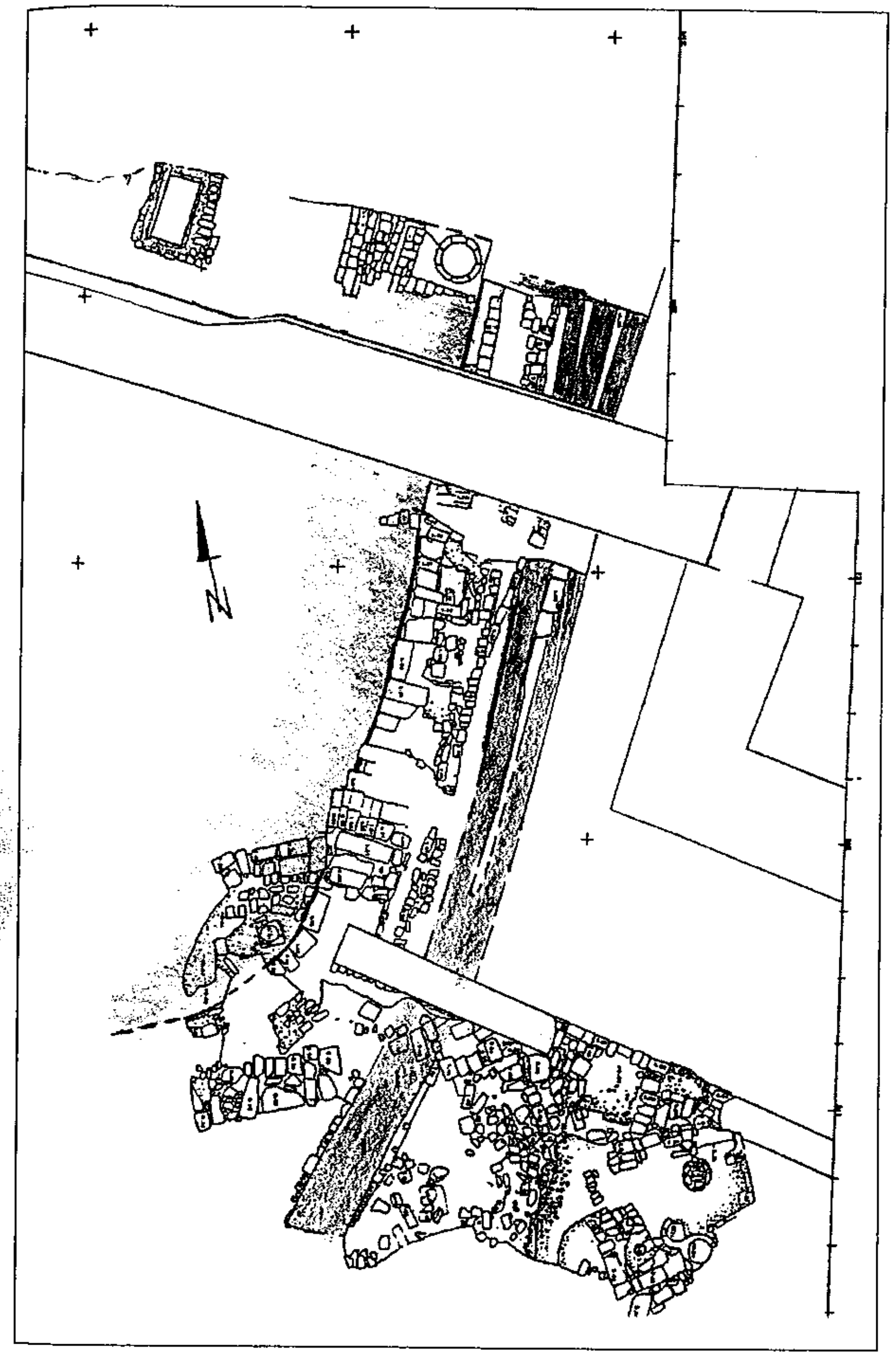

Figure 12. Sketch plan of the flushing channels at I9 and I12.

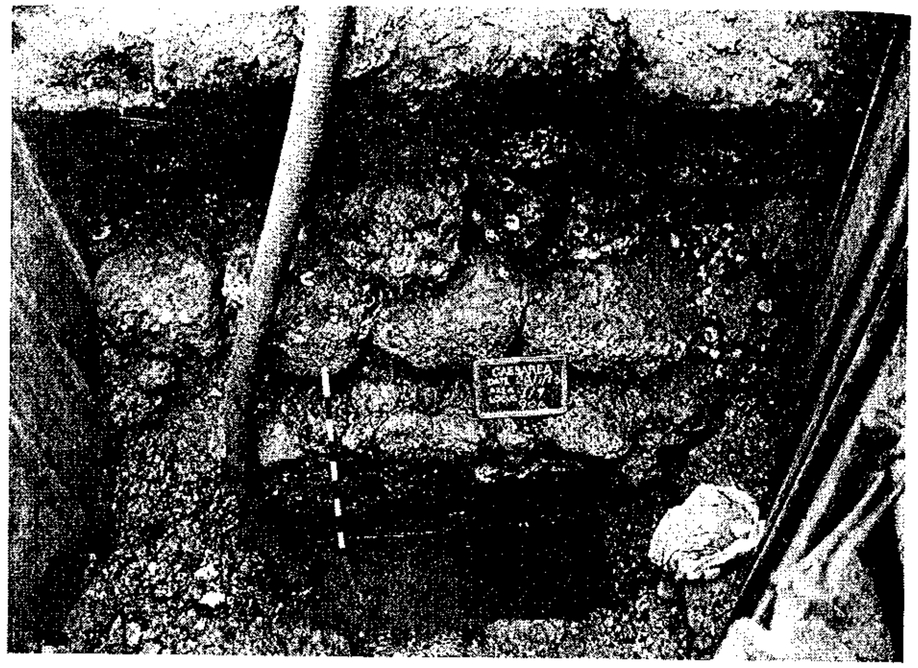

Figure 13. Locus 906 at Area 19, from the west: the quay, almost all the way to the bedrock.

Figure 14. The quay at the Area 112, looking from the SW.

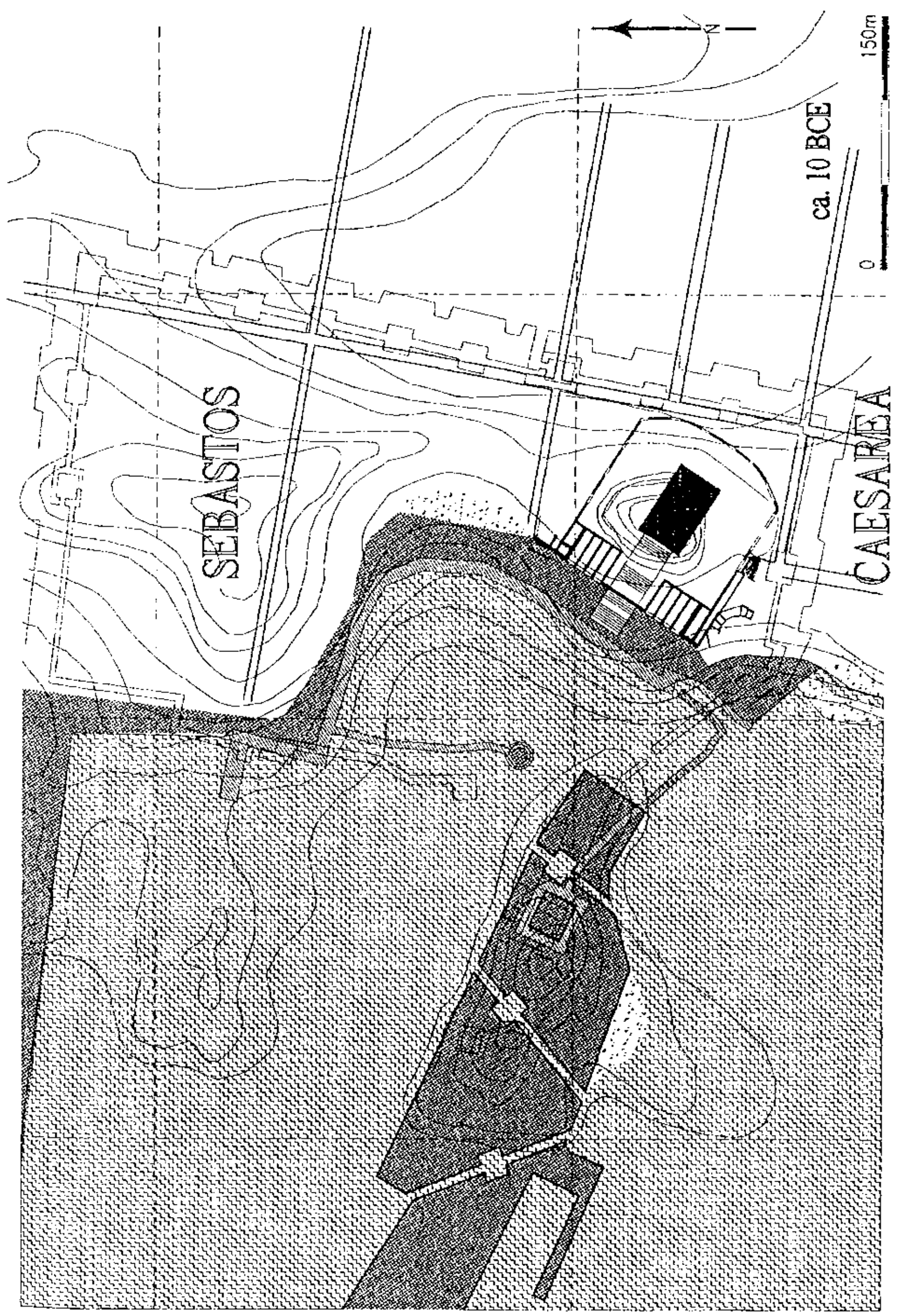

Figure 15. Sketch plan of the Inner Basin of Sebastos.

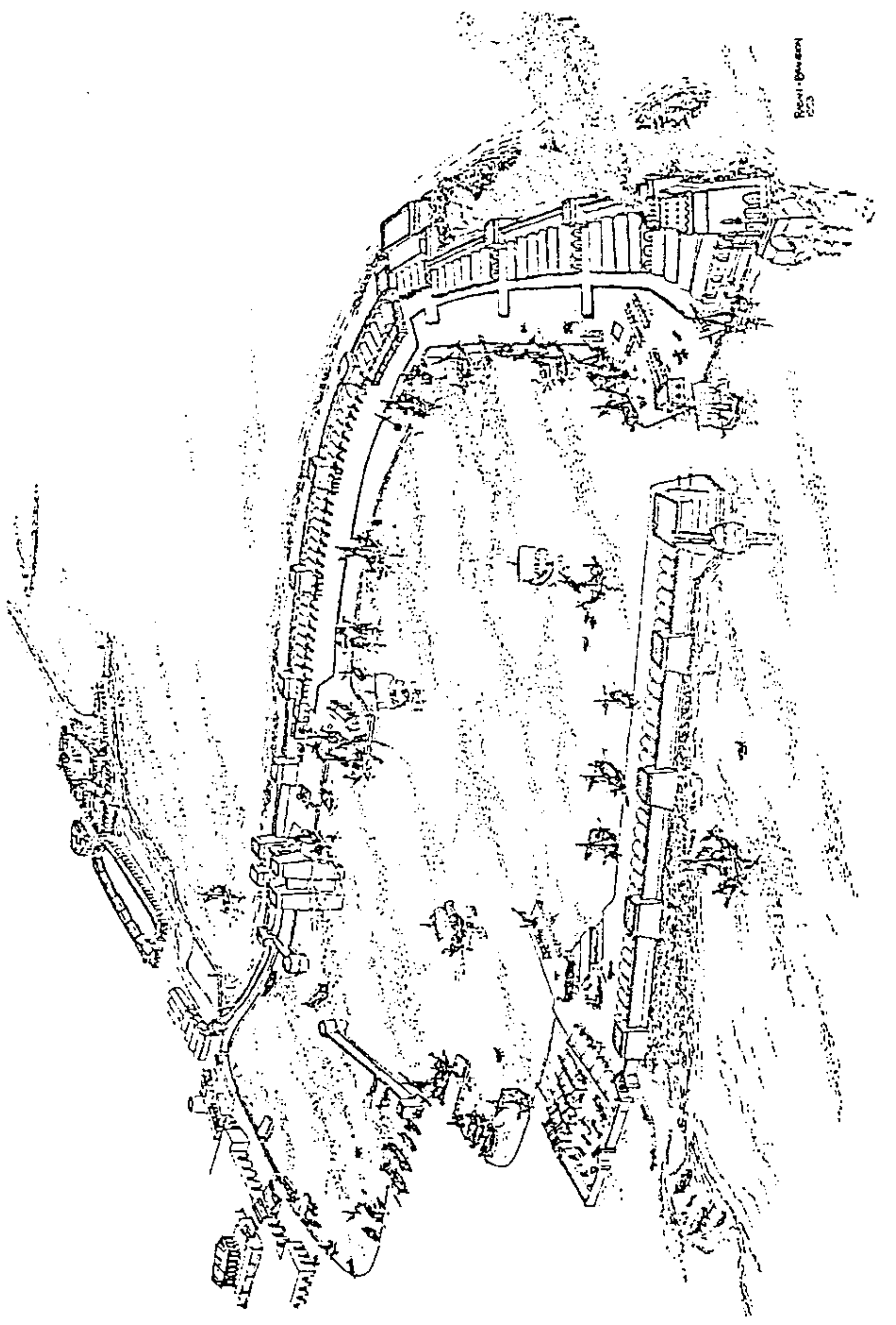

Figure 16. Artist's rendering of Sebastos.

4. The Inner Harbour during the Later Roman Era

As a topographic "Terminal" for sediments, the Inner Basin's water depth was most sensitive to any deficiency of the flushing system and altered rate of wave energy at its western entrance. It seems that the original depth of the Inner Basin of Sebastos had been properly maintained for over a century, with properly functioning flushing system, relatively narrow entrance channel (between the Round Tower T1 and the "Harbour Citadel") and, probably, occasional dredging attempts. The thin layer of fine mud, encrusted by a rather extensive colonies of *ostreae,* are good evidence to attest to it (*Report 1989-1990*, 89-93).

Yet, there is circumstantial evidence to suggest that the main mole of Sebastos had lost integrity already toward the end of the first century C. E., and that the surge overran it, into the harbour's basins, in an ever increasing manner, all through the following two centuries[4]. From the theoretical model for sedimentation and the so-far sketchy data we have from core drills, made within the Inner Basin, it seems to us that sand started accumulating soon after 70 C. E., mostly at its northern half and next to its southern seawall (Fig. 17). The still operating flushing channel at the SE seemed to enable maintain navigability in the area between its outflow and the western entrance. Yet, sometime during that period an attempt was made to add a protruded quay to the seaward facade of the eastern quay, at the area facing the entrance and adjacent to the molded Herodian jetty on its northern side (Area **I1** and I6). This quay was build of loosely fitted large ashlars, laid over a layer of sand, some 0.3-0.6 m thick, mixed with abraded seashells and Early Roman sherds, which had been silted from the original floor of the Herodian basin. The quay was built up to about 0.4 m above the present MSL. Next to the NE corner, between that new quay and the Herodian one, a circular staircase was built, leading from the seafloor (!) to the face of the new quay, its northern extension being cut in the bedrock, next to the older one (Figs. 18, 19).

A second staircase was added next to the SW side of the new quay, along its western face, leading down southward from the water level of the time (0.4 m above the present one?). This 1.2 m wide staircase comprises 7 stairs (like the circular one) and was based on 0.3 m of sand (over bedrock) at –2.1 m below MSL (Figs. 20, 21). The face of the staircases was covered by gray plaster, rich in volcanic ash and pieces of charcoal. This plaster, which had been applied manually, also covered the face of the bedrock and the retainer of the western face of the quay, found at its NW end (**I6**, Locus 148). This retainer was made manually by laying courses of small rubber, mixed with cement, around wooden upright posts (Fig. 22).

The cement and the plaster were found to be very soft and non-coherent, after being rinsed for centuries in fresh ground water. Yet, the marine encrustation adds much to solidity their surface - indicating that the composition of both was calculated as a "Marine" one, rather than "Hydraulic". The entire structure is of very intriguing character:

[4] For the wreck site of late 1st century C. E. over the northern tip of the main mole, see Brandon's paper in this volume (Holum et al. forthcoming; Raban 1994, 119-133). For other data see Raban (Raban 1992a, 111-124; 1992c, 68-74).

Figure 19. The staircase in I1. Looking from the east.

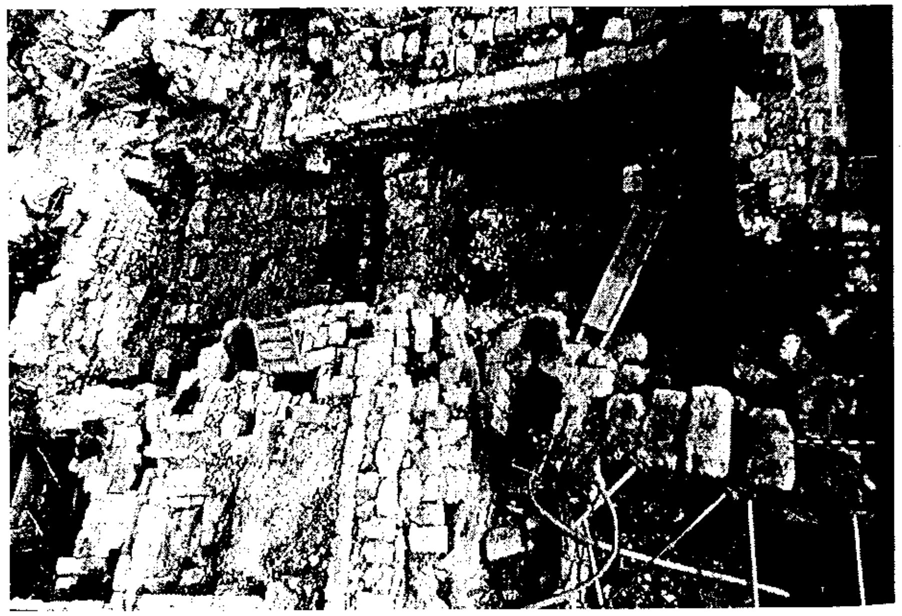

Figure 20. Overview on part of I1 and I6, showing much of the 2nd-3rd c. C.E. quay and some of the later structures over it, looking to NE.

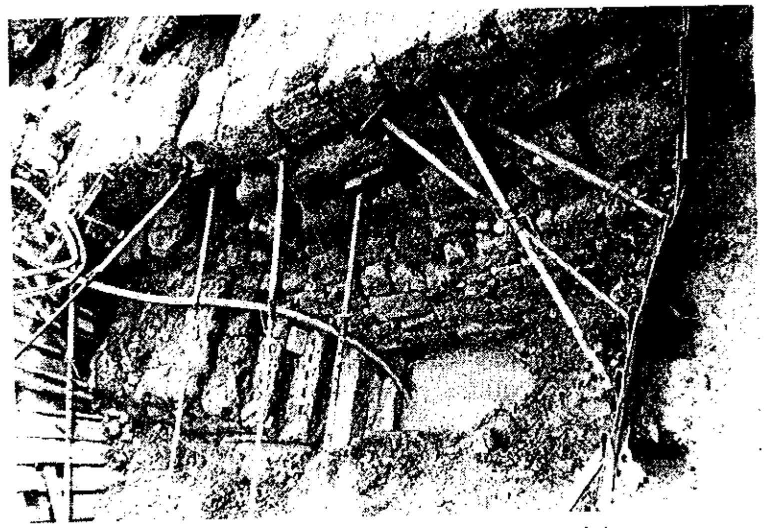

Figure 21. The staircase in I6, looking toward the east.

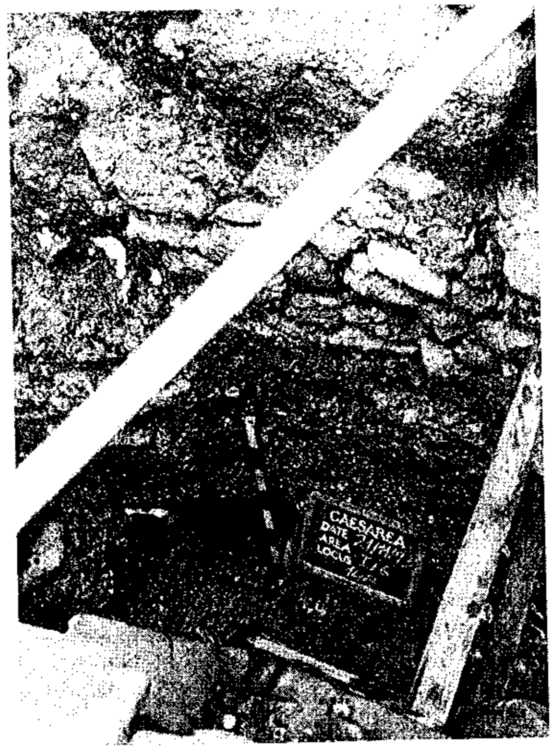

Figure 22. The west face of the "New Quay" at I6 (Locus 148), looking from the west. The meter rod is at present MSL.

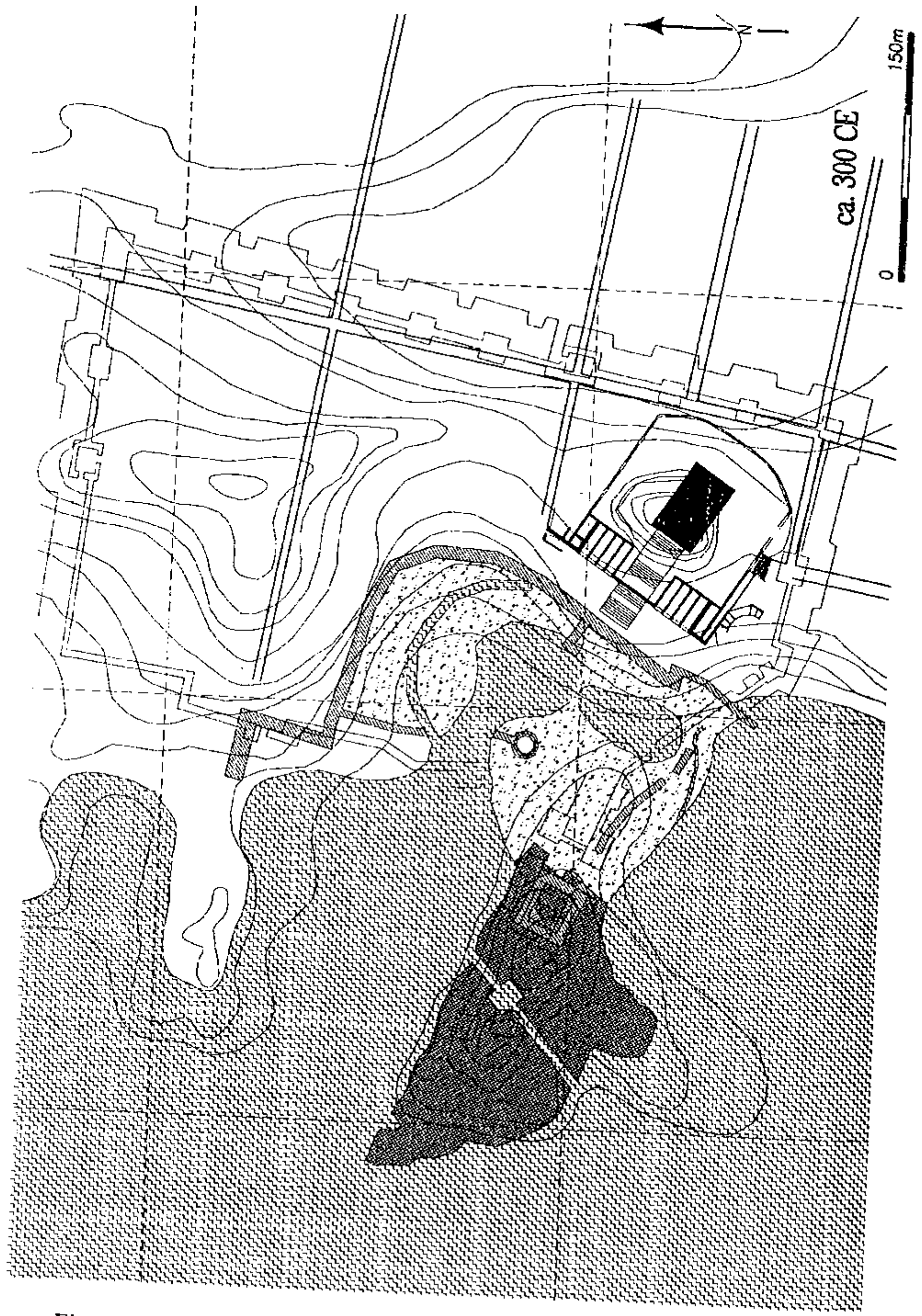

Figure 23. Sketch plan of the Inner Basin toward the end of the 3rd c. C.E.

Having no additional data from elsewhere in **Caesarea**, along its waterfront and in other parts of Sebastos, to suggest radical changes in land/sea relations during these centuries, the enigmatic features and the logic behind the construction of such a "quay" remain to be solved, hopefully by future research and exposure of additional data.

The history of that structure seems to have been even more complicated. Deducing from the fill next to it, to the north and to the west, there was a body of seawater, gradually silted up, mainly during the fifth c. C. E., almost to water level, by what seems to have been deliberately dumped broken vessels (mainly jars and amphorae), building stones, decomposed plaster and cement, mixed with fine mud and covered by *ostreae* shells. This marine fauna indicates that seawater was flowing next to that structure in a pace which facilitated continuous supply of oxygen, but not enough to erode the sherds and carry in sand.

Some time during the first half of the third century C. E. the southern sea wall of the Inner Basin was breached, either deliberately, by the people of Caesarea, or by the transgressing sea. One might argue for contemporaneous occurrence with other dramatic changes at the waterfront of Caesarea at that time. Such as the abundance of the amphitheatre along the coast of the South Bay and its replacement by a new one farther inland (Rorath 1994, p.15*); the additional submergence of the western mole (Raban 1992a, 113-119; Hohlfelder 1992, 75-78); and the renovation of the western facade of the Temple platform (Porath 1993a). At that time the flushing channel at the SW went out of use and was deliberately filled (see above). Instead, a non-controlled flushing of seawater, carrying quantities of coarse sand, shingles, eroded sea shells (mainly *Glycimeria*) and sherds flow in through the southern gap. The solid load was deposited next to the gap, within the SE corner of the Inner Basin. Additional sediments were brought up by the surge from the west, through the wide seafront that had been created following the dismantling of the western seawall. The double source of sediments have created sandbars in the Inner Basin with at least one big hollow, filled with stagnant water at its southern side (Fig. 23). A probe made in Area **I9**, about a dozen meters west of the point where the eastern quay of the Inner Basin passes under the medieval city wall, have exposed, under the base of the Byzantine seawall (and see below) a thick and very compact layer (Locus 904) of almost pure organic materials. The top of that layer is at –0.6 m and its base, over bedrock and thin layer of sand, at –2.3 m below the MSL. The organic content of that layer included wooden branches, pieces of rope, mats and woven baskets, and vast quantities of food remains: fruit stones, olive and grape pits, fig seeds, cereals, beans, sesame seeds, chicken and cattle bones, etc. All uncarbonized and nonoxidized and still retaining their original color and texture. The pottery found at that context and C^{14} dates for samples of the rich organic repertory enable us to date that dump to the late 3rd - early 5th century C. E.

During the late months of 1993, a team of archaeologists, from the Museum of London, excavated an area designated as **I14**, within the southern part of the Inner Basin. Within this project a well-shored probe was carried, by Brian Yule, in an attempt to study very carefully the alternating layers of sediments (Fig. 24). There, too, a layer of compact silt with a high percentage of organic material, of the same type and state as in Locus 904 of Area 19, have been found between -2.5 m and -0.9 m below MSL (Yule and Rowsome 1994; Williamson 1994; Yule forthcoming).

We can therefore deduce that during the Later Roman era and probably as late as mid-5th century C. E. the Inner Basin went through a process of decay, perpetuated by continuous addition of deposited wave-carried sediments and urban dump. Yet, there was some rather confined body of flowing seawater along the southern half of the eastern quay, with possible access for small navigating vessels entering it from the west, through a narrow passage next to the round tower.

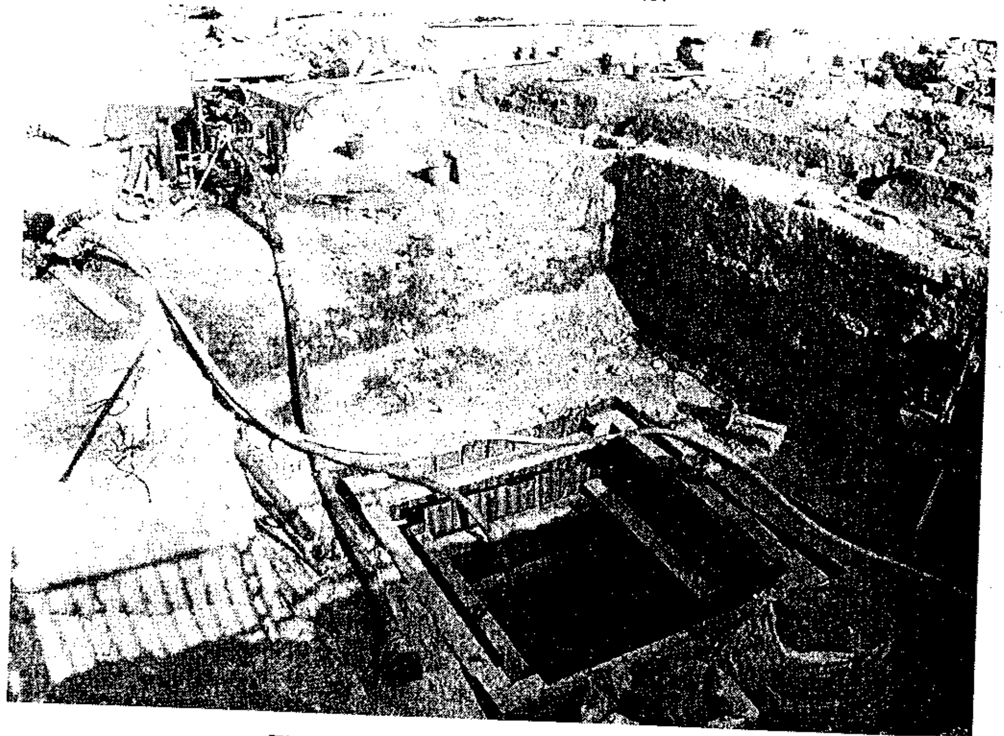

Figure 24. The shored probe (700) in I14.

5. The Inner Basin during the Byzantine Era, up to the Mid-6th century C. E.

The next stage in the history of the natural processes and human reboundings is tentatively dated by us to c. 500 C. E. For that time period we have a rather unique reference for imperial money available for the people of Caesarea given by Anastasius I (491-518 C. E.) for "amending the ill-stated harbour and its restoration as navigable one" (Procopius Gazaeus Panegyricus in Imperatorem Anastasium, PG, 87.3, 2817 §19). So far, the only structural remains that have been traced along the external harbour basin, which can be attested to that attempt, are of a rather extensive, loosely laid rampart, comprised of small rubble. This spill follows and covers the inner half of the northern main mole and beyond it to the west, filling up the original harbour channel and reaches the northern tip of the western mole (Fig. 25) (Raban 1989a, 130-131, 290-292; *IEJ*, 38, 1988, 273-275). At the present stage of our field work we

cannot suggest the whereabouts and character of the water line at the lee of Anastasius' mole. Yet, it is quite clear that it was at least 50-60 m west of the eastern quay of the Inner Basin. Some time before Anastasius' supported building attempt took place, the area of the Inner Basin had been covered by depositions of wash-carried beach materials characterized by well-eroded small sherds, sea-shells and coarse sand. That type of depositions has been found everywhere within the Inner Basin, over those of the previous era, described above (*CCE* 1992., 20-22, 26-27). Everywhere along the eastern and southern edge of the Inner Basin there are very impressive remains of major architectural features which are tentatively related to that imperial-initiated building project, allegedly sponsored by Anastasius. Most probably the renovation of the entire Temple Platform, including the renovation of the pediments vaults, extension of the retaining walls on the south and on the north sides, the construction of a large staircase which led from the eastern edge of the former Inner Basin to the Temple platform and the building of the Octagonal monument (the alleged "Martirium of St. Procopius"), were all parts of that project.[5] At that building phase temporarily designated by CCE as stratum XI, a new sea wall was established along the south side of the Inner Basin, within the line of the former, breached one, at a course later to be used as the base for the medieval city wall (Porath et al. 1989/1990, 132-134). That sea wall (Fig. 26) was exposed during the 1992 season by Y. Porath, for IAA and in our 1993 probes in Area **I9**, for over 40 m, just west of the eastern quay of the Inner Basin. That wall was based on a foundation comprised of reused column shafts that had been laid within that layer of beach deposits described above, in a rather loose manner. Over it, a well-constructed ashlar structure of a considerable width (probably 3 m or more. But its southern face is buried within the later medieval wall) with its surface sloping gently toward the west (being at about 1.6 m above the MSL next to the old quay and only 1.2 m above the MSL 20 m farther to the west). It is quite interesting that the easternmost end of that wall is about 3 m shy (west) of the line of the eastern quay. As if a calculated passage was left non-retained, by the Byzantine constructors, enabling excessive seawater of the wash of the storm breakers at the South Bay to find its way to within the area of the former Inner Basin, for yet a non-comprehensible reason.

The eastern quay, at that phase, lost its original maritime function, but was renovated as a retainer between *Terra Firma* on its lee and the still-inundated landlocked Inner Basin. The former, additional 2nd-3rd century C. E. quay at **I1**, was altered at that phase, by an elevated confining wall along its edges, creating what might have been a rectangular "Reflection Pool", in front of the staircase which led to the Temple Platform (Fig. 20). On its NE side, the northern side wall of that alleged pool was incorporated with a rather wide, ashlar paved platform that laid over the original quay, extending a couple of meters behind its edge, to the west. That extension has been based over that beach deposits in what seems to be a very ill-substantiated manner. From that platform there was a small staircase,

[5] Holum et al., *Report 1989-1990*, 100-107; *CCE* 1992, 37-42 (Areas I7, I8 and the date of the staircase); 50-51 (the southern retaining wall of the Temple Platform in Arae Z2); 54-55 (the Temple Platform)

leading down to the low ground in the west (see Fig. 27), which was probably inundated at the time, at least during the winter and spring seasons, by shallow groundwater. As has been attested by a set of column drums that we found laid in the mud at a pace intervals, leading west from the base of the staircase (*CCE* 1992, 18-21, figs.28,37). The elevation of that dry walk facility -0.9 m above MSL, is almost half a meter too high for the one demanded at present and might indicate the water table of that time was higher by that much (as was probably the eustatically-altered sea level). This low area was retained by some wall that had been laid parallel to the ashlar platform, 6-7 m west of it, so it was confined and protected from being hampered and silted by wave-carried sand. These beach depositions were found up to almost 2 m above MSL, against the "shadow" of that looted wall, while within it here were "Terrestrial" depositions of mud and quantities of late Byzantine pottery (Fig. 28) (*CCE* 1992, 18-21, figs.28,37).

Figure 26. The Byzantine sea wall in Area I9, lokking from the west.

Cut-off columns that had been inserted vertically in the eastern quay, as mooring posts (probably during the later Roman era), might indicate the non-maritime function of that Byzantine platform (Fig. 27). The overall alternated area as it was established around 500 C. E. (Fig. 29) seems to have been functioning and retaining its integrity for about half a century. During that period of time several marine transgressions overran the western side wall of the "Reflection Pool", depositing wave-eroded sherds, sea shells and coarse sand over its ashlar paved floor. That floor was consequently raised by about 0.3 m of rubble fill, mixed with gray mortar and retained by three parallel ashlar retainer courses. On top of that floor, an additional deposition of beach sediments indicates for another transgression that again necessitated establishing of yet another, higher floor, this time about 0.8 m above the MSL, sometime around mid-6th century C. E. That elevated floor and all the surrounding structures were abandoned and silted up, by coarse beach deposits, to about 1.3 m above MSL (Fig. 20). At this rather thick deposition one can clearly define two laminas of even coarser materials that should have been carried there by extremely high energy. A survey of recently published researches concerning the so-called "Mid 6th century Tectonic Paroxism" and the update list of historically recorded Tsunamis along the coast of Caesarea, might be connected with that laminas and maybe also as one of the reasons for the

radical change and the urban demise of the coastal quarters along the south bay. This argument refers to the Tsunami of 542 C. E. (according to Michael the Syrian) and to that of July 9th 551 C. E. (Pirazzoli 1986, 31-49; Amiran, Arieh and Turcotte 1994, 260-305, p.294: Appendix 5).

Figure 25. Artist's rendering of the harbour after Anastasius' renovation c. 500 C.E.(S. Giancetti.

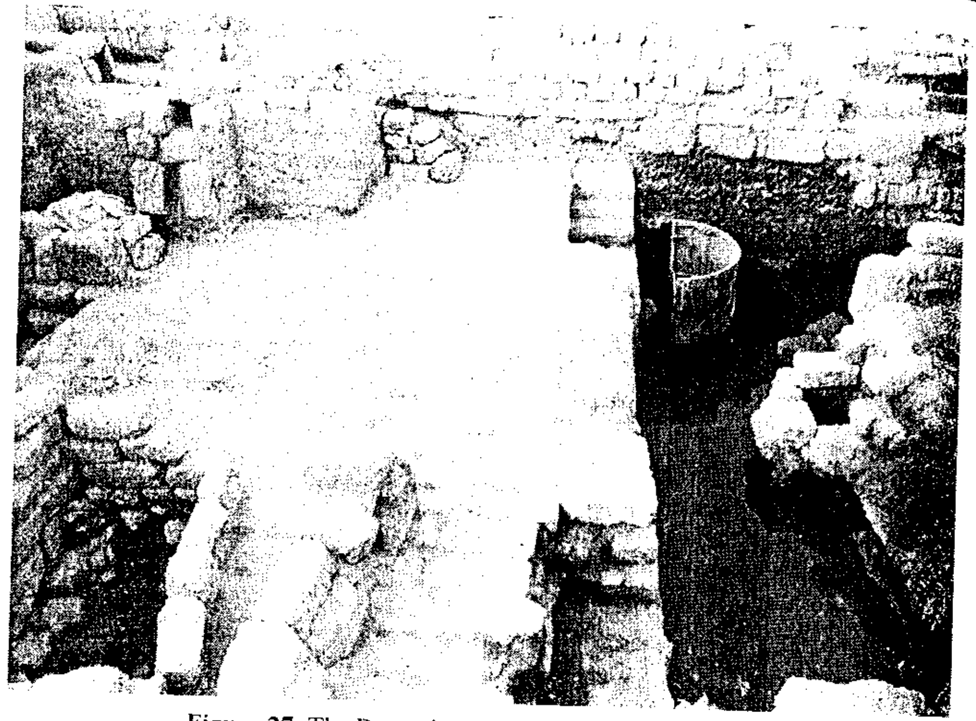

Figure 27. The Byzantine Platform in I1, from the NW.

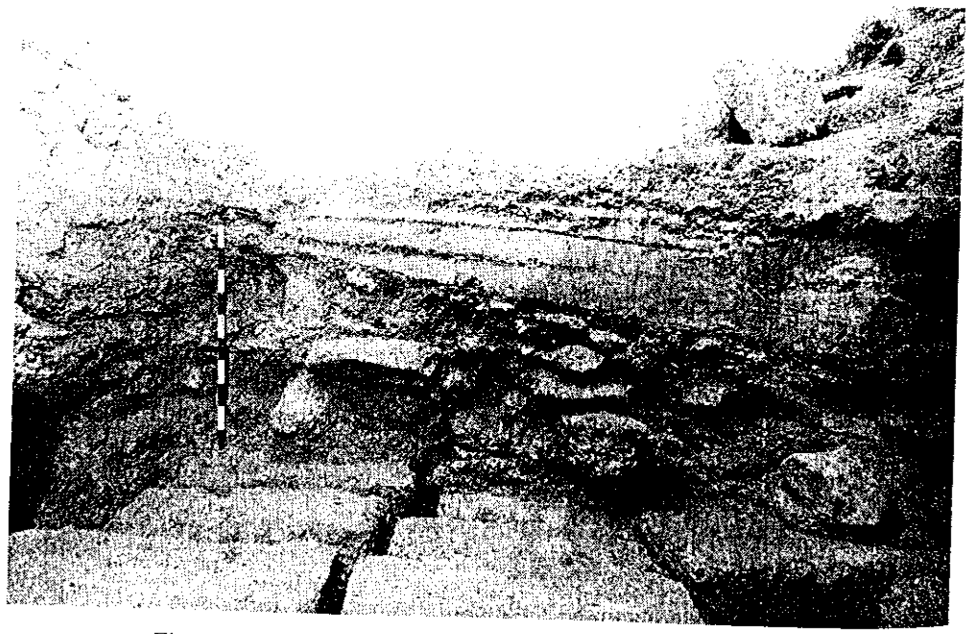

Figure 28. View of the southern bulk of Locus I12 in Area I1.

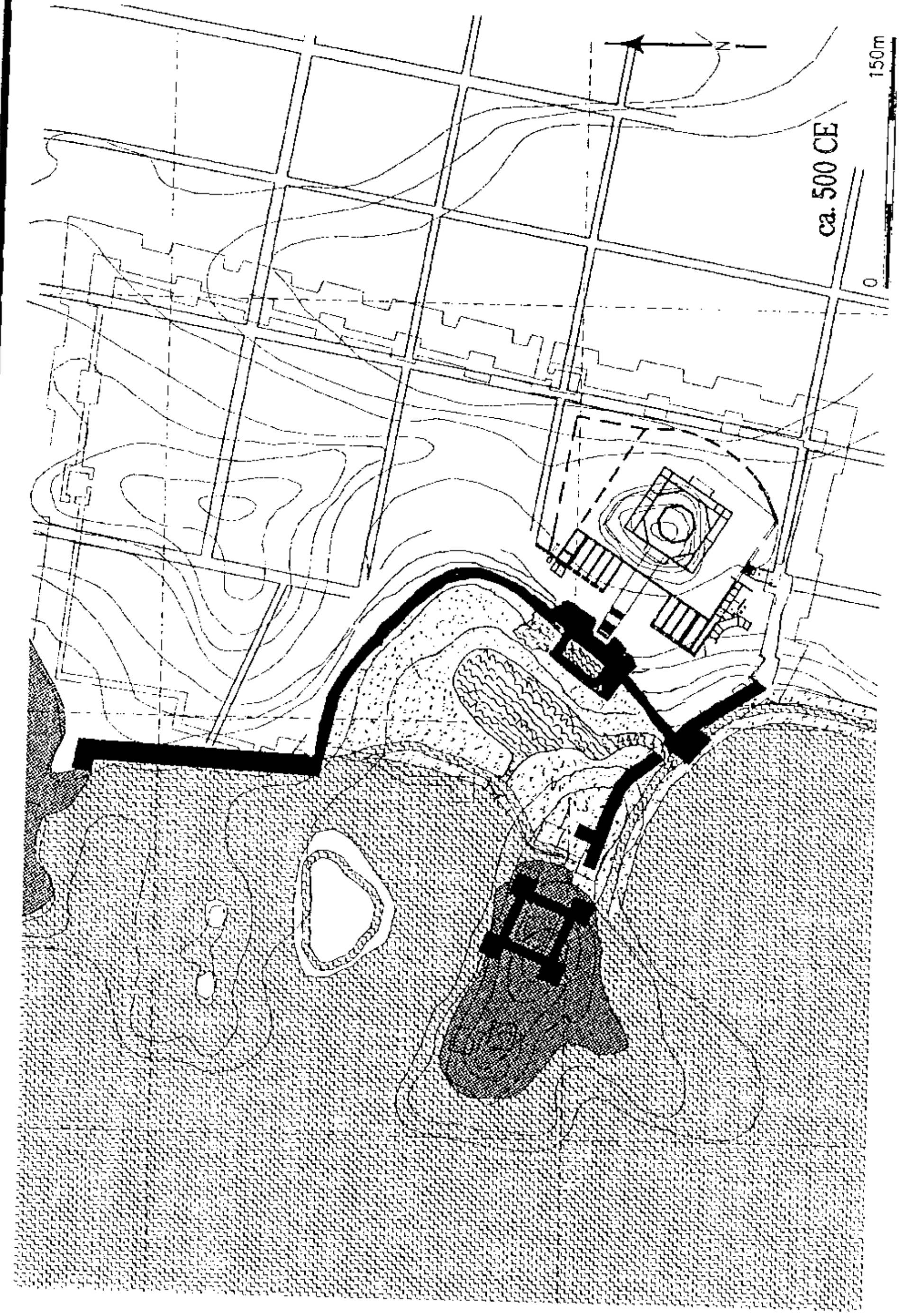

Figure 29. Sketch plan of the Inner Basin around 500 C.E.

6. The inner basin during the Latest Byzantine Era

During the last 80 years of the Byzantine era, the area of the Inner Basin continued to gain elevation of beach and coastal sediments, with larger component of eolian sand incorporated in it. In various decreasing areas within it there were still natural and artificial pools of either fresh, or brackish water, that were used as dumping sites for urban garbage. In other parts, mainly in the central and northern areas, there were higher sand bars, up to 2.5-3.0 m above the MSL. Both on these higher and drier ground and at the area extending west of the facade of the Temple Platform and the old quay, some "Terrestrial" buildings were constructed, the nature and extent of which are yet to be studied (*CCE* 1992, 51-21, 26-37). These structures represent at least two successive buildings phases (Levels X and IX in CCE tentative nomenclature), the earlier one might be of the later years of the 6th century C. E., such as the building with the mosaic floor decorated by the political inscription which praises the "Orthodoxes" (*CCE* 1992, 15-17, fig. 25); and the latter, with such installations as the drainage channel that runs from Area 18, westward, through the south side of **I1**, to **I6** (**I8**-8012, **I1**-1042, **I6**-712) and the nearby settling basin 727. Farther to the west, at the NW part of Area **I6** and the western half of **I4**, there are some ashlar walls and stone-slab floors, at a relatively low elevation (+1.2–1.6 m above MSL) that should be dated to the same, latest Byzantine phase. Everywhere these structures are under at least one layer of shell-rich beach deposits.

Probably the best illustrated sequence of that type is the southern bulk of Locus 216, at the SW corner of **I1** (Fig. 30). There, next to the external face of the confining wall of the "Reflection Pool" and its overlaid, later drainage channel (1042) and ashlar course (W. 1214), there are three layers of coarse beach deposits, interbedded with fine sand. The lower one, at +1.1 m above MSL; the second - at +1.35 m; and the third, uppermost - at +1.6 m, covering an ashlar floor which is the latest Byzantine structural element in the area. That deposition is the last and the uppermost in the stratigraphic sequence of beach or marine sediments. Directly above it there is a fill of "Terrestrial" silt, mixed with recirculated Byzantine sherds and some pieces of broken pottery vessels of the Umayyad period. This type of fill, which substantiates the earlier Abbasid buildings, everywhere within the silted-up Inner Basin, might indicate that by mid-8th century C. E. this area was properly protected from any potential marine transgression, probably as part of a large scale precaution measures taken by the Arab residents of Caesarea following the great earthquake of 749 C. E. (Amiran, Arieh and Turcotte 1994, 266-267) (Fig. 31).

7. The Aftermath and Later Maritime Facilities

The long-lasting story of man versus nature at the Inner Basin seems to have come to an end with coastal processes sealing in the odds and the people of Caesarea giving in. However, the seaborne trade was so cardinal for the economical prosperity of the city that some kind of maritime facilities had to be kept functioning, even if at lesser quality. Probes made at the sea floor near the present day public beach, around the Round Tower (T1), north and south of it, have exposed the same picture everywhere:beneath the upper wave-disturbed layer there is an extensive fill of rather

homogeneous nature - a mixture of building materials and broken pottery vessels, mainly amphorae, of late Byzantine date (6th-7th century C. E.) (Raban 1989a, 177-181, p.275; *Report 1989-1990*, 79-83; 1993-1994 Report, in *Caesarea Papers*. 2, forthcoming). Only a few sherds of the Herodian and Early Roman Periods were picked near the base of that fill, within a thin layer of mud that remains at the very surface of the *kurkar* bedrock, at –2.4 –2.7 m below MSL. This phenomenon of a harbour fill consists of debris of only one period (the latest one), might be explained either by the assumption that this part was constantly dredged, even though the area at its lee was in a process of rapid silting; or by an alleged deliberated artificial silting. Considering the data from Area I (as described above), the fact that almost no sherd from the area T context is wave-eroded, the significant percentage of household pottery and the typical "Terrestrial" oxidation of the coins, one might prefer the second tentative. Maybe that alleged deliberated fill is to be attributed to the Arab conquerors of Caesarea, in 640 C. E. who would silt up Byzantine harbours in order to prevent potential seaborne invasions of Christian fleets. Yet, this alleged deliberate fill might be a consequence of late Byzantine alternation in the location of the main municipal anchorage, from that basin to the south bay (Porath et al. 1989/1990, 132-134). In either case, that deliberate fill was in a marine environment of low wave energy and ample oxygen-rich seawater supply to its components, long enough to be coated by extensive marine fauna (*vermetides* and *ostreae*). The same repertory of large pottery sherds, coated by the same type of marine fauna have been found in quantities within the artificial "Sand dunes" which topped Areas CC and KK, at the lee of the South Bay (*CCE* 1992, 74-75, fig. 144; Boice and Thomas forthcoming). Stratigraphically, these artificial mounds are above a natural layer of eolian sand that covers a complex of 7th (or early 8th) century C. E. irrigated gardens with wells and stone-built water conduits. Above it there was a burial ground that was initiated some time around 900 C. E. It is therefore quite safe to suggest that these sand mounds were the spill of dredged sediments from the harbour basin, either next to the south bay, or at the present-day fisherman's haven, just west of Area T, an attempt carried out by the Abbsid regime (or the following, Toulonide one) in the 9th century C. E.[5]

So far we have no archaeological data of meaningful topographic context that might enable us to suggest the whereabouts and the character of the maritime installation that would facilitate seaborne trade during the Early Islamic era (640-1101 C. E.). Though one would advocate location adjacent to the fortified core of the city, in that case - more or less where the present fisherman's haven, built in 1951, is. There are two major structural complexes there which are related to maritime activity: the Harbour Citadel and the columns jetty, both tentatively dated to the Crusader era (SWP, II, 17-18; Abel 1914, p.588; Raban 1989a, 79-80,154-156, 291-293). Yet, recent studies, both historical and archaeological, raised the issue of possible earlier, 10th-11th century C. E. dates for the construction of both (Porath et al.1989/1990, 132-134; Gertwagen 1991). In either case the Crusaders did use them up to their final defeat in 1265 (Figs. 32, 33).

[5] For the seaborne trade at Caesarea during that period see Arnon 1995; forthcoming.

Figure 30. The southern bulk of Locus 216 from the NW.

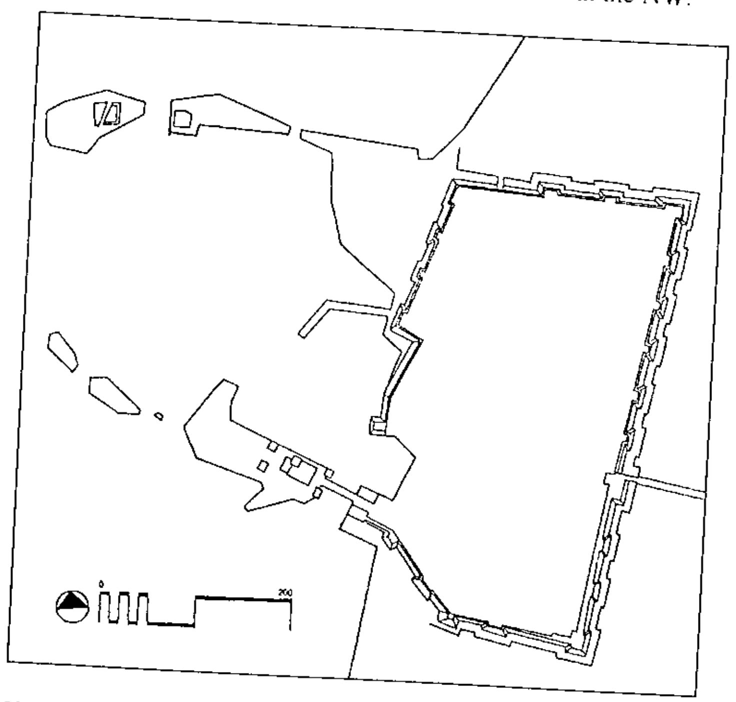

Figure 32. Sketch plan of the Inner Basin and other maritime facilities in the 12th c. C.E.

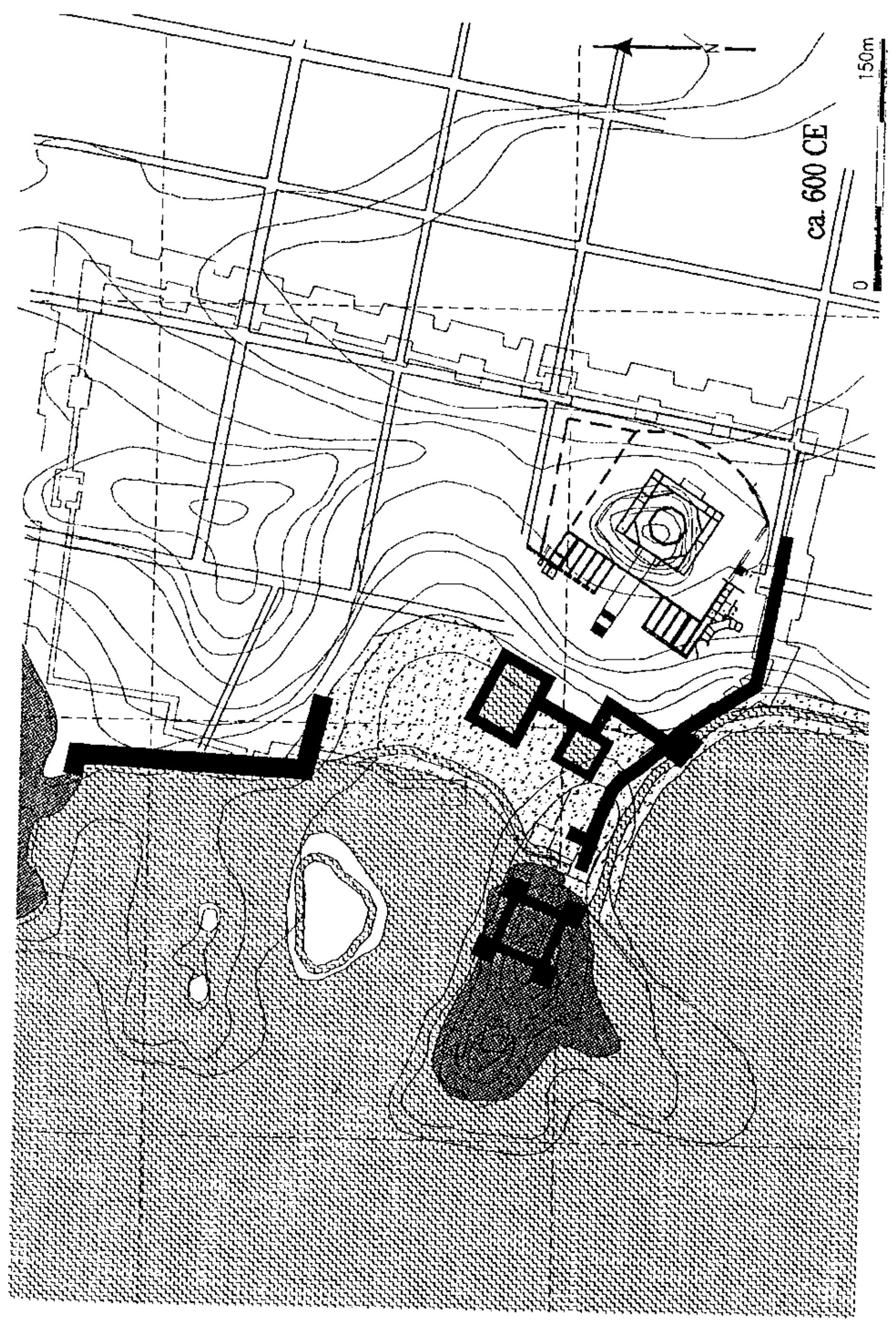

Figure 31. Sketch plan of the Inner Basin toward the end of the Byzantine era.

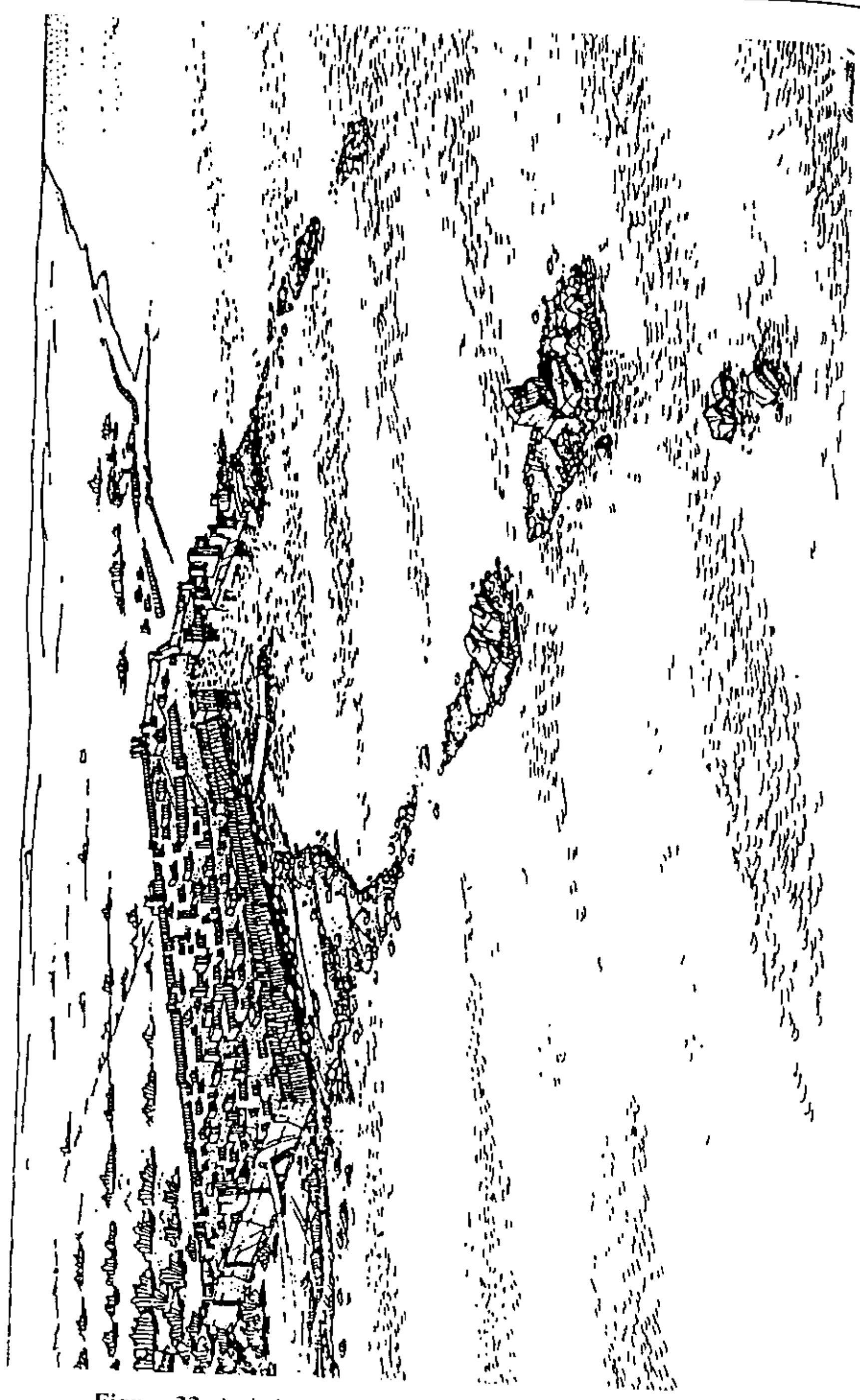

Figure 33. Artistic rendering of the Crusader's harbour.

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ANTIQUE HARBOUR FACILITIES IN KAVARNA BAY
(PRELIMINARY REPORT)

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The antique harbour facilities are situated in Kavarna Harbour, just next to the sea shore. They are concentrated in two main groups in the West and East parts of the bay; the first group of 25 constructions is situated along the eastern part of the bay; the other group of 6 constructions is under the fore-part of Cape Chirakman - the location of the ancient settlement Bizone. Their height above the sea level varies from 2.50 m to 15 m. These are caves hewn into the soft rock which have semi-cylindrical entrances. Their width at the base is up to 3 m, they are up to 2.50 m high and up to 18 m long.

Two caves are partially investigated up to now (Salkin 1987).

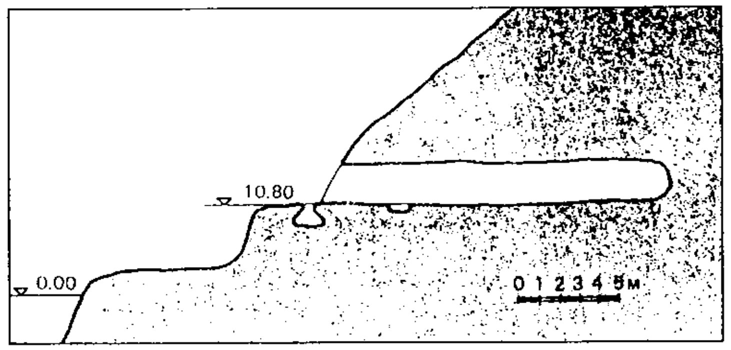

Figure. 1.

The height above the sea level of the first cave is 10.80 m (Fig.1). It is 18 m long but in the past the cave was probably longer, because its front part is now destroyed by the water and stones which have collapsed from the slope. The cave is 2.80 m wide at the base and 2.50 m high. The rock in which the cave is hewn is soft; there are layers in the profile of the rock. The cave is well ventilated and dry. Two