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CENTER FOR MARITIME STUDIES AT THE UNIVERSITY OF HAIFA

Recent maritime archaeological research in Israel

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In the past three years, the underwater researchers of the Center for Maritime Studies at Haifa University have concentrated on four main projects:

1. Side scan sonar surveys of the sea bottom along the Mediterranean coast of Israel, the main object being the location of Phoenician wrecks.
2. Continuation of the systematic excavations at the sunken port of Caesarea already reported in this Journal (see below), in collaboration with academic institutions from abroad.
3. Studies of the ancient topography; historic changes of sea level; man-made marine installations and other geomorphological and archaeological data relating to the ancient maritime activities at Dor within the framework of the Dor archaeological excavations project, headed by Prof. E. Stern, under the auspices of the Hebrew University and the Israel Exploration Society.
4. An interdisciplinarian study of the purple dye industry in antiquity, combining marine biology, archaeology, dyeing technology and historical records. This project is sponsored by the Israeli Academy of Sciences on a special grant from Dr S. Edelstein, USA.

Some of the more significant archaeological data of the recent work on projects **1**, **2** and **3** will be briefly set out in the following report. Part of the site described at Dor, (**3**), is also relevant to **4**.

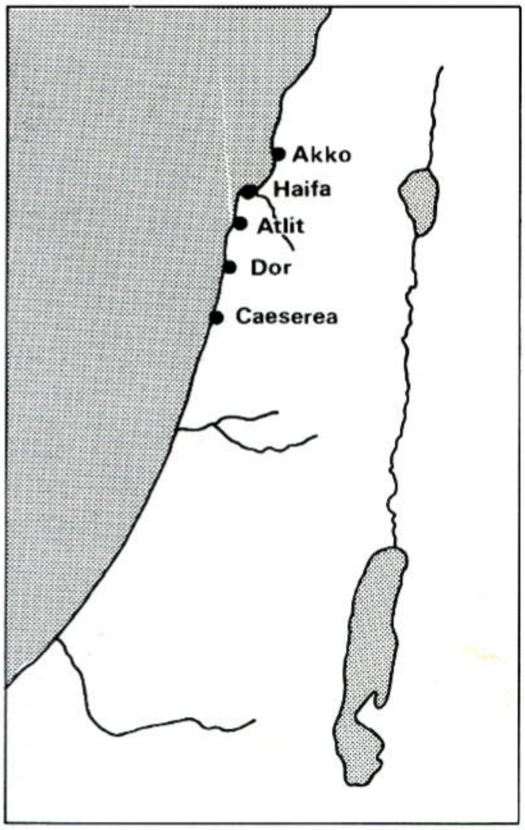

Figure 1. Map of the Israel coast and the sites.

1. While surveying the sea bottom in search of wrecks, some interesting discoveries were made.

A. Roman composite anchor

Half-way between Haifa and Atlit (Fig. 1), some 300 m off shore at a depth of 5 m, an intact wood and lead anchor was discovered. The sea bottom at the site is covered by 1–2 m of sand, on top of dark brown loam. The anchor was stuck at the compact loamish substrata and it seems as if the sandy protection served to

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Figure 2. The Roman anchor from the sea off Tel Hreiz.

protect it from biological and chemical destructive processes. The wooden shank is over 5·2 m long and 0·22 × 0·22 m in section, probably with a lead core. Only one wooden arm survived, buried deep in the mud. There is no lead assembly piece and the arms were held to the shank by three wooden pins. The lead stock is over 2·2 m long and probably weighs over 700 kg. By the style and dimensions, this anchor (Fig. 2) resembles the one found with the Nenonian barge of Lake Nemi (Ucelli, 1950). As far as we know, this anchor of the gigantic pleasure vessel is the only other Roman anchor of this type to survive intact, with its wooden parts.

Although the discovery was made over two years ago, we are still keeping the anchor at its original location (usually under 1–2 m of sand) until a proper preservation tank is built at the National Maritime Museum at Haifa.

B. Pre-historic submerged sites

The sea bottom off the coast between Haifa and Atlit (see above) is basically a submerged basin, which was part of the coastal plain during late Pleistocene and early Holocene. At that stage it was filled with fine sediment, mostly brown loam. After the sea level rise of the post-glacial era, it was flooded. The nature and dates of these Transgressions are much discussed among geologists and prehistorians, with the prevailing notion of multiple Transgressions (two to three at least) during the Epi-Paleolithic and Neolithic eras (10,000–4000 BC).

The recent sand quarrying along this coastal segment caused remarkable exposures of the subbottom of the sea nearby, for the first time since the last Transgression. Such seasonal exposures (Raban, 1973) are excellent opportunities for unique archaeological finds, usually in a fairly good state of preservation. Among these there are some prehistoric settlements, now submerged under 7 m of water, 200–300 m offshore (Wreschner, 1977; Ronen & Olami, 1978).

One of the recent new discoveries belonging to this category is a Neolithic-early Chalcolithic settlement off the public beach of Hof Dado, several miles south of Haifa. There, at 2–3 m depth, a series of floors made of flat round sandstones and a number of walls composed of double rows of roughly dressed rubble stones were surveyed. The exposed part of the submerged site covers about 0·5 acre of the sea bottom. In it at least six separate building units were plotted. The walls (Fig. 3) delineate rectangular structures some 3 × 7 m in size; between them there are paved fireplaces and small circular, stone-lined pits which might have served as silos.

The small finds included flint blades, points and axes; some broken sherds of pottery; and a few flakes of obsidian. The style of the tools and the pottery is characteristic of the late 5th and early 4th millenia BC.

About one mile south of the above site, at a depth of 6·4 m and 300 m west of the coastline, divers from CMS located a tree trunk, still in a vertical position with its roots in the ground. Similar trunks and the roots, visible on the mud exposures, are quite common phenomena in the area and have been traced in numerous other submerged localities, at various depths and distances from the present coast line. The uniqueness of the recent find is that a man-made stone circle encompassed the tree trunk in antiquity (Fig. 4). Samples of the wood were examined by the Paleodendrological laboratories of Tel Aviv University. It turned out to be Tabor Oak (*Quercus ithaburensis*), the most common wild tree of the coastal park

Figure 3. Walls of sunken chalcolithic building at Hof Dado.

Figure 4. Stone circle around the Chalcolithic oak.

Figure 5. Bronze ram with the wooden bow post.

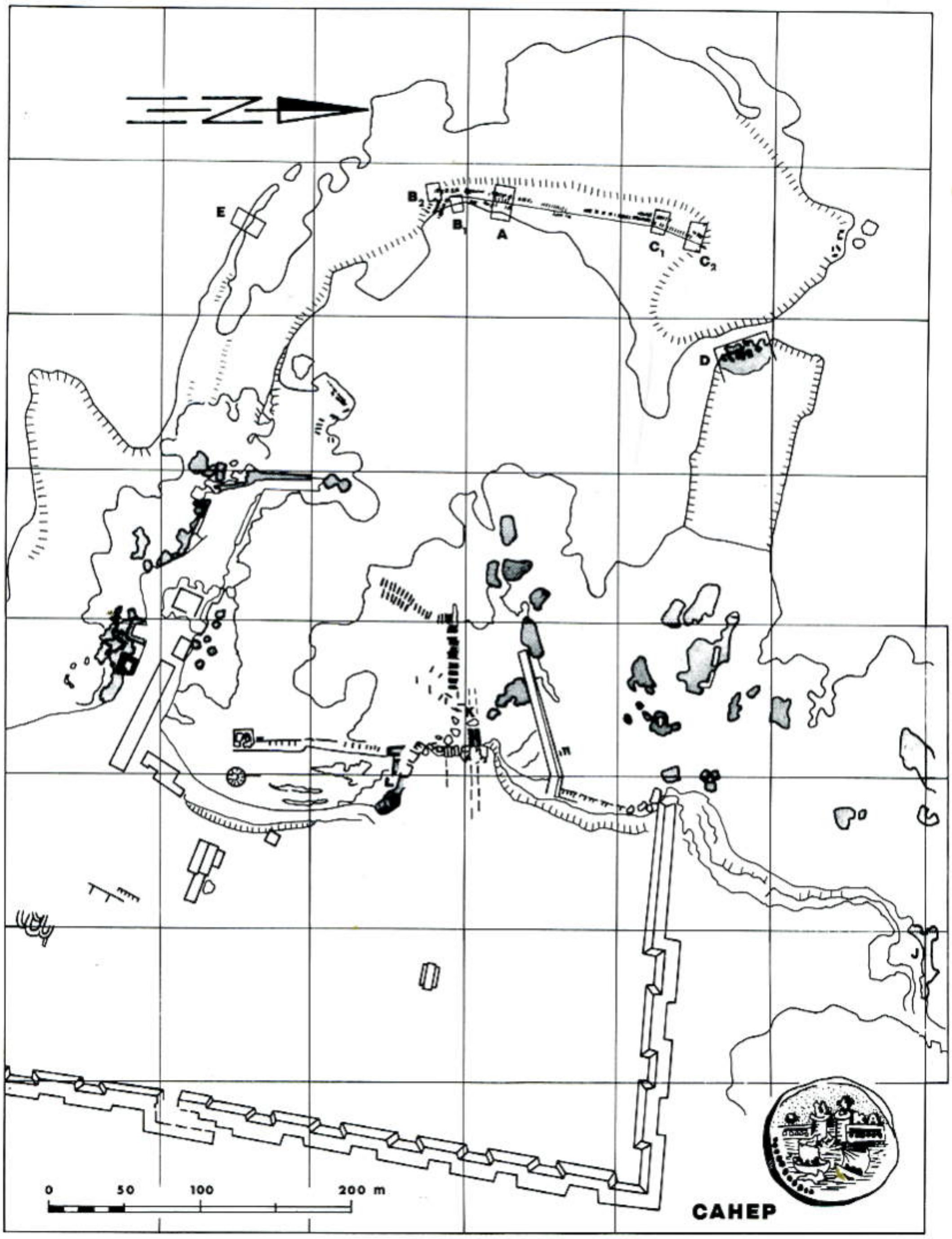


Figure 6. Caesarea—general plan of the site.

forest in biblical time. The calibrated C14 date for it is 5930 b.p. ± 140.

It seems that these two recent discoveries add more weight to the assumption that the early Holocene sea level was never higher than (or even near to) the present one, prior to the late stage of the Chalcolithic period, and that the so-called Flandrian and Sheffelaite Transgressions are probably the same ones, to be dated at the beginning of the Bronze Age, or even somewhat later.

C. Bronze ram from the sea off Atlit

The most recent discovery made along the northern coast of Israel is a three-pronged bronze ram, of the classical period. The ram, weighing over 600 kg, engulfs its wooden structure which has been broken off the warship's prow. This unique find (in an excellent state of preservation) was spotted last November in the northern bay of the Phoenician harbour of Atlit, by J. Ramon, a graduate student of the Department for the History of Maritime Civilizations. Ornamented in relief by tridents, Diascuri helmet, Caduceus and eagle, the ram is temporarily dated to the 4th century BC (Fig. 5).

A full report, including laboratory analysis results of the wood and metal, C14 dating, and technical data based on naval architectural calculations, is being prepared for publication.

2. Caesarea

As noted above, initial reports of work within the framework of CAHEP (Caesarea Ancient Harbour Excavation Project) have already appeared in this Journal, and individuals and institutions who have contributed to the project are acknowledged there. Further illustrative material will now be presented here, and this should be considered along with those accounts (*IJNA*, **7**, 1978: 240–43; **10**, 1981: 157–60).

Figure 6 shows the general layout of the site, in relation to the Crusader city wall. Whereas previously the team's efforts were concentrated on mapping the remains visible underwater, the 1980 season was devoted to developing excavation techniques suited to the dimensions of the site and the volume of sand covering its submerged structures (Fig. 7).

Figure 7. Caesarea—airlift at work at area B.

Figures 8 and 9 show, respectively, the lower course of masonry at the base of the quay in area B, and sections in areas A and C. There the main part of the breakwater was built of blocks cast in wooden frames. The width of this filling is 30 to 40 m, and it was supported on the outer (western) side by two or three layers of hewn oblong stones 3–4 m long, many of which appear to have been re-used in the lower layers of the towers of the harbour fortress, and in the base of the sea wall of the Crusader city (Fig. 10).

In area D, at the eastern side of the entrance to the harbour, the ruin of a massive tower was uncovered. It is composed of enormous hewn stones (5·4 × 1·2 × 1·2 m). As Figs 11a & b show, some of these have niches in which iron fasteners were cast and then reset with lead, or lead 'boxes' that were made to hold iron hooks for the chain that closed the entrance (which was only 15 m wide).

In area E, excavation demonstrated that the thin wall constituting a separate unit of the

Figure 8. Caesarea—the lower course at the base of the quay at area B.

breakwater was built of medium sized (60–70 cm) unhewn stones, placed in an orderly fashion (Fig. 12) but with no cement whatsoever.

Figure 13 shows a section of the Hellenistic quay in area J. The western part of this was rebuilt in Roman times to serve as the base of a structure on dry land to the south. Most of the central and eastern stretches of the wall are built of two rows of headers made of narrow stones, unequal in width (between 25 and 40 cm) but of a uniform length of *c.* 1·2 m, while underneath this stratum another layer was uncovered at a depth of 75–80 cm (Fig. 14).

Figure 15 shows the Roman quay in area K. The pier to the south there, made up of re-used Roman columns (Fig. 16) corresponded exactly in constructional details with the Crusader city wall. There seems no doubt that this quay was built by the Crusaders when the relative sea level was about 1 m lower than at present.

The result of last season's excavation enabled us to reconstruct the way the main Herodian breakwater operated. The dimensions and the basic division into outer Prokomia and the inner part, which served as a quay for loading and unloading merchantmen and as a road (or promenade) and wharves, correspond to the detailed description by Josephus Flavius (*Jewish Wars*, V: 21). The narrow breakwater in the southwest was very probably a construction with no parallel in other ancient harbours known to us. Its function was to cause the great waves of the southwest winter storms to break away from the main breakwater and so prevent firstly the destructive effect of an undermining current at its base, and secondly the wetting of the loading area with the breakers' spray (Fig. 17). This additional structure reduced the immense task of maintenance of the main breakwater and enabled the use of the harbour during most seasons of the year.

3. Dor-Yam (sea and coastal Dor), 1980

The first season at Dor dealt with three main issues, as well as a test excavation on the southern coast of the tell:

1. Geomorphological survey and mapping,

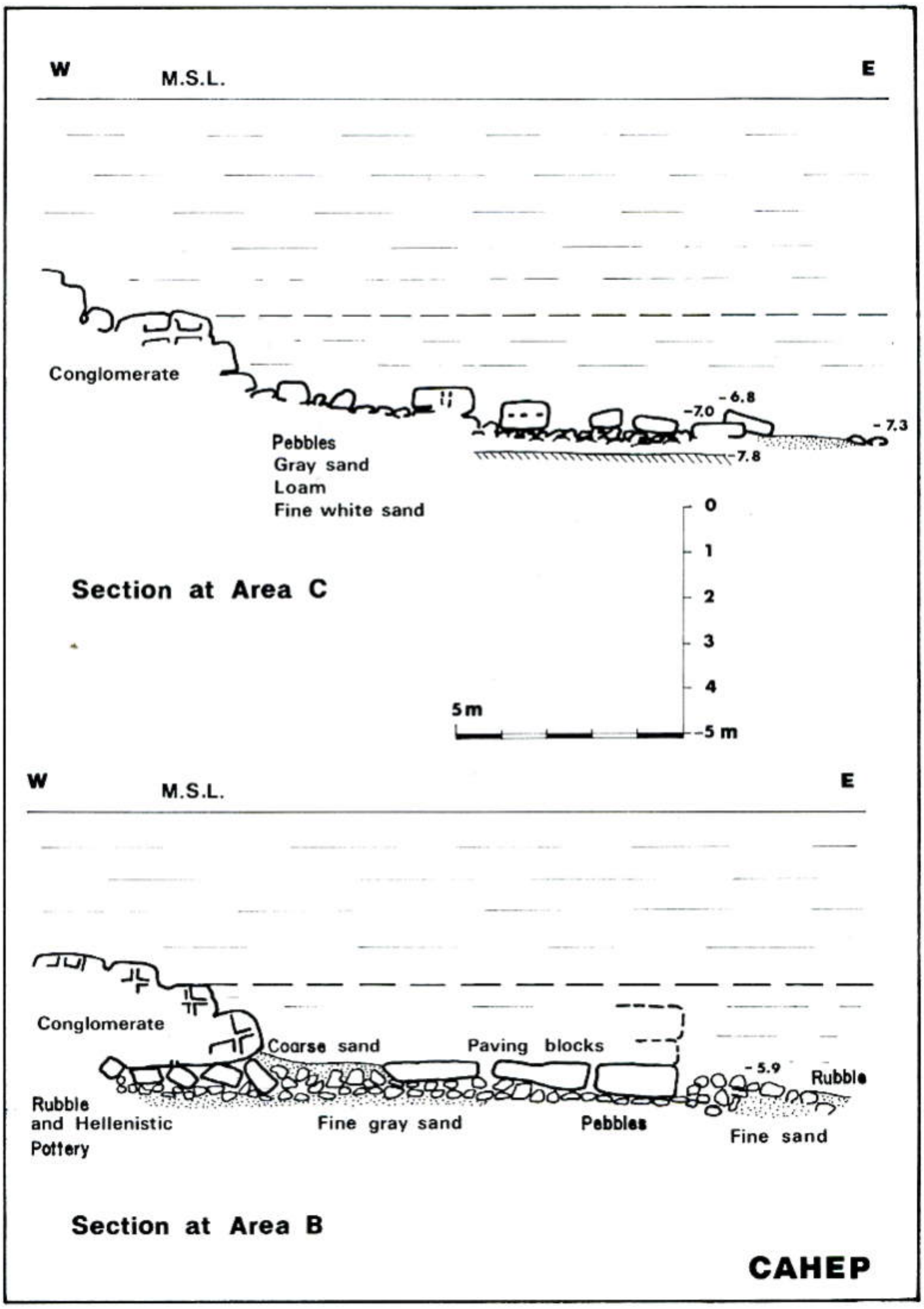


Figure 9. Caesarea—sections at areas B–C.

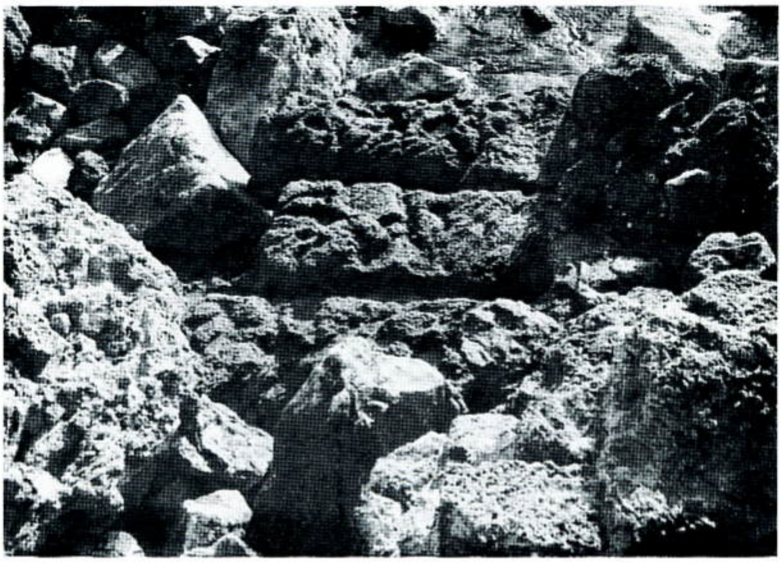


Figure 10. Herodian ashlar slabs from the quay of the main breakwater in secondary use in the crusader sea wall.

which included collection of archaeological and geological data. This was done so as to establish the topography and coastal line of the tell in antiquity.

2. Systematic survey of the sea bottom at the southern and western side of the tell.

3. Survey and research of ancient installations and buildings along the coast line.

1. Geomorphological survey and mapping

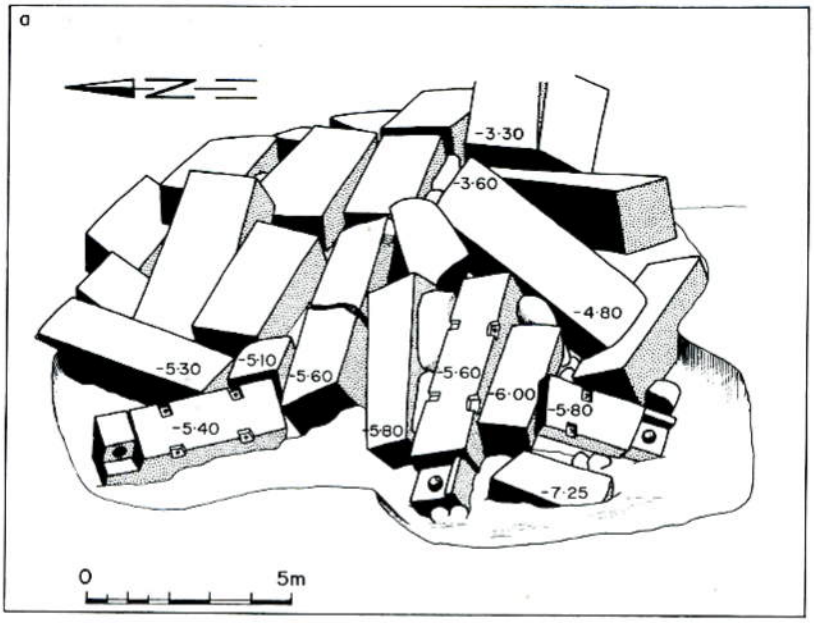
The main goal was to determine the land–sea vertical and horizontal relations, as well as the type and date of various natural deposits along the coast line. At this point it is safe to say that there is evidence for radical changes in the natural deposit types (interchanged layers of sand, fine silt and sea shells) and of abrasive levels during the historical periods. It seems that before the first settlement of the tell, in the beginning of 2nd millenium BC, there was a rise in sea level which disturbed the drainage system in the coastal regions and caused lagoons to be formed. These lagoons encircled the tell on the south and the east (Fig. 18: nos 14–15). Later, towards the middle of the 2nd millenium BC the level abated and some of the lagoons were filled with sand. The second rise in sea level (hence inundation) took place close to the end of the late Bronze Age. It is documented by a layer of stratified shells which cover the earliest installation in the southern part of the tell. Another change in the level of the sea took place in the levels of the Hellenistic period on the northwestern side of the tell (Raban, *Sefunim*, **VI**, 1981: 15–26). During the Roman period there was a slow and continuous rise of the sea level, reaching even higher than today's level. Its apex was at the end of the Byzantine or the beginning of the Arab period. In the time of the fortified acropolis in the southwestern part of the tell the level was a metre below today's sea level (Fig. 18: no. 12).

2. Underwater survey

This was done as a continuation and with co-operation of the Department of Antiquities (*IEJ*, **28**, 1978: 281 ff.; *IJNA*, **9**, 1980: 259–61) and the Underwater Exploration Society of Israel. The main interest is in locating sunken ships, cargoes, ancient anchors and other data on the ancient maritime activities in the vicinity of the harbour site. The survey will be augmented by Dr Dan MacCaslin and students from the Institute of Marine Sciences, the University of California at Santa Barbara. Thus far we concentrated on the area south of the tell where there are many coastal ruins.

3. Coastal ruins and installations along the coast

These ruins are found along a stretch of more



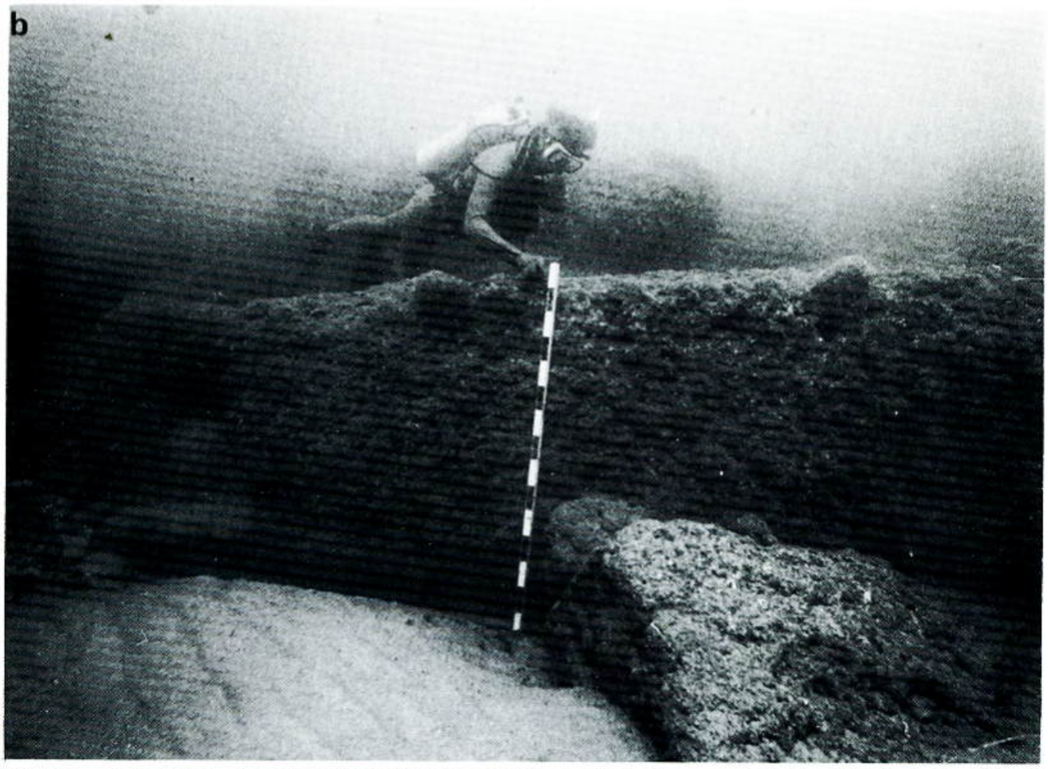


Figure 11. a. Caesarea—isometric view of the excavated area D. b. Caesarea—details of block at tip of breakwater in area D.

Figure 12. Caesarea—the inner face of the additional breakwater in area E.

than 1 km. North of the site, in the southern corner of the bay, between the water and the sandy hill (Fig. 18: no. 2), just west of the Roman theatre (J. Leibowitz, *Alon*, **3**, 1951: 38 ff.), there are the foundations of a rectangular building whose ashlar walls (35 × 37 m) were built in a header construction (Fig. 18: no. 3). The first stage of it borders the sea in the north and west. The foundations were later used in the construction of warehouses. The floors are made of calcite cement with pebbles and crushed Roman ceramics as inclusions. The western wall extends to the quay, also constructed in the header style. These may be the borders of an anchoring pool, as a continuation of the bay with a sandstone ridge protecting it on the west. A drainage canal was cut through the ridge to prevent clogging of the anchorage (Fig. 19). There is evidence in this area for changes in sea level which caused the drainage channel to change its position (Figs 20–21).

The mapping of the area (Fig. 18: no. 6) included plastered basins, sluice gates, aquaducts, rock cut pools, inlets for sea water and drainage systems which may have all belonged to a purple-dye industry on the southern kurkar ridge (Raban, 1981: 20 ff.). The plans of a shipyard (Fig. 18: no. 8) and the wave catchers on the western folds of the tell were redrawn. In this area there is also evidence for the change in sea level after the establishment of the installations (Figs 22–23).

Excavations were carried out in the coastal area below the southern slope of the tell (Fig. 18: no. 14). The western part of this area, about 300 m in length, is a sandstone ridge abraded 2–3 m above the present sea level. It has been used as the base for the western part of the tell as well as the acropolis (Fig. 18: no. 11). A British excavation in 1923 under the direction of J. Garstang sectioned the eastern side of the ridge (J. Garstang, *BBSAJ*, **IV**, 1924: 40–5). In the eastern border Garstang noticed a well-built stone wall of a house which he dated to the beginning of the early Iron Age. This wall is a cyclopian semi-circular retaining wall which is built with the kurkar ridge in mind. Extending east of Garstang's wall on the sandstone ledge is a pavement of large and rectangular slabs partially worked which extends to a distance of *c.* 80 m (Fig. 24). In many parts of it, the pavement is completely destroyed by sea waves and is covered by slabs whose origin is the debris of buildings to the north. Despite the bad preservation one can still distinguish four lines which add up to 10 m width (Fig. 25). Near the eastern end of the pavement, large ashlar masonry replaces the pavement slabs. These ashlars turned out to be one tier in a wall whose other layers are buried in the sand under present-day sea level (Fig. 24D). Ten metres north of this wall and parallel to it there is a 2·2 m thick wall which supports the southern slope of Tel Dor (Fig. 24H). The eastern part of the wall (H), 60 m from the edge of the kurkar ridge, is buried under a fortification wall (Fig. 24E) which in size and style is similar to the Persian–Hellenistic fortifications excavated in the last season at Dor by Prof. E. Stern (*IEJ*, **30**, 1980: 210, fig. 1).

A small trench verified that wall H has four tiers and it continues to the east. Wall H was built in two stages; the lower part has two layers of ashlars based in a dark mud about 1 m above sea level (Fig. 26A–B). In the second stage there is a possible secondary usage of paving slabs. These have a unique shape, with cut-off corners as well as a pair of drilled holes. More pieces of these slabs are strewn in the debris along the coast. They are similar to the paving slabs in the Mycenaean harbour at Kition, which is dated to the 13th century BC. The second stage has ashlars and smaller, partially worked stones which were added. This wall is preserved to a height of 3 m above sea level in its western side. The ceramics collected from the surface above the wall date to the early part of the Iron Age (Fig. 27A). The

Figure 13. Caesarea—the Hellenistic quay in area J, looking west.

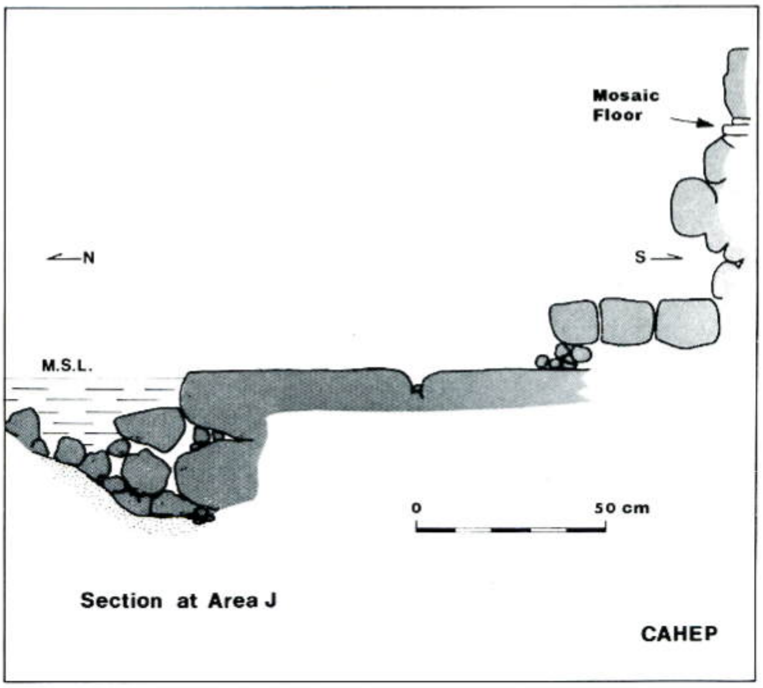


Figure 14. Caesarea—section in area J.

Figure 15. Caesarea—the Roman jetty in area K, looking west.

Figure 16. Caesarea—the re-used Roman columns in the crusader pier.

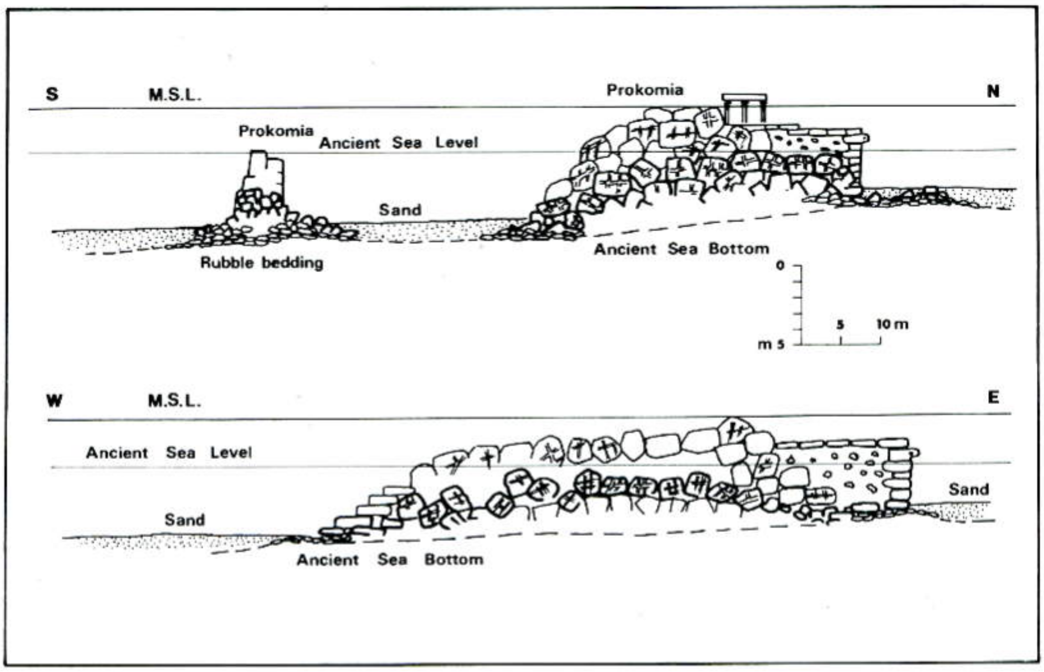


Figure 17. Caesarea—reconstructed section through the great Herodian breakwater.

debris and large stones were removed and three trial trenches were made during the fall of 1981 so as to determine the connection between the quay and wall H.

Trench A

Trench A (Fig. 26A) is located on the eastern part of the area *c.* 35 m from the slopes of the kurkar ridge. There, wall H was preserved only on its lower-most part. The first tier was built of ashlars in secondary use, these in turn were placed on an earlier ashlar pavement. Much of it is destroyed, either by man or the sea. In its eastern side we found that a fill under it contains ceramics which can be dated to the 13th century BC. The pavement itself superimposes an installation constructed of elongated ashlar headers, as well as worked slabs. It is hard to ascertain if it was used as a wall, floor or quay. It was constructed in clean sand with no ceramics or shells in it. Because of the absence of sea shells, we presume that the sea at the time of its construction was further away and lower than today. The sea waves played such havoc with it that no connection between the lower tier and the quay in the coast line can be seen. From the section it seems a possibility.

Trench B

Trench B is 20 m west of trench A. There is a tier of narrow and long headers. These are 5·2 m south of wall H, but parallel to it (Fig. 26B). This layer of stones was badly affected by the sea and no structure at the same level remains *in situ.* There is, however, some fill of debris which was on top of a pavement of roughly cut slabs, under which there is clear sand much like the sand in trench A. By enlarging the cut, however, we found inter-digitated layers of sand and dark mud. The level of the base of the wall H is higher than wall Q.

Trench C

Trench C (Fig. 26C) was placed in the eastern borders of a red conglomerate floor which is more than 10 cm thick. The floor was uncovered from the debris brought in by the last winter's storms. The floor, which is covered by an organically impregnated dark mud, continues under the slopes of the tell. *In situ* on

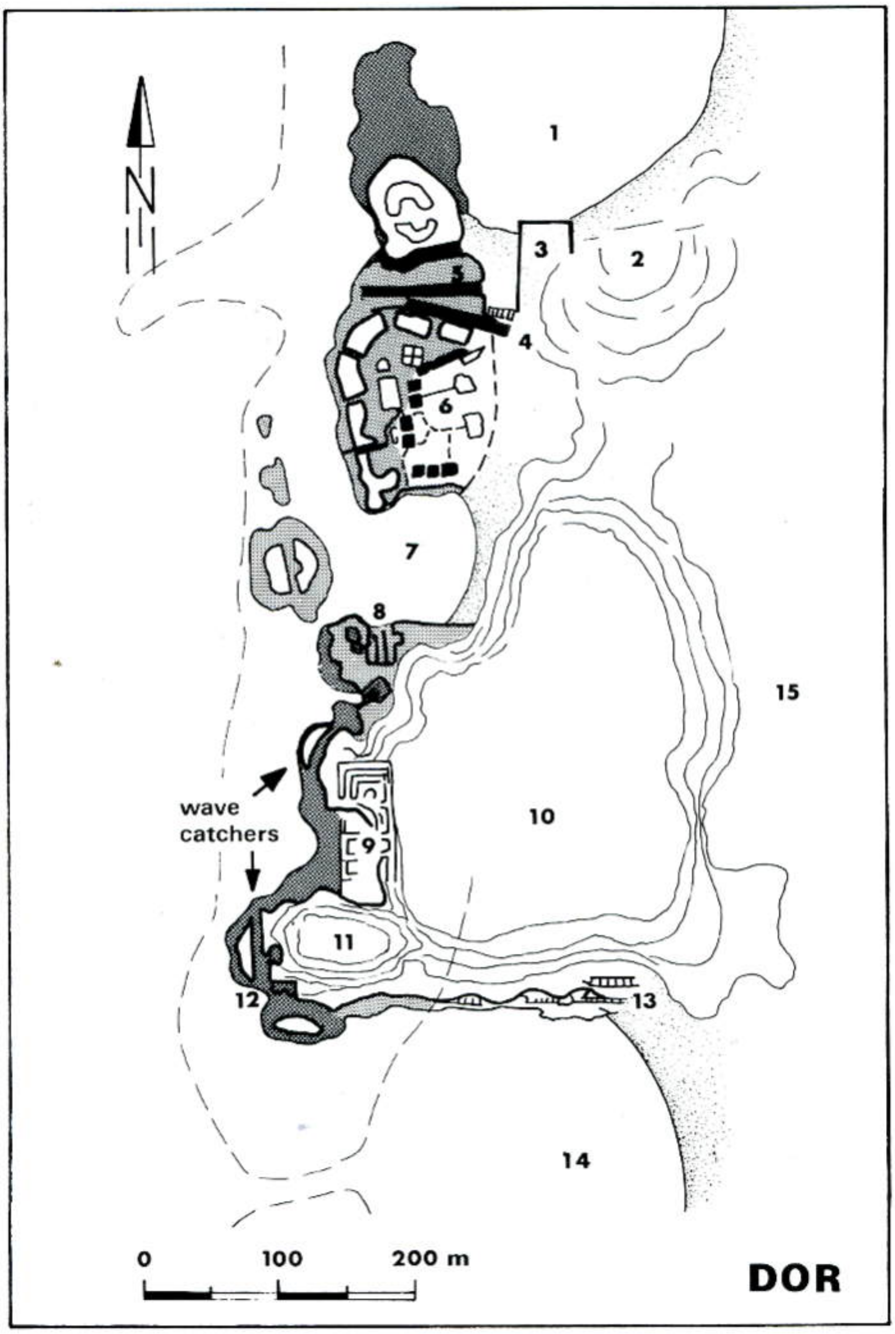


Figure 18. Dor—general plan of the site.

Figure 19. Dor—air photo of the draining channels.

Figure 20. Dor—the eastern end of the low level draining channel.

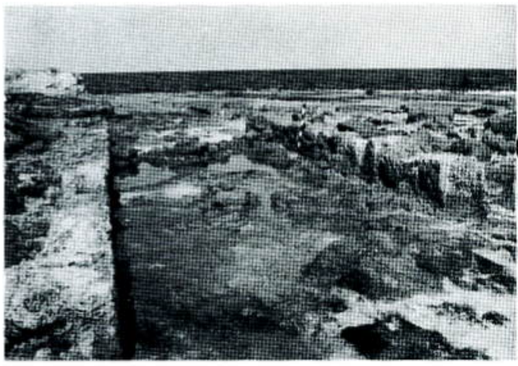


Figure 21. Dor—the high level channel, note the notches on the building stones—indicating ancient high sea level.

Figure 22. Dor—the northern wave catcher, from the northeast.

Figure 23. Dor—a fish tank southwest of the acropolis, with built on modifications for rising sea level.

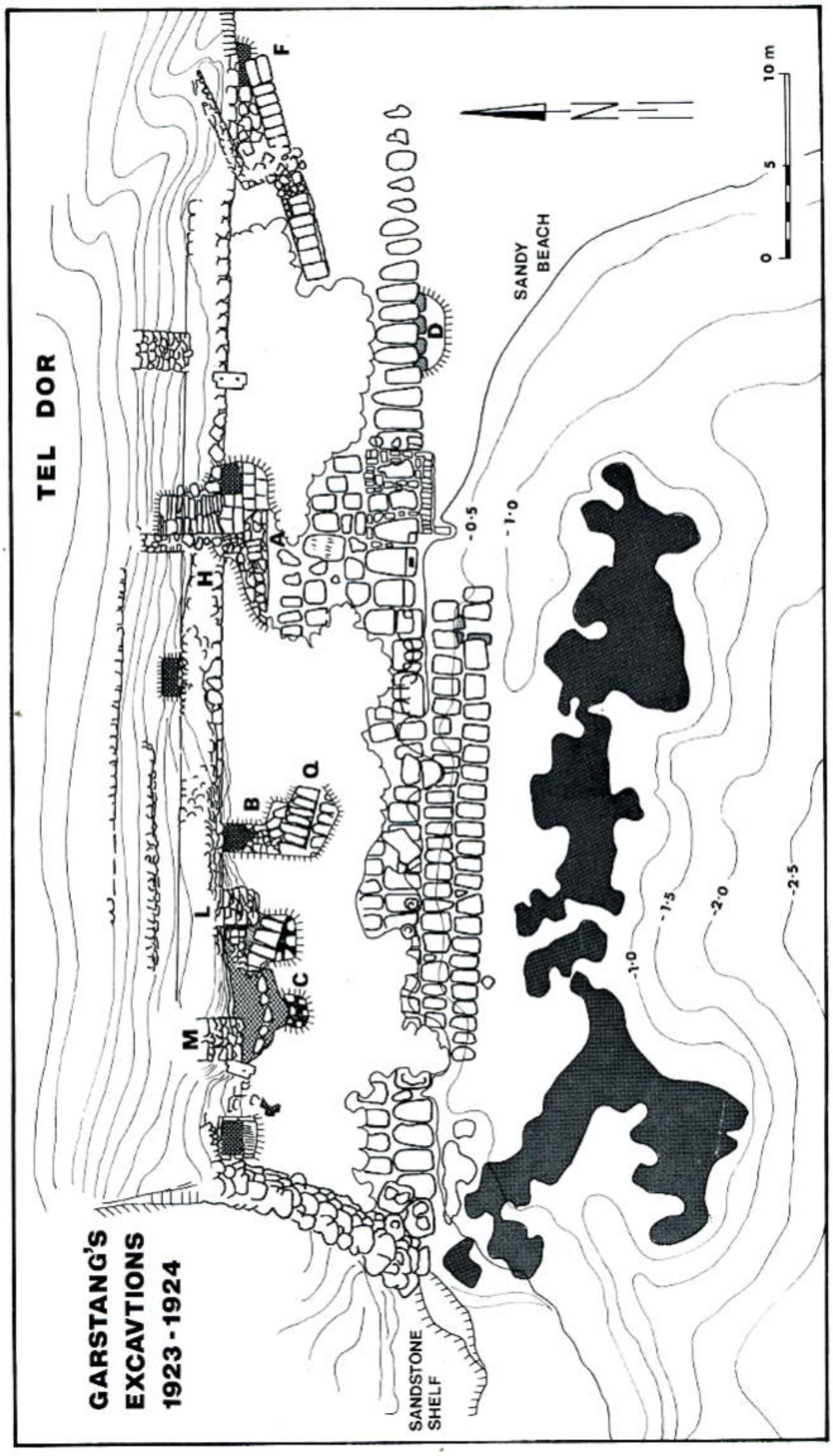


Figure 24. Dor—general plan of the excavated and surveyed areas at the south coast of the site.

Figure 25. Dor—the submerged quay at the foot of the tell, looking southwest.

the red floor, below the dark mud, there were crushed shards which can be dated to the end of the late Bronze and the beginning of the Iron Age (Fig. 27B). Even the material from the dark mud which may be dated a bit later, and is a continuation of the earlier tradition, can be dated to the beginning of Iron Age I. In both *loci* we have bowls and storage jars. On the dark mud there is a floor of pebbles and calcite cover. This floor continues under two thick walls (Fig. 24M,L) which lean in turn on wall H and can be said to be later than its first stage. The calcite floor itself belongs to this stage of wall H. The area above the floor is filled by earth and ceramics which streamed in from above wall H. While clearing a corner east of wall L we collected ceramics, all of which are homogeneously part of the Iron Age I period (Fig. 27A). Under the red conglomerate floor, a continuation of wall Q was located. Much of the floor at this point was destroyed by sea waves. A wider section through the floor revealed that the wall was covered by chalk-hardened shells, a phenomenon brought about by a possible sea inundation (Fig. 28). Unfortunately, even here we could not find a connection between the lower layer and the quay at the coast line. In this section as well as in the others, the level connection seems very important.

During the forthcoming seasons we will try to find architectural and stratigraphical connections. There is good reason to suppose that the structures which we have been dealing with are a part of the quays and storeroom areas of the late Bronze–Iron Age city of Dor. The similarities between it and Kition, Minet el-Beida and Ras ibn-Hani are there and will be discussed further elsewhere. The similarities to the material of late Cypriot III bring to mind the question of the identity of the inhabitants of Dor at the period. If indeed our conjecture as to the late Bronze Age dating of the quay in the coastal line could be verified, we would have the first and only example of harbour installations built on the coast line at such an early period. The usage of the header construction at such an early stage is surprising since it is considered to be a Phoenician technical innovation.

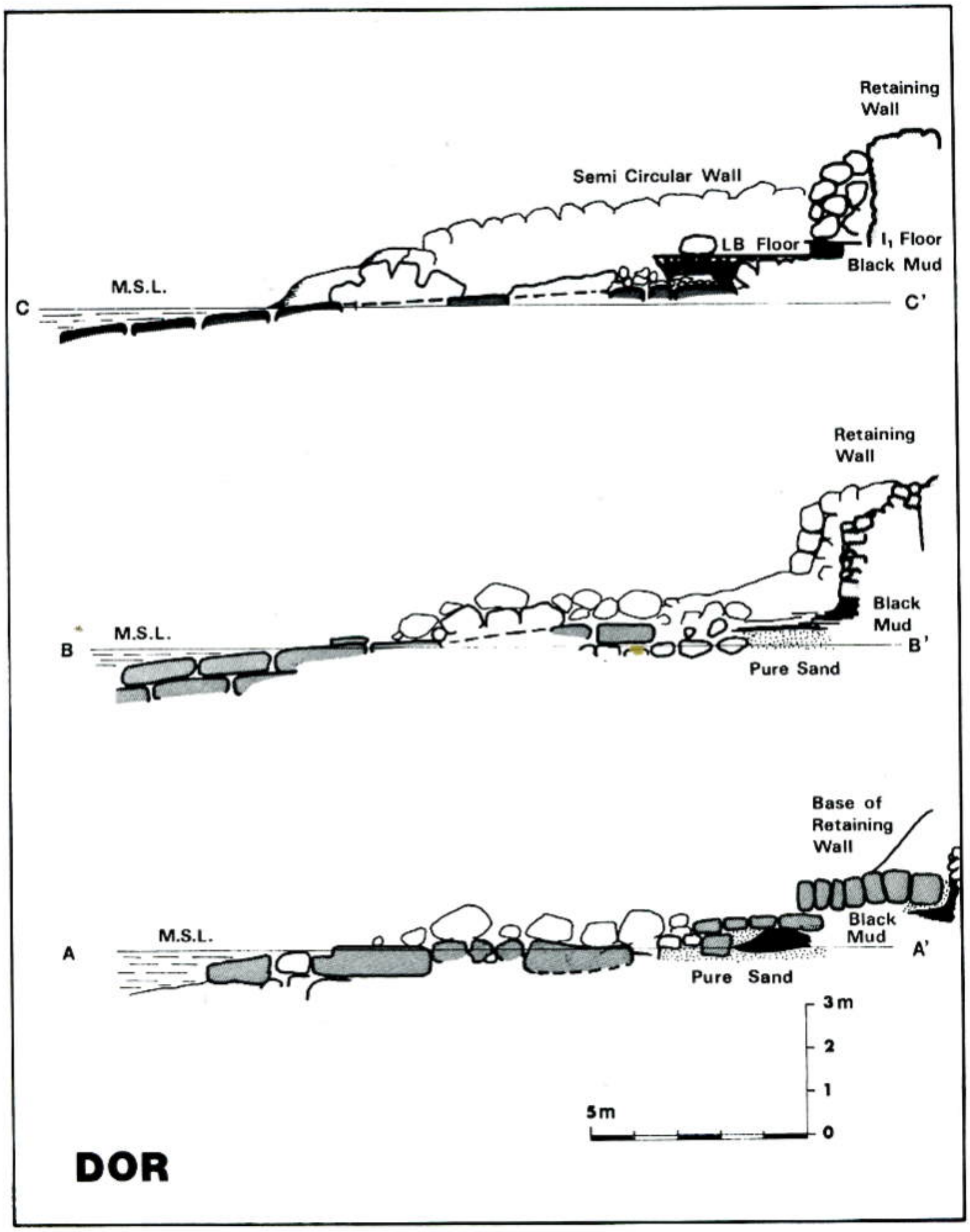


Figure 26. Dor—sections through the excavated areas A, B, C.

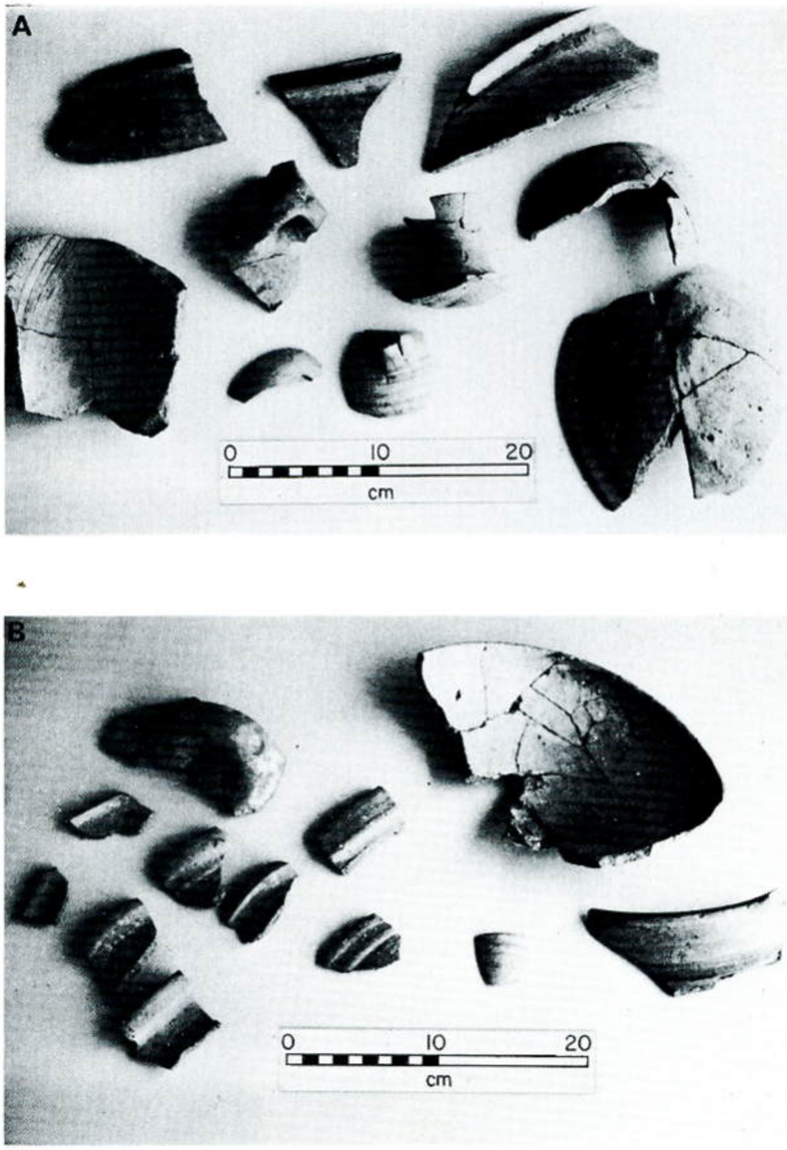


Figure 27. Dor—pottery shards found in stratigraphic context.

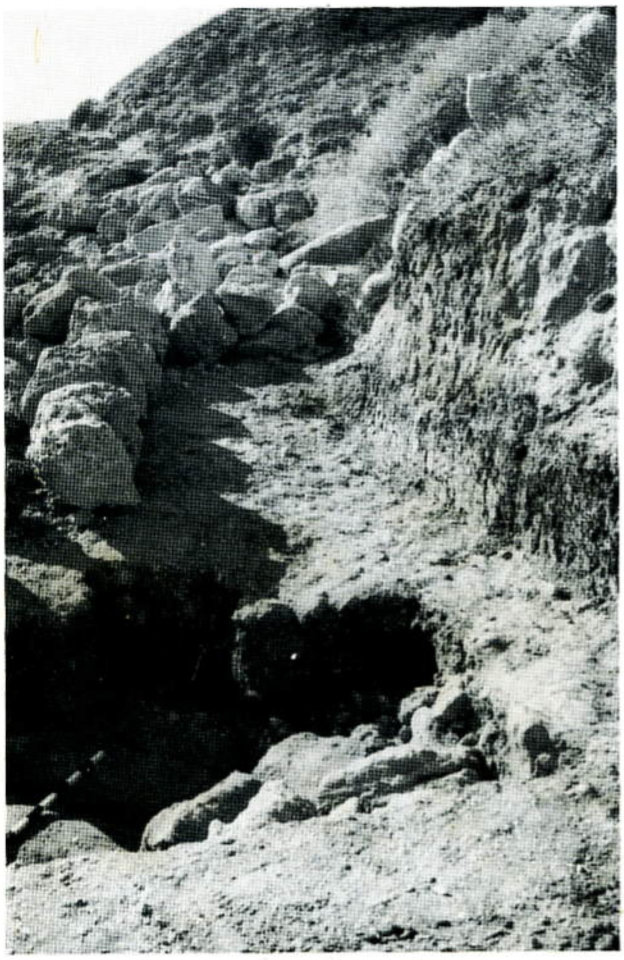


Figure 28. Dor—the red floor in area C, looking northwest. Note the course of headers underneath and the black mud on top of the floor.

References

Basch, L. & Frost, H., 1975, Another Punic wreck in Sicily: its ram, 1. Basch, L., A typological sketch. *IJNA*, **4**: 201–18.

Casson, L., 1971, *Ships and seamanship in the Ancient world.* Princeton.

Raban, A., 1973, Survival of Ancient wrecks in varying conditions off the Israeli coast. In N. C. Flemming (Ed.), *Science diving international.* London.

Ronen, A. & Olami, Y., 1978, *Archaeological survey of Atlit map.* Jerusalem: Israel Archaeological Survey.

Ucelli, G., 1950, *Le navi di Nemi,* 2nd edn: 235–47. Rome.

Wreschner, E. E., 1977, Newe-Yam—a submerged late Neolithic settlement near Mount Carmel. *Eretz-Israel,* **13**, Stekelis volume: 259–70. Jerusalem.