THRACIA PONTICA IV

SOFIA, 1991

PROTO HARBOURS OF THE EAST MEDITERRANEAN

Honor Frost

. 31 Welbeck str., London W1M 7PG, UK

Archaeology is multi-disciplinary, nevertheless archaeologists usually dig before scienists start analysing. Harbour research reverses the priorities, not only because of the size of harbours,but because harbours are mechanisms. As a mill is driven by a stream, so a harbour must respond to the sea. Technically, the general precedes the particular: disciplines involving sophisticated surveying -air and even satellite photographs - core-sampling and the like - preceed digging. The archaeologist is turned into a "ring leader" directing a circus of specialists and in order to do successfully,he himself has to have a clear idea of the nature of harbours and how and why they function. Dimensional, chronological, geological and sociological characteristics all need to be considered from the outset.

Dimensionally, proto harbours can be vast, because their size is dictated by natural features, instead of being imposed on nature by some architect. Chronologically, harbourworks may have been constructed over several periods before being engulfed - almost without exception - as a result of one or more geological event.Consequently it is important to remember that the dating of proto harbours involves a geological as well as an archaeological time-scale. It is also important to remember that, sociologically,the demands of specialized fleets were and are, almost invariably, mutually exclusive. Consequently major harbours are rarely multi-purpose;for instance, in contemporary Europe, naval bases like Toulon, Portsmouth and La Spezia serve fleets of war; ports such as Marseille, Southampton and Naples serve commerce, while St. Malo, Brixham and Mazzara in Sicily serve fishing-fleets. Regardless of period and place;other millennial functions include: ports of call, - of refuge, - of transshipment,- of ferry-services,- of cabbotage - even strongholds for pirates.

In origin, proto harbours antedate man's discovery of how to build on the sea-floor; consequently, instead of imposing a harbour onto a shore,he had to carve it out of some appropriate land-mass (Fig. 1). This technical solution originally evolved out of the very limitations of the flat, shelterless shores which characterise the Eastern Mediterranean. Phoenician engineers became so successful at carving harbourworks that Phoenician experts were employed by other nationals (for example by Xerxes to cut a canal through Athos (Herodotus VII, 100). Even after they had learned how to build on the sea floor, their carved installations went on being echoed wherever they, or their colonists had bases (for example Carthage). Be it noted that carving natural rock does not provoke silting whereas, in-

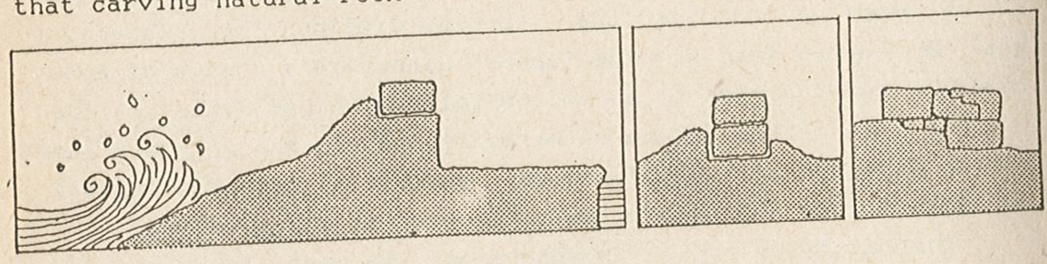


Figure 1. Schematic section of a Levantine reef showing the ancient method of flattening the sheltered side to make a quay, then using the stone thus quarried to reinforce (by various methods) a sea-wall.

evitably, walls built on the sea floor obstruct the currents that flow across it, causing them to loose their impetus and in so doing, to drop the sand they carry along with them. The obvious result is a build-up of silt.

HISTORY

Our theme being the methodology of coastal research, which I am illustrating by showing the major Levantine proto harbours of Arwad,Sidon and Tyre (Fig. 2), I will give only the briefest reminder of some of the historical data which links them with the Bronze Age and,in addition,some later events connected with sea-power which affected their harbours. Needless to say, no example of rock-cutting is,by itself evidence for dating;equally,surveys and historical references are too general to be conclusive, nevertheless when all three are combined a coherent picture begins to emerge.

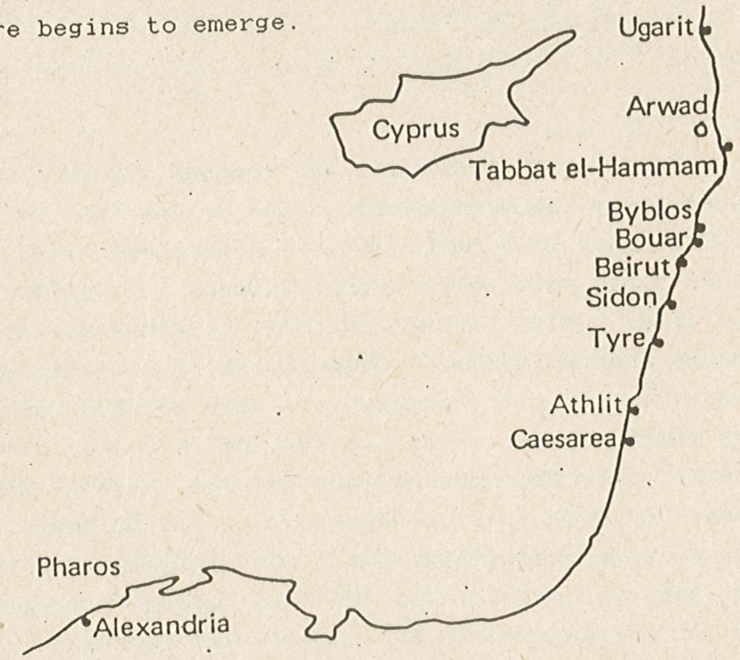


Figure 2. The Levant coast.

1) ARWAD, according to a tradition quoted by Strabo, was founded by islanders from the Arabian Gulf who bore the same name (which means "explorer"). Biblical tradition names Arwadites as the sons of Ham and Caanan (Genesis) and as "the oarsmen of Tyre" (Ezekiel). An inscription at Karnak throws a more direct light on Arwad's importance during the 15th century BC by boasting of spoils of corn and oil taken by Thutmose III; considering that the rocky Island itself is small and barren,this boast

shows that Arwad must already have had mainland posessions. Later, certain 14th century Tell el Amarna Letters, from Byblian rulers begging Egyptian protection against the Arwadian fleet, imply that the Island already had considerable sea-power - particularly since these references also indicate that the Island could not be besieged unless the attackers had an equally strong fleet. During the 12th century BC, an Assyrian inscription records that Tiglath-pileser the First hunted a "horse of the sea" off Arwad. By the 8th century BC,Arwad like other city-states of the coast, was paying tribute to his successor Tiglath-pileser III, a relief in his palace at Nineveh may represent Arwad's fortifications. Finally, the fact that the Island prospered under the Greeks and the Romans, is indicated by its coinage.

2) SIDON, according to F.C.Eiselin, was founded around 2800 BC. The high percentage of imported artifacts in the Chalcolithic, Bronze Age, Iron Age, Late Hellenistic and Roman material excavated in the town, confirms the importance of its port during all these periods. Again, texts help to fill in the picture: in a 14th century Amarna Letter, a Sidonian ruler begs protection from Amenophis IV against raiders from the North. During the 12th century Sidon headed a federation of the coastal city states,but like other Phoenician towns, its alliances - whether with neighbours or with Great Powers such as Egypt, Assyria and Babylon - were in constant flux.In the mid-ninth century BC,the severity of Assyrian rule caused the emigrations from both Sidon and Tyre which resulted in the founding of Carthage. In 525 BC the Persian King Cambyses made Sidon the seat of a Satrapy. The port then reached the peak of its prosperity: Sidonian sailors fought for Persia during the Greek wars; the Phoenician mercenary fleet was commanded by a Sidonian King;Xerxes himself travelled on a Sidonian flagship; Phoenician engineers bridged the Hellespont and cut a canal through Athos.By 351 BC Diodorus (XVI, 41-45) mentions 100 triremes and quinqueremes in Sidon's harbour. Ships of such size (judging from the known number of their oars) could hardly have fitted into an inner harbour, but the remains of Persian period masonry that they were surveyed

underwater, along the offshore Island anchorage point to its having been a suitable mooring for a great number of ships at precisely that period.

3) TYRE (or SUR meaning rock),although the most famous in name, is from the surveyor's point of view, but a ghost among proto harbours! Its general conformation is archetypal, but within this layout its installations have been so damaged by historical and natural events as to justify Ezekiel's 7th century BC predictions about their disappearance (only the date he had in mind proved premature!)

Herodotus places Tyre's foundation at 2550 BC (the time of the Caananite wars). On archaeological evidence, D. Harden observes that during the 18th to 17th centuries: "we may assume the coastal cities (including Tyre) were building up their power". After the 15th century Battle of Megiddo, Tyre appears in Egyptian inscriptions as a vassal town.During the Amarna period Abimilki King of Tyre, begs Egyptian help against Sidon. By the 10th century, Tyre flourished under King Hiram the Great (the ally of David and Solomon).He improved its harbour. His descendant, Ithobal,fathered Jezebel who married Jehoram of Judea.His grandson, Mathan, fathered Pygmalion and Elissa,or Dido - which brings us to the founding of Carthage. In the 6th century Tyre was destroyed by Nebuchadnezzor. Its harbour was eventually rebuilt; its definitive destruction came in 332 BC,when Alexander the Great conquered the Island by making a causeway that joined it to the mainland. The resulting build up of silt produced the present peninsula.The geological changes that followed combined to blur all but the outlines of the original harbour site.

GEOLOGICAL CLUES TO DATING

Where there is no soil (as on the reef-island of Arwad and indeed on all other rock-cut reefs) stratigraphic dating is out of the question; so besides odd fragments of stylistically datable masonary, the only clues left are geological. The slides that I projected during this communication included aerial photographs of a general nature, taken during the 1930s, by the great pioneer of harbour research, the R.P. André Poidebard, as well as more detailed photographs which I myself took during the 1960s; in particular a series of aerial photographs I made while surveying the Arwad reef for the Syrian Department of Antiquities. All the photographs I made illustrate the interplay of archaeological and natural features; they were examined and interpreted by the many academic and "oil company" geologists who were - at that time - based in Lebanon and who for various reasons were interested in dating sea-level changes along the Levant coast (see bibliography). Five main points emerge from this evidence.

1) On Arwad, **drillings** made for the Compagnie Française des Petroles, by Wetzel and Haller, produced some interesting facts. They demonstrated that after the deposition of the Arwad reef (Fig. 3), the sea (relative to the land) rose above its present level, then retreated again, returning towards the end of the Iron Age to a height of 3-4 m **above** its present level. Finally it sank once more to its present level. In other words, **before** the Iron Age the reef would have stood higher above the water than it does now, strongly suggesting that the submerged, rock-cut foundation courses which I recorded must antedate the Iron Age (Fig. 4).

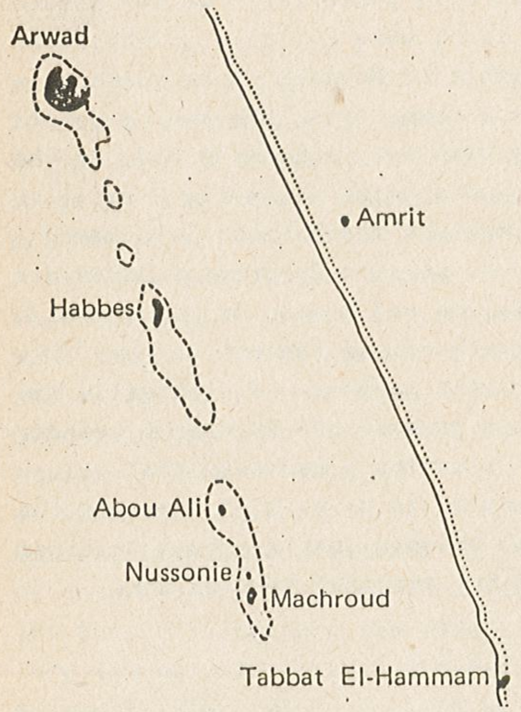


Figure 3. The Arwad (or Rouad) reef, and mainland site of Tabbat el Hammam where, after installations, on the reef became submerged, a jetty was built during the Iron Age.

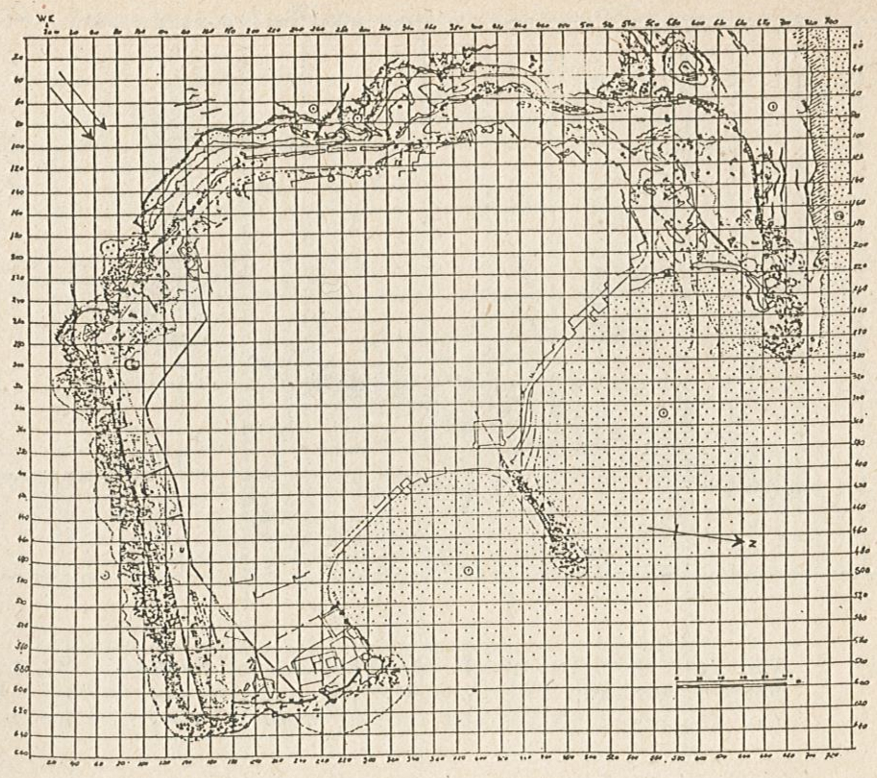


Figure 4. Arwad: Plan (based on land and underwater survey and aerial photographs) showing details of the basically rock-cut sea-walls and the natural shelter to landwards.

Archaeological confirmation of this finding is shown by a 9th century BC jetty on the shore opposite the southern end of the Arwad reef (Fig. 5). Exceptionally, the date of this particular jetty is firmly established, because its landward end finishes in a trench in Tell Tabbat el Hammam, which Braidwood excavated during the 1930s. His stratigraphic dating for the jetty coincides with the period when the harbour installations on the opposite reef would have become submerged and useless; consequently alternative installations such as this jetty would have had to have been built on the mainland shore to replace the old and useless installations.

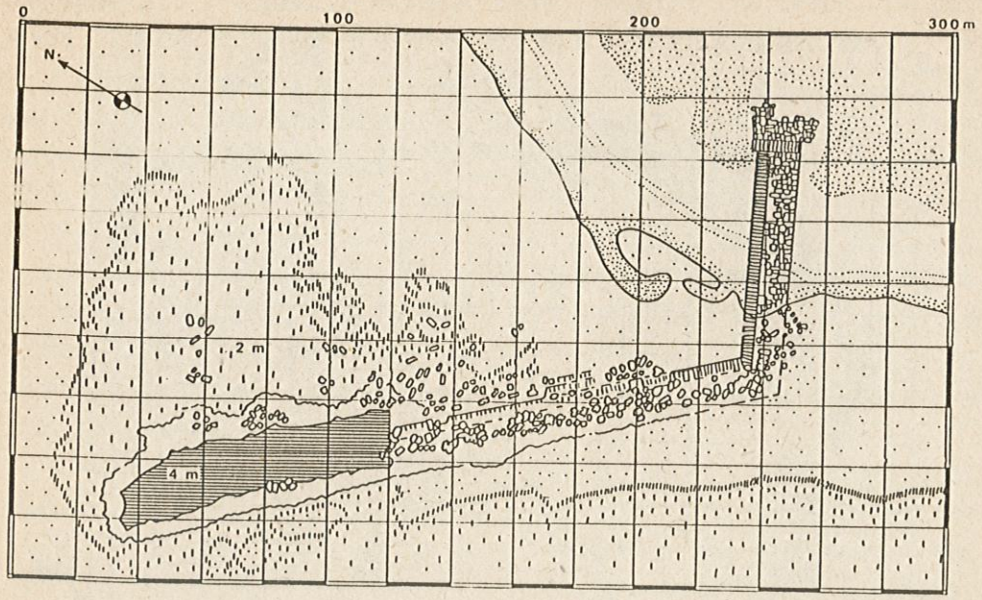


Figure 5. The Iron Age jetty at Tell Tabbat el Hammam: its submerged portion based on marine and aerial survey, and its landward extremity on the sounding of the Tell.

2) Aerial photographs clearly demonstrate further evidence of oscillations, which it is difficult to discern at close quarters particularly on this Southern extension of the Arwad reef opposite Tabbat el Hammam. These features include: wide "trottoirs" caused by wave-erosion and pitted with natural holes called "solution-basins", or "marmites". Like the "trottoirs", the "marmites" are also caused by wave-action (being the result of waves joggling a heavy stone until it wears a hole into the soft beach-rock of the "trottoir" on which it lay the stones themselves usually remain in the bottom of such holes). From the air similar holes can be seen on underwater shelves which must therefore represent submerged trottoirs (since both "trottoirs" and "solution-basins" can only be formed by waves at mean sea-level).

Longitudinal fissuring running through Arwad itself and southwards down its reef also shows clearly on aerial photo-

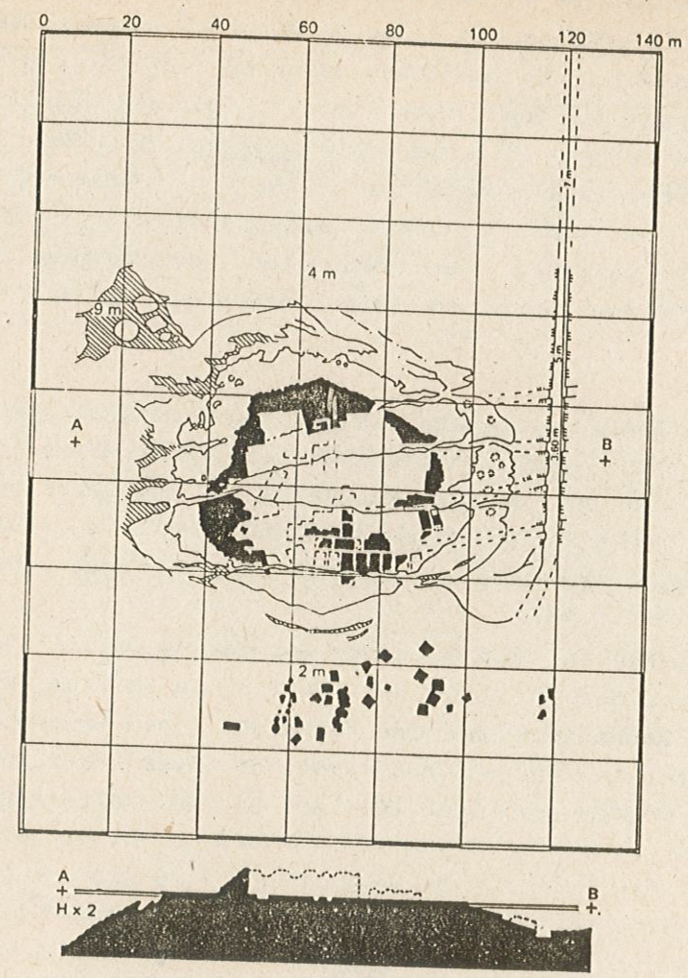


Figure 6. The islet of Machroud at the southern tip of the Arwad reef (based on marine survey and aerial photographs). Sea-level changes postdating the submerged rock-cut foundation trench (to the right) are marked by erosion trottoirs and solution-basins at and below present sea-level; these are traversed by longitudinal fissuring of the reef rock. A scatter of large square-cut blocks of stone lie underwater to landward. After the original installations became useless, the Iron Age jetty on the opposite mainland may have replaced them, meanwhile the islet continued to be used as a quarry.

graphs and also denotes an earth movement which, again, is most striking when it crosses the Islet of Machroud opposite Tabbat el Hammam. Throughout the reef the fissuring runs through various forms of rock-cutting (both installations and quarrying), but at Machroud it runs at right angles across a man-made rock-cut trench (probably a foundation course) now submerged to a depth of some 2 m. Finally, on the landward side Machroud both large blocks of masonary, now underwater, seem to have fallen from a pre-Iron Age structure that once stood on the Island (Fig. 6).

3) During the 1960s certain geologists and geographers working in Lebanon (see bibliography) realized that the remains of **Vremetedae** which live only at mean-sea-level and edge erosion trottoirs, could be dated by Carbon 14; consequently so could the raised, or submerged trottoirs on which they had once lived.

4) Along the Lebanese coast, evidence for dating oscillations by wave-notches was deduced by Dr.Paul Sanlaville.Calling two such notches the "Zennadian" and the "Tabarja" lines (respectively at 2 m and 1 m above present sea-level) he dates the first to a period between 2000 and 1500 BC, and the second to 200 BC to 400 AD.

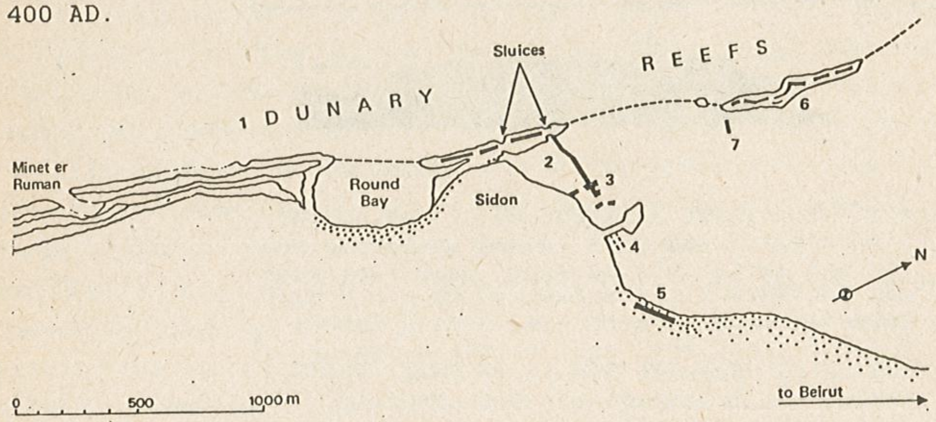


Figure 7. The reef-formation tangental to the shore at Sidon (1). Harbour unstallations on land (2-3); the jetty still visible on the surface (6) and the rock-cut sea-walls which (7); all surveyed by R.P.Poidebard.

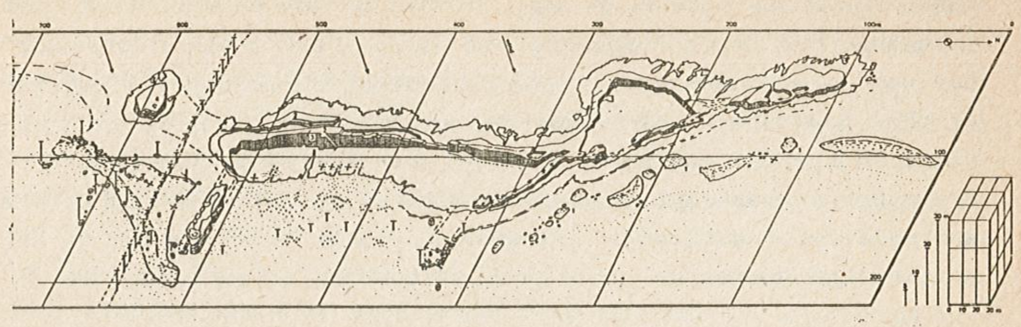


Figure 8. The detailed land and underwater survey on the Island harbour of Sidon, made in 1968-9, showing: in deep water to the south a tumble of large blocks of masonary (mostly of the Persian Period) (6) then, to the north of landing quays, the underwater foundations of a second jetty (5) and, further north, lines of rock-cut mooring-bitts (indicated by black dotts) which are to be found both at and above present sea-level. A large number (2) is hewn in the rock-cut sea walls (3) which protect the weather-side of the Island.

The Tabarja line shows clearly on the rock-cut installations of the Island Harbour at Sidon, where I recorded them between 1967 and 1968 (Figs. 7 and 8). The Lebanese Department of Antuquities asked for the site to be surveyed, because the ancient remains were threatened by a project for the redevelopment of the harbour.With the help of the Department's surveyors and in collaboration with P. Sanlaville, J.C. Chaumeny and many other experts, it was possible to carry out a quite detailed examination of the offshore anchorage, thus answering questions that had been left outstanding in Poidebard's original survey of Sidon, which had concentrated on the installations on the mainland shore.

Thereafter, political events in the region put a stop to all this coastal research. Surveying at Arwad ended in 1965, thereafter neither P. Sanlaville, nor I were able to return to check whether evidence collected in Lebanon also applied further north. After 1969, it became impossible to continue research at Tyre (Fig. 9), where my 10 years familiarity with the site had resulted in a project for testing the stratigraphy of the harbour by core-sampling. It had become evident that, for instance, the area Poidebard had called "the Southern Harbour" had not been a harbour at all, but rather an industrial quarter of the town which had become submerged at an early date. Core-sampling there, and also on the area silted as the result of Alexander's causeway, should have clarified not only the nature and period of geologocal changes, but also the location of the original harbourworks. This project too had to be cancelled.

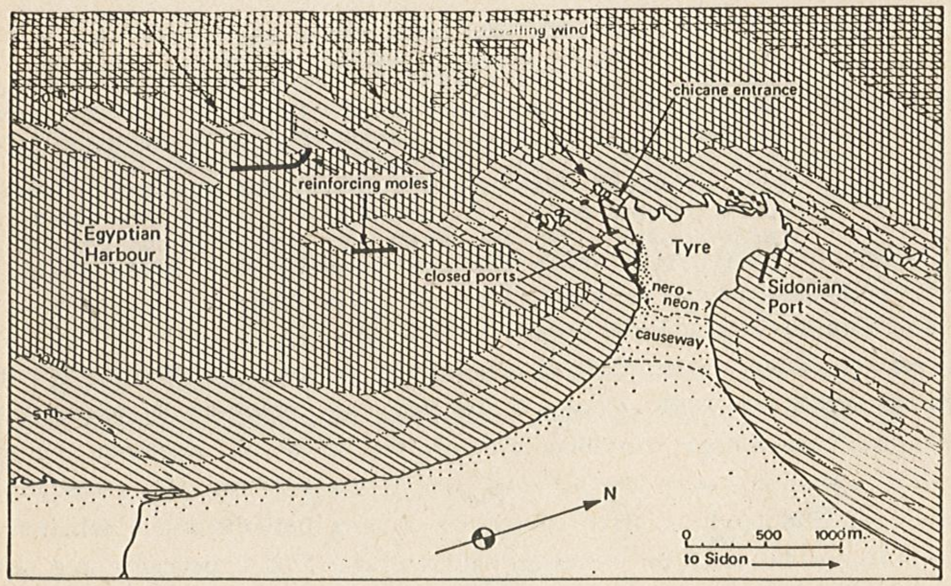


Figure 9. Tyre, after R.P.Poidebard. Underwater examination and excavation on land have since thrown doubt on his structural interpretation of the "reinforcing" of the southern "moles" and "closed potrs" This research was cut short in 1969.

COTHONS AND OTHER CUTTINGS

The only cuttings I have mentioned so far, in discussing proto harbours,are quays,sea-walls and foundation-trenches. But in protecting their trade the Phoenicians are reputed to have

made other cuttings (including the throats of those who spied out their trade-secrets!). Along the open, shelterless Levant coast,if trade needed naval defence, this meant making some artificial form of installation whence fast oared ships could be both kept unobtrusively and launched quickly. The word "cothon" which is associated with Phoenician harbours and interpreted as an artificial basin cut into land (or rock) before being linked to the sea by a channel, would fulfill this need, but no such installation has ever been identified for certain along the Levant coast. Poidebard hinted at the possibility of an inner, or "closed" military harbour at Sidon, which might have adjoined the installations he studied on the mainland. If indeed such a cothon existed, it would now lie beneath the modern town.

Elsewhere,no cothon was archaeologically proven until 1974, when two lakes were confirmed as docks cut into the land,parallel to the ancient shore-line. The investigations were carried out by two of the international teams working on the UNESCO-sponsored Carthage Excavation project. These cothons shared a single entrance, so that oared warships reached the inner, circular, military cothon after passing through a larger rectangular dock, used by commercial shipping. The British team under Dr. Henry Hurst, investigated the military harbour in some detail: they found slipways radiating from a building in the middle of the artificial Island in the centre of the cothon; it is possible that more slipways, for larger warships, may have existed around the circumference,but excavation of the cothon's shore did not come within the set-limits of Hurst's campaigns. Archaeological sequences, established in both cothons confirm their Punic origin, then continuing use until the end of Roman Carthage.

Two large tanks associated with the Phoenico-Punic sites of,respectively,Motya in Sicily and Mahdia in Tunisia,have been called "cothons". At Motya (one of the earliest colonies of Tyre) the "cothon" consists of a rectangular basin, only 52 x 37 m, whose walls are faced with masonry. Not only is it too small to have accomodated oared fighting-ships of the period (again judging size on the known number of oars), but its entrance which is both narrow and crooked could hardly be negotiated by a small fishing boat. The structure is more reminiscent of a fish-tank, or a sacred basin such as the nymphaeum at Amrit (on the Syrian coast opposite Arwad). The rock-cut basin at Mahdia is, perhaps, just large enough to qualify as a cothon, but it still needs to be investigated archaeologically from this point of view.

Finally, other kinds of rock-cut features crop up at sites with Phoenician associations. The ancient town of Lilybaeum which was built on a cape, was protected to landwards by a huge rock-cut moat, part of which survives in modern Marsala where it is known as the "Fossatto". The Carthaginians built Lilybaeum to replace the earlier Phoenician colonial town of Motya (destroyed by the Greek Tyrant of Syracuse in 397 BC); the new site was also a typically Phoenician choice for a port, since ships can always find shelter on one side of a cape. The seaward extremities of the Fossatto lost under overbuilding, because the rock is lower near the shore; its line does, however, suggest that the cutting might originally have linked the twin harbours. History and archaeology both confirm that Lilybaeum's walls were built from stone quarried from the trench beneath them - in the same way that stone cut from the landward side of reefs to form quays, was promptly used to strengthen the protective sea-walls on the weather side of Levantine proto harbours.

Another evocative example of rock-cutting exists at Phalasarna, a most interesting harbour on the western extremity of Crete, which is currently being excavated by Elpida Hadjidakis. This 5th century BC site is now on dry land, having been raised some 6 m above sea-level by earth movements. Certain installations are rock-cut, but the feature which long intrigued me consists of a couple of larger than life, stone thrones. One of them has the Phoenician "bottle motive", in relief, on its backrest. What are these if not "Astarte Thrones" (I know of no other parallels)? For further signs of Phoenician presence we must, however, await the results of Dr. Hadjidakis' excavation. In the meanwhile, I cannot help wondering whether Phoenician

engineers may not have been employed in the designing of Phalasarna's harbourworks.

Reverting to the major Levantine proto harbours, I have not mentioned the fourth and last of these well-spaced, major Bronze Age island-sites: the Homeric Pharos. Although I had the privelege of examining the submerged remains of the Hellenistic Pharos at Alexandria, I was unable at the time to visit the more ancient, rock-cut installations which were surveyed before 1916, Gaston Jondet.

BIBLIOGRAPHY

Braidwood, R.J., Report on two Soundings on the Coast of Syria, South of Tartous. - Syria XXI, 208-218, 1940.

Eiselen, F.C., Sidon, a Study in Oriental History, Columbia Univ. Oriental Studies IV, New York, 1907.

Févret, M., Sanlaville, P., Contributions a l'étude du littoral libanais. - Méditerranée 2, Ed. Univ. Aix en Provence, Avril - Juin 1965; also Sur l'utilization des vermets dans la détermination des anciens niveaux marins, ibid. Octobre - Décembre 1966.

Févret, M., Picard, J., Sanlaville, P., Sur la posibilité de datation de niveaux marins quaternaires par les Vermets. C.r. Acad. Sci., 264, 1407-9, Paris, 1967.

Harden, D., The Phoenicians. Penguin Books, London 1971.

Hurst, H., 1974-78, Excavations at Carthage (interim reports). - The Antiquaries Journal (London): LV 55(1975), 11-40; LV 56(1976), 177-197; LVII 57(1977), 232-261; LIX 59, (1979) 19-49.

Frost, H., - Rouad, ses récifs et mouillages; prospection sous-marine. - Annales Archéologiques de Syrie XIV, 67-74, Damascus 1964

- The Arwad Plans 1964; a Photogrammetric Survey of Marine Installations. - A.A.S., XVI, 13-28, Damascus 1966.
- On the Plotting of Vast and Partly Submerged Harbourworks from Aerial and Underwater Photographs. - Surveying in Archaeology Underwater, Colston Monograph No.5, 31-45. London 1969.
- The Case for a Bronze Age Dating for the Submerged Harbourworks at Arwad. - In: Actes du 8e colloque internationale d'histoire maritime, 63-71. Paris, 1970.
- Recent Observations on the Submerged Harbourworks at Tyre. - Bulletin du Musée de Beyrouth, XXIV, 103-111, Beyrouth 1971.

- Ancient Harbours and Anchorages. - In: Marine Archaeology a Nascent Dicipline, Manuai Series, UNESCO, I, 7, 75-84, Paris 1972.

- The Offshore Island Harbour at Sidon and other Phoenician Sites in the Light of New Evidence. -The International Journal of Underwater Archaeology, 2, 1, 75-94, London & New York 1973.

- Mediterranean Harbours and Ports of Call in the Bronze and Iron Ages. Les Grandes Escales. - In: Actes du 10ᵉ Colloque de la Commission Internationale de l'Histoire Maritime, Soc. Jean Bodin No. 32, 35-41, Bruxelles 1974.

- The Pharos Site, Alexandria, Egypt. - I.J.N.A. 4, 1, 75-94. London & New York 1975.

- Port. - In: Dictionnaire de la Civilization Phénicienne, Ed. Brepols, Liège, (in press).

Jondet, G., Les Ports Submergés de l'Ancien Pharos. Cairo,1916.

Poidebard, A., Tyr. Paris 1939, and with *Lauffray, J.*, Sidon. Beyrouth 1962.

Sanlaville, P., - Les variations holocènes du niveau de la mer au Liban. - Rev.de Géog.de Lyon, 45, 3, 279-304.Lyon 1970.

- Vermetus dating of changes in sea-level. - In; Underwater Archaeology a Nascent Dicipline, 185-91, UNESCO, 1972.

- (with *H.Fleisch*) Sur les niveaux marins quaternaires de la région de Tabarja. - In: C,r. Sommaire des séances de la Soc. Géol. de France, 157, (Mai) 1967.

- (with *P.Fleisch & J. Remiro*) Gisements préhistoriques découverts dans la région de Batroun. - In: Mélanges Université St. Josèph XLI, 1-28, Beyrouth 1967.

Wetzel, R., *Haller, J.*, Le quaternaire cotier de la région de Tripoli. - Etude Géologique sur le Liban, la Syrie et le Moyen Orient, 45ff, Beyrouth 1945-1948.

(I am also indebted to M.Wetzel for personally communicating his opinion).

Williams, J.C.C., Simple Photogrammetry. Academic Press, London & New York, 1969.

THE SUBSIDENCE OF SEBASTOS: WHEN THE HERODIAN BREAKWATERS IN CAESAREA WERE FLOODED?

Avner Raban

Center for Maritime Studies, University of Haifa, Mount Carmel, Haifa 31999, Israel

1. THE HISTORICAL SOURCES.

Procopius, the Bishop of Gaza and a native of Caesarea wrote in early 6th century the following (*Migne*,1865,col. 2817) "The harbour of the city named after Caesar had disintegrated through age, and lay open to every threat of the sea. Its structure no longer measured up to the category of harbour, but of its former condition it kept the name alone." (trans.to English by J.P.Oleson, in *Oleson,J.P. et al*. 1984:294,n.20). The "Name" Procopius referred to in his narration,is "Sebastos", the Greek equivalent to the Latin title "Augustus",which was given to the first Roman Caesar and Herod's patron - Octavianus. This name was designated for the Royal harbour of Caesarea, by the city builder Herod the Great. There is quite convincing circumstancial evidence for maritime activities in and around the subsiding harbour basin during the 4-5th centuries (*Hohlfelder*, 1988: 59, n.20) and even historical documents referring to the entity of Sebastos as an existing one (*Hohlfelder*, 1985). Yet all the direct and indirect testimonia presented by Hohlfelder refer toward one point: the harbour at Caesarea (whether Sebastos or the municipal one to the south of it) were used for maritime purposes during the later Romen era (3rd-4th centuries). Such activities could be attempted in a manner so vividly depicted by Procopius: "...the merchant vessels that after escaping the open sea, often suffered shipwreck in the harbour. Indeed they who required the goods had the more pitiable anguish, for, see- ing the wares they happened to need perish, all they could do was watch'

A single Rabbinic reference that might be dated to the turn of the 4th century is of a more "positive" character concerning the existence of an intact harbour basin in Caesarea (*J.Gittin*, I. 1, 43b): "Rabbi Ya'acov berbbi Zivdi said: "It happened that someone brought a bill of divorce from the port of Caesarea (Literally the phrase used is "Lamina" = Limen of...). The case came before Rabbi Abbahu(the famous head of the Rabbinic School at Caesarea, known as "Rabbanan de Kisrin') who said: "Yes, one is obliged to attest - "it was written in my presence, it was signed in my presence" (as is the case with bills of divorce brought from places abroad)."But is not the port of Caesarea to be considered as Caesarea itself?" Rabbi Abin said: "The reason in this case was that it was a departing ship, already under sail within the harbour". This text is brought up as a case for the integrity of Sebastos at the time (*Levine*, 1975:17). Yet other explanations might be considered. One possible reason might be the fact that Caesarea, the urban part within the old city walls of Straton's Tower were considered to be outside the boundaries of the Holy Land (see e.g. *Ringel*, 1975:76, 124-8; *Raban*, 1987) and therefore bills written within these walls, or west of them would be considered as brought from abroad. Other explanation might be that at the time, due to the state of the harbour, the mooring merchantmen would set sail directly from their mooring positions off shore, with no need to be towed out through the harbour channel, as might have been the case when the existing breakwaters necessitated such a procedure.

A single numismatic evidence discussed by Levine (1975:18) who quotes Kadman (1957:66-7) refers to a third century munici- pal coin with the Latin legend **Portus Augusti** (=the Greek epi- thet **Sebastos Limani**). Ringel, who treats the numismatic evi- dence for the history of Caesarea and its maritime activities

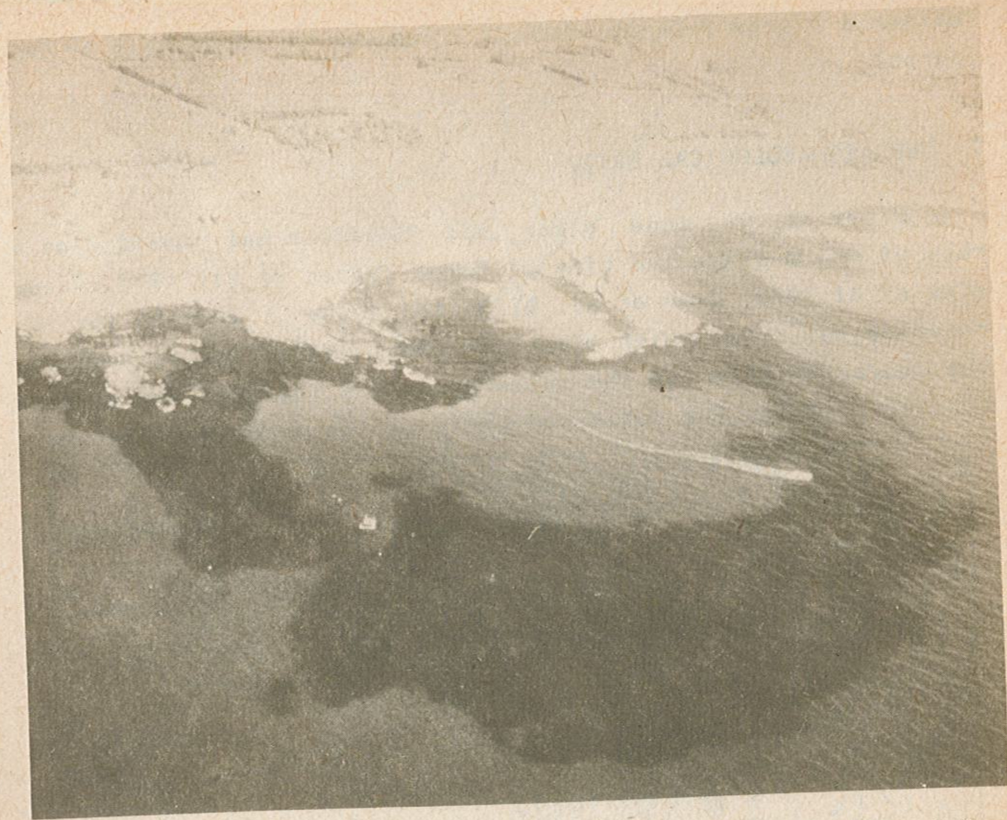


Figure 1. An aerial photograph of the submerged features of Se- bastos from the NW (photo: Bill Curtzinger).

in two places (*Ringel*, 1975:151-160; 1988) never refers to that coin (neither does Hamburger in his treats of 1955 and 1986). Moreover, in Ringel's later paper (1988) there are some indirect references from Rabbinic sources of the 2nd-4th centuries indi- cating an unsafe situation for ships approaching Caesarea, much like the Byzantine testimony of Procopius quoted above (*Ringel*, 1988:68-72). Summerizing the historical evidence one might sa- fely claim that the picture depicted is of an on-going maritime activity in the city all through the Roman and Byzantine eras, and a rather flourishing trade with oversea centres around the Mediterranean. Yet, there are no indications for the very exi- stence of Sebastos as a Royal entity later than the Neronian coins of his last regnal year (67/8) with the Greek epithet

"Kaisaria h pros Sebastu Limeni" (Caesarea which is next to Sebastos).

2. THE ARCHAEOLOGICAL DATA

Since it was made clear that Sebastos has subsided at a rate of 5-6 m since the time of Herod (*Raban et al*. 1976, *Flemming et al*.1978, *Neev et al*. 1978) the issue of looking for archaeological data which might be instrumental for determining the characteristic of the submergence and its date was given a special priority.The submerged basin of the great Herodian Har-

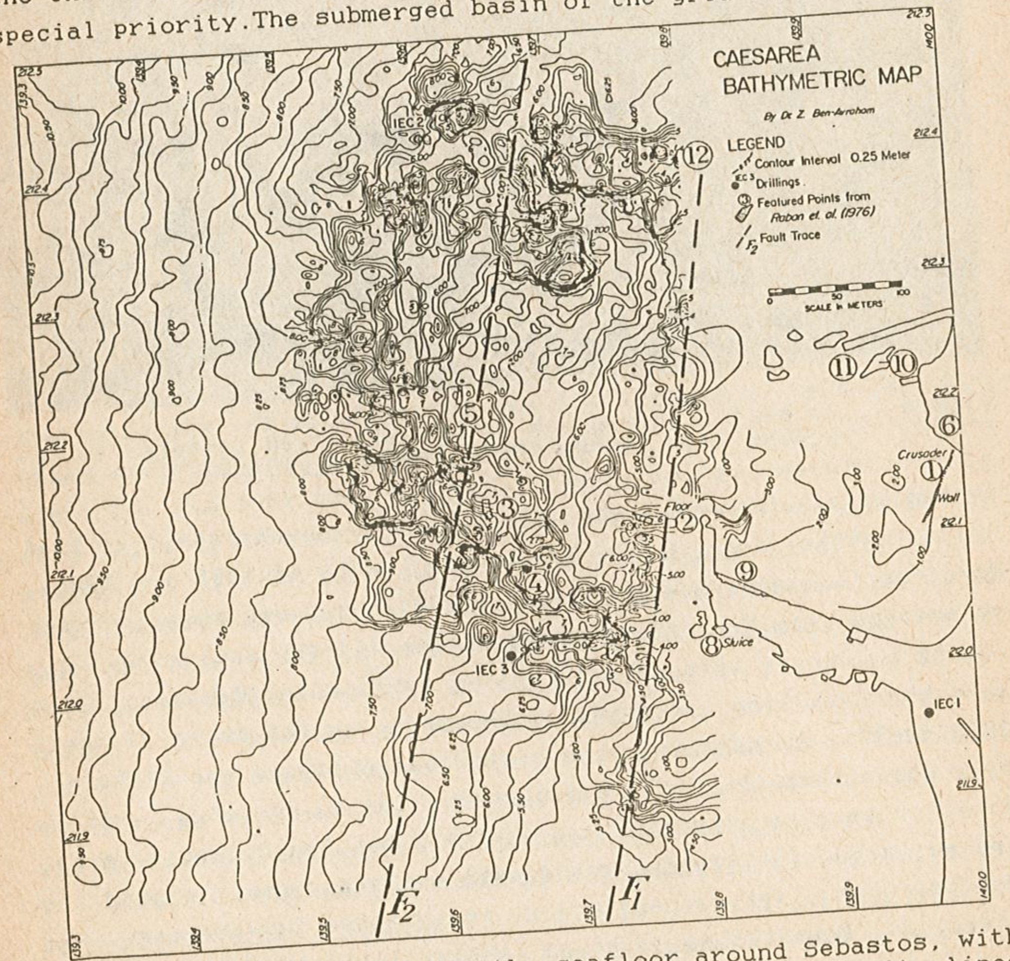


Figure 2. Bathymetric map of the seafloor around Sebastos, with the suggested location of neo-tectonic fault lines (after Neev et al. 1978, compiled by Z. Ben Avraham).

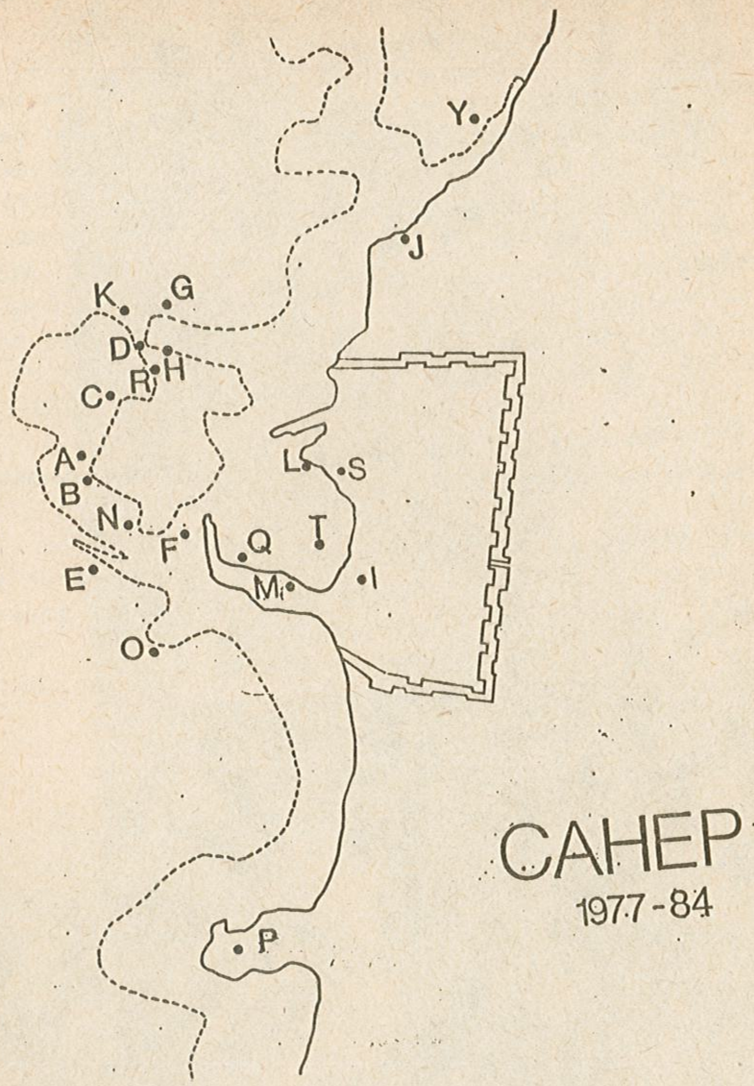


Figure 3. Schematic map of Caesarea with locator for CAHEP's various working areas.

bour (Fig. 1) was surveyed for Israel Electric Company in 1975 for the very goal of detecting architectural features which are at present significantly off their original relation with the level of the sea. This survey has produced bulk of data to suggest that most of the main basin of Sebastos subsided by 5-6 m, while its eastern part remained more or less at its original elevation related to the sea level. A geomorphological survey which was carried for the same purpose has produced data for a Neotectonic claim, with two recent fault lines presumably detected across the Herodian breakwaters (*Neev et al.*1978 and see Fig. 2). Yet the character of the submerged features, such as the sunken floor at area F (see Fig. 3) and lack of any historical reference to a single catastrophic event (such as the alleged earthquake of 130 A.D.)led the various scholars to assume that the subsidence was rather gradual (*Flemming et al.*, 1978: 59-65, 75-79; *Raban*, 1985: 163; *Hohlfelder* 1985: 181-3; 1988: 55, 59).

As for the date of the submergence of the breakwater the following archaeological remains might be instrumental:

a. **Wreckage sites**, on the top of the breakwaters, which are datable through typology of pottery vessels, might give us the latest possible date for the breakwaters being still intact, or at least well above the water along the majority of their cir-

Figure 4. Broken amphoras from various wreckage sites on top of the western breakwater of Sebastos.

Figure 5. Broken amphoras from various wreckage sites on top of the western breakwater of Sebastos.

cumference. A survey for such wreckage sites was carried twice, in 1975 and in 1983 (*Raban et al.* 1976, *Raban* 1985:161). Though there are some controversies among CAHEP's co-directors concerning the exact number of wrecks actually found and identified as such (while I claim that every heap of balast stones,that is - stones of heavy minerals which are different from those used in the harbour construction and of foreign provenance - are to be considered wreckage site, my colleagues would claim as such

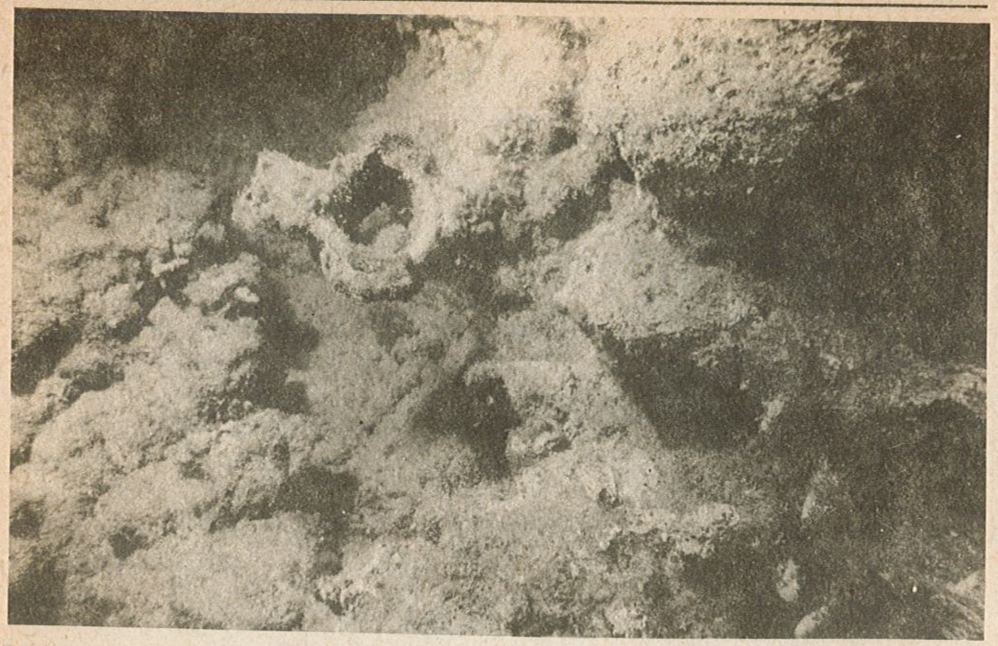


Figure 6. Broken amphoras from various wreckage sites on top of the western breakwater of Sebastos.

only clear concentration of broken amphoras or other components of a sea-borne cargo,and see e.g. *Hohlfelder*, 1988:62, n. 20), there is no real argument questioning the fact that concentrations of broken amphoras were located on top of presently higher parts of the tumbling breakwaters.Some of the better preserved sherds might be typologically dated no later than 3rd-4th centuries (Figs. 4-6). These shipwrecks testify for a clear case: the wreckage took place on top of already inundated tumbling and subsiding upper structures of the main breakwaters of Sebastos.

b.Wreckage site inside the harbour basin was traced during 1987 season just east of area R (Fig. 3). Among many finds that were scattered next to the piles of basalt balast slabs there were over a dozen of coins, all of which are dated to the first half of the third century (*Raban & Stieglitz* 1988). During 1988 season more coins and other artifacts of the same period were retrieved from that site.Even if one would argue that such a site might not be of homogenious and non-disturbed character,the im-

portant fact is that such small metal objects were found on almost one meter of coarse sand mixed with rubble,shingle and sea shells. These sediments are deposited on top of the original floor of the harbour wich is clearly distinguished by its fine compact clay deposits (*Raban*, 1985:161-3, Fig. 5). The coarser sediments could be deposited within the harbour basin only after its breakwaters were overflooded by the surge and wave energy was prominent at previously still water area.These coarser sediments were deposited at the site east of area R prior to the wreckage event - either very early in the third century or already in the preceding one.

c. Excavations at the shore in area L (Fig. 3) during 1986 and 1987 (see *Stieglitz* 1987: 187-8 (demarked as S1);*Raban & Stieglitz*,1988) exposed land structures on top of Herodian pier (see also *Levine & Netzer*, 1986:50-65). The earliest floor on top of the pier is of cemented plaster and belongs to a terrestrial building with no opening toward the sea. This building excluded the maritime function of the pier and is to be dated to the second half of the 2nd century.It is clear that by that time this part of the harbour was no more functioning as part of the original Herodian complex (and see below,for sedimentological data from the same site).

d. The rubble spill along the inner part of the northern Herodian breakwater (Fig. 3, area H) that was carefully studied during 1984 season (*Raban*, 1985: 158-9, **Hohlfelder**, 1987: 2,1988) was well attested as a part of Anastasius' attempt to renovate the harbour around 500 A.D. The rubble spill of this Byzantine rampart was laid directly on top of the lower components of the original breakwater. It is clear that by the time of Anastasius the north breakwater of Sebastos was already stripped off of almost every single ashlar block of its original quays, vaults, towers and walls. The remainings were well below the waves, as indicated by the remains of late Roman amphoras that were found burried underneath the Byzantine rampart. (Fig. 7).

Figure 7. Early Byzantine amphora on top of the debris of the north Herodian breakwater and covered by the rubble blocks of Anastasius' rampart (photo: M. Little).

3. SEDIMENTOLOGICAL DATA

As it has been indicated above, marine sediments at coastal environments usually grain-sized, show features and composition derived directly from the types of nearby resources of non-con-

solidated sediments and depend on the rate of the energy available that carries them around and deposits some of the suspence when subsiding (see e.g. *Kraft et al.* 1981, *Nir*, 1982). Dealing with a well confined segment of nearshore sea floor and the beach at its lee, as is the case at Sebastos, one would suggest sedimentological changes as a by-product of two variables:

a. Deeper floor to the harbour basin which by itself would produce deposited sediments of somewhat finer particles.

b. Lesser protection against the surge through the process of the discomposition and submergence of the breakwaters.

This second trend would produce coarser sediments both on the sea floor at the harbour basin and on the beach at its lee, if such natural feature would be allowed within an operating harbour (and see e.g. *Josephus*, JA, XV =: 333).

Having these sedimentological facts in mind one can survey the data exposed through CAHEP's various probes, bearing in mind that arcaeologically or stratigraphically dated natural marine deposits might be characteristic and indicative of the topographic situation at the time. This hypothesis is to be tried for the following data:

a. The beach deposits in area L (Fig. 3, 8), at the north side of the intermediate basin of Sebastots. During 1986, 1987 seasons the Herodian pier (Fig. 8: N210-W40-15) and the quay adjacent to it (N 200 W 20) were studied and unearthed. Through the excavations it became clear that both architectural features went out of use within a few generations after their completion. Following a short phase during which an ashlar structure with cemented plaster floor was laid on top of the eastern part of the pier, the entire area was abandoned and steep beach was deposited on top of the tumbling structures. Sometime in the 4th century this area was rebuilt in a different orientation. The two main features of this new phase are a rectangular building above the eastern part of the pier (N 209-14, W 15-21 in Fig. 8 and see also *Levine & Netzer*, 1986: 50-1, plan 11, Ill. 73), and of the same complex are the lower courses of an ashlar wall which was built east of the quay (Fig. 9). This wall has a wide foundation which was inserted into a trench that was dug down through the beach deposits. The trench was then filled with red loam of the same type that was used as a binding agent between the wall's ashlar blocks (and those of the nearby rectangular building). It is therefore quite clear that these structures are later than the beach (see Figs. 10, 11). Considering the beach as being a product of extensive wave energy, one would argue

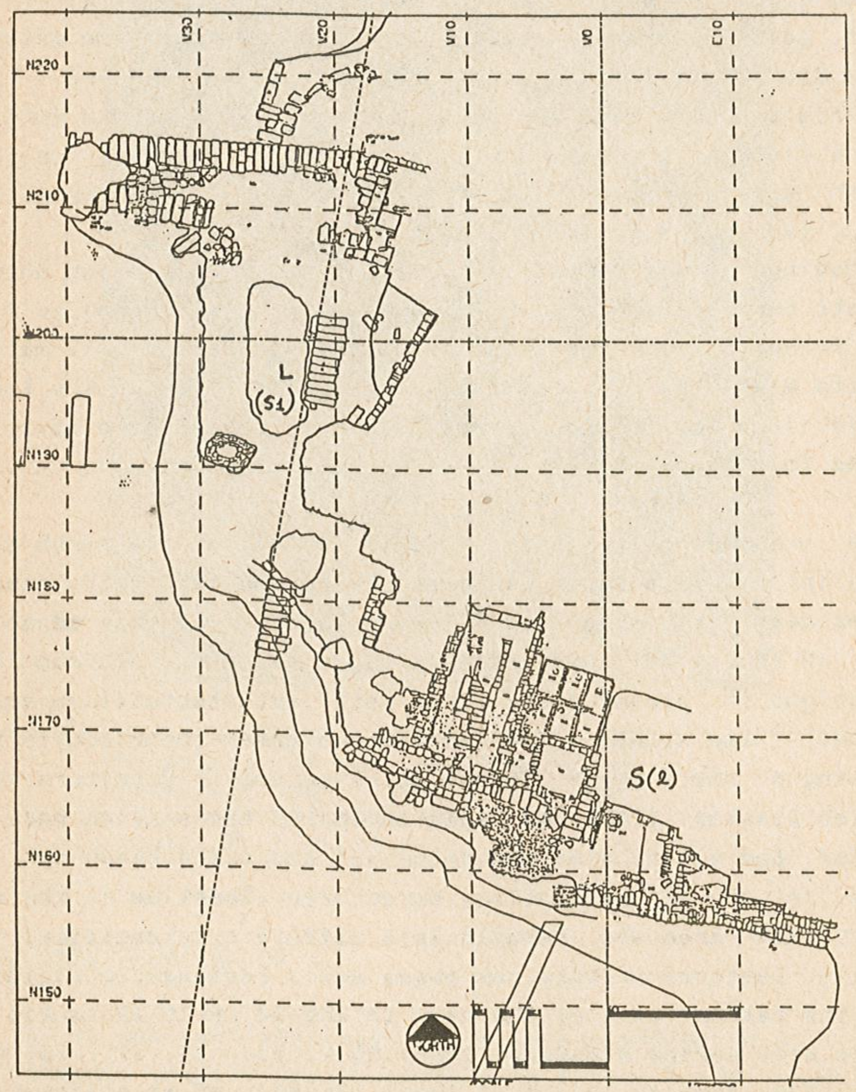


Figure 8. Computorized map of CAHEP area S (= S1, L).

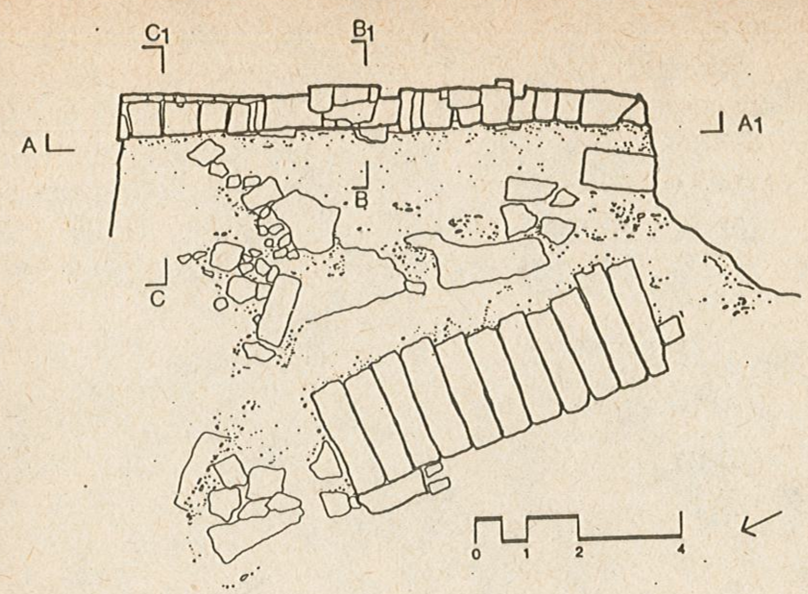


Figure 9. Plan of part of the Herodian quay and the Late Roman wall next to it in CAHEP's area L.

that at the time it was created the breakwaters of Sebastos ceased functioning as an effective protective instrument against the waves and were after flooded by the surge.

b. CAHEP excavations in the harbour channel during the seasons of 1981, 1982, 1984, 1986 and 1988 have reached, in area D1 and D-2 (see Figs. 3, 12) the various deposits on the seabed, below the base of the structures laid by Anastasius (*Oleson et al.* 1984: 294-7; Fig. 13). Just below the base of these Byzantine ashlars and rubble spill there is a layer of 30 cm of grey clay mixed with shells, pebbles and wave worn sherds (Fig. 14). The pottery pieces are to be dated to various periods, but the latest are of Early Byzantine types (Fif. 15). It is therefore quite certain that prior to Anastasius this area was fairly exposed to the surge. Similar deposits were found next to the sunken floor (area F) well inside the harbour basin (*Raban*, 1985: 163). The deposit below is of sand with only few well-worn sherds and many shells, 15 cm thick. This layer might have been deposited during a time of reduced maritime activity around the

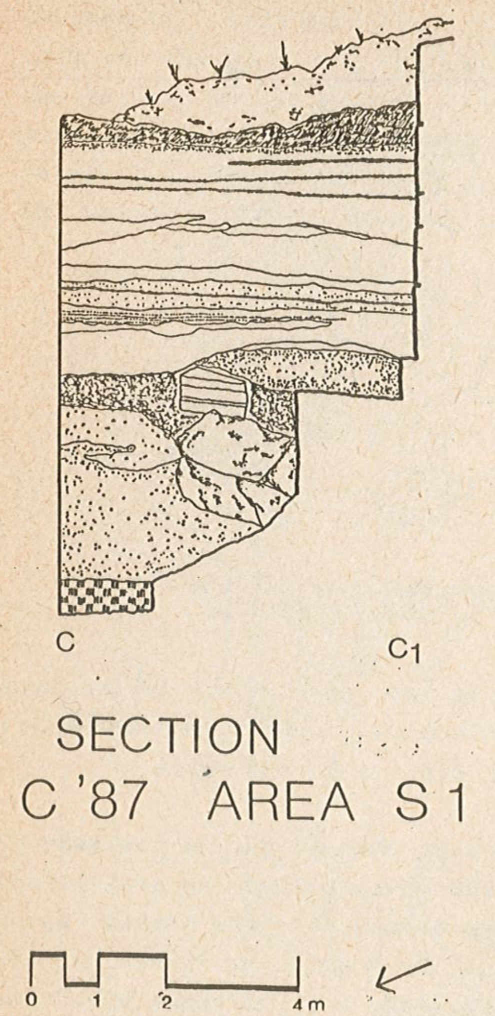


Figure 10. Section C-C1 of the same.

harbour entrance and at a stage when the harbour's flushing system went out of use, maybe due to the fact that the harbour channel was no longer the only way out for the flushing current. The underlaying deposits below that one consist of about 25 - 30 cm rather fine grey mud mixed with many wooden fragments (from discomposed beams of the wooden caissons of Sebastos?) and rich repertory of clay vessels, wooden utensils and other artifacts of the Herodian and first century dates (see *Oleson et al.*, 1984: 296; *Raban*, 1983: 243-5). This deposit no doubt represents the time Sebastos was functioning properly with its breakwaters still intact. Below there is a layer of coarser sand with shells but no artifacts. A deposit of open water predates the construction of Sebastos. The deepest layer reached in CAHEP probes is of a very compact grey-to-lihgt-brown clay, mixed with loam. This layer represents an early Holocenian marshy deposition at what was a coastal basin prior to the last post glacial transgression.

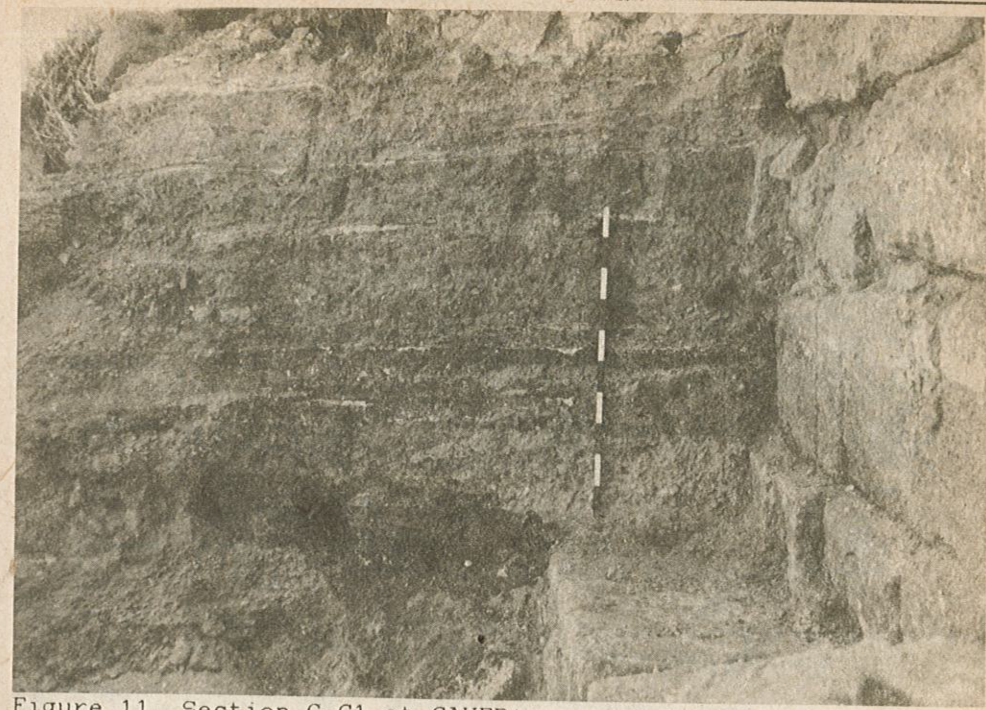


Figure 11. Section C-C1 at CAHEP's area L, looking north. Notice the dark foundation trench that cuts through layers of coarse beach deposits.

4. CONCLUSION

From the data presented above there is a good solid base for claiming that Sebastos breakwaters had lost their integrity and were flooded by the surge no later than early third century, but probably already during the later half of the second century of our era. We can not reconstruct the full combination of events and processes that had caused these magnificent structures to gradually disappear below the waves. Yet it is possible that two effective potentials were the main factors in this scene: First, the potentially unstable sea floor was triggered by the extra burden of the breakwaters and slowly subsided, either through compaction, fluidation, slumping, or tectonic down faulting. One might consider all four processes taking place, with the last one (the tectonic) being probably the main factor - if one might recall that the subsidence is of rather

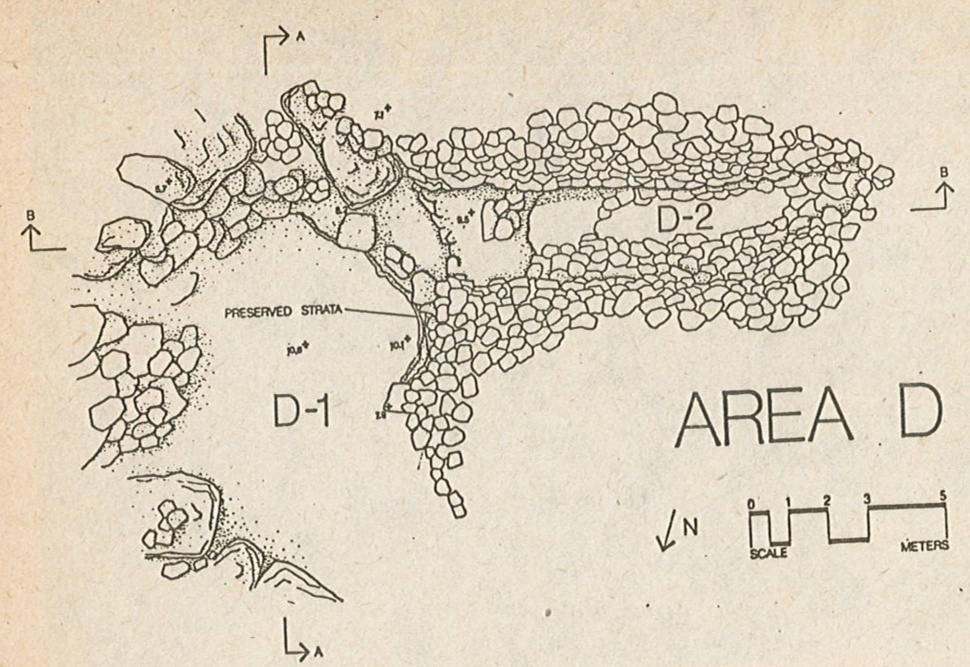


Figure 12. Plan of CAHEP's area D.

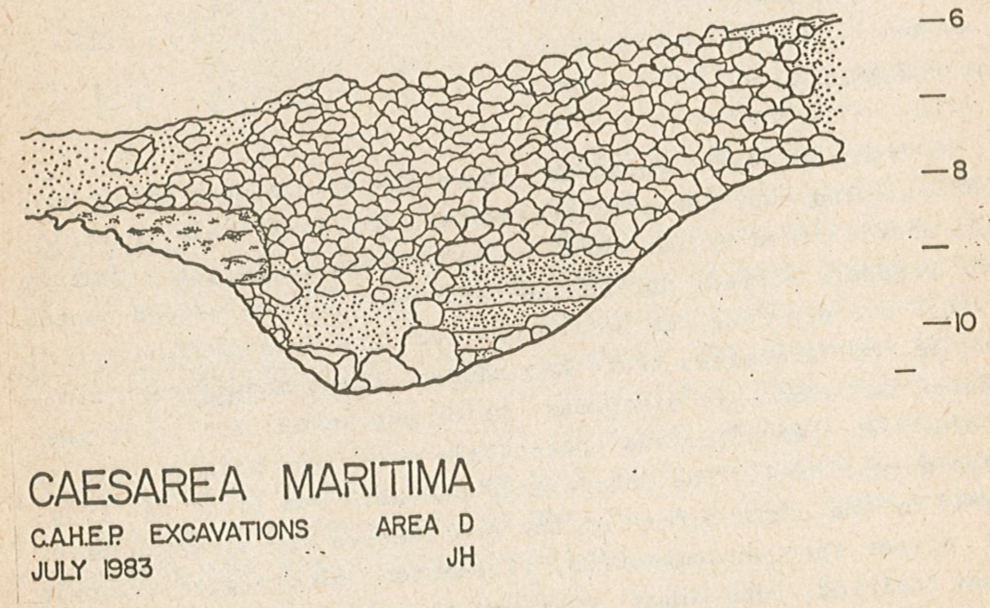


Figure 13. Section B. (east-west) in CAHEP's area D.

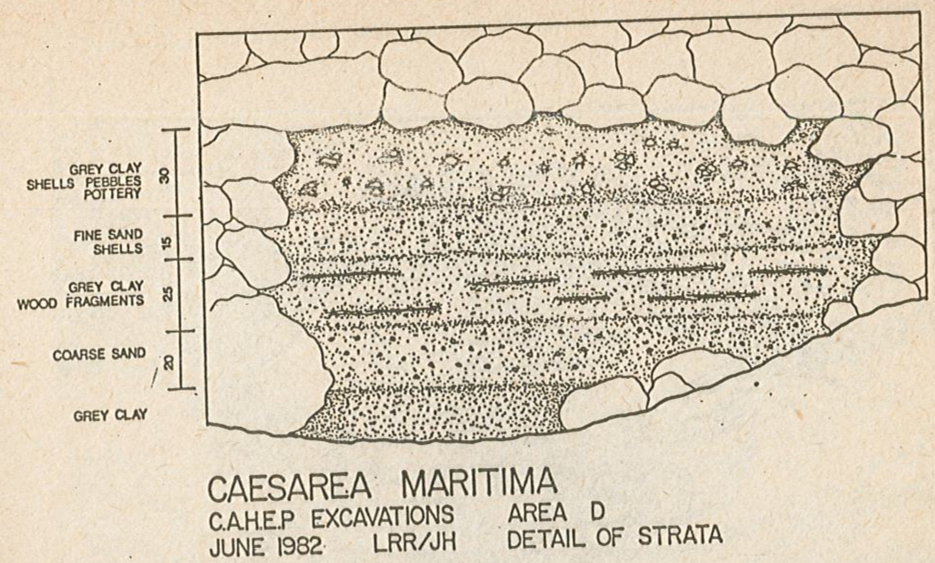


Figure 14. Schematic section through the non-disturbed strata below the rubble spill between D-1 and D-2.

Figure 15. Waveworn sherds and seashells at the base of Anastasius' spill in CAHEP's area D (photo: H. Wadsworth).

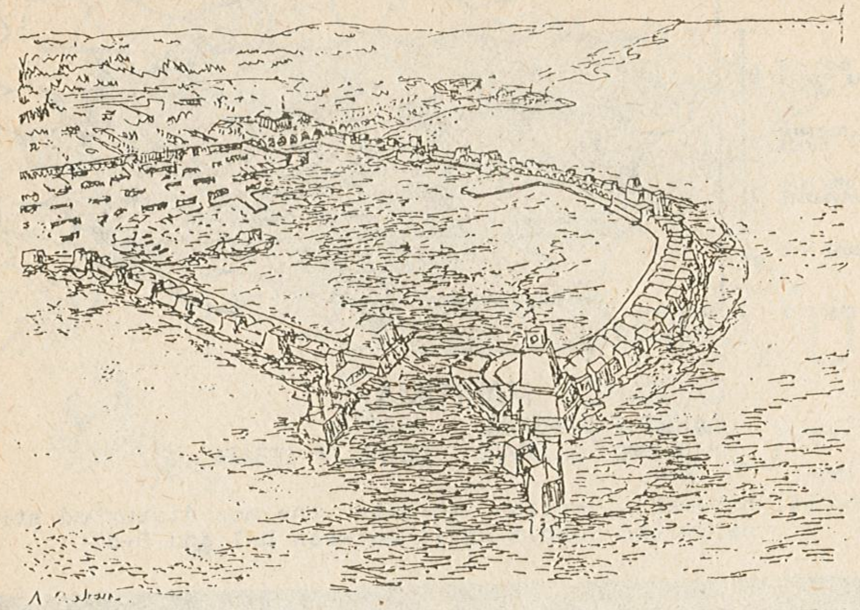


Figure 16. Suggested reconstruction of Sebastos: original phase

even scale all over the area to the west of the alleged fault line (*Flemming & Web*, 1986: 15).

Second, the Sebastos was built as a Royal installation, with the main purpose of serving the Royal needs of Herod's international trade and to be maintained by its revenues. Herod's death five years after the inauguration of Sebastos and the eventual change in the political state of his Kingdom cut off the economic reasoning for such a sophisticated and expensive in maintenance facility (see *Raban*, 1988: 204). We have to recall that Sebastos was not the only harbour near Caesarea and was probably never meant to be serving its municipal demands. For that purpose the south bay was good enough and was used as such until late in the first century (*Holum et al*. 1988: 148-9), when some of the **Horrae** vaults along its shore were turned to other uses (Fig. 16). Soon after the great Jewish revolt and the de-

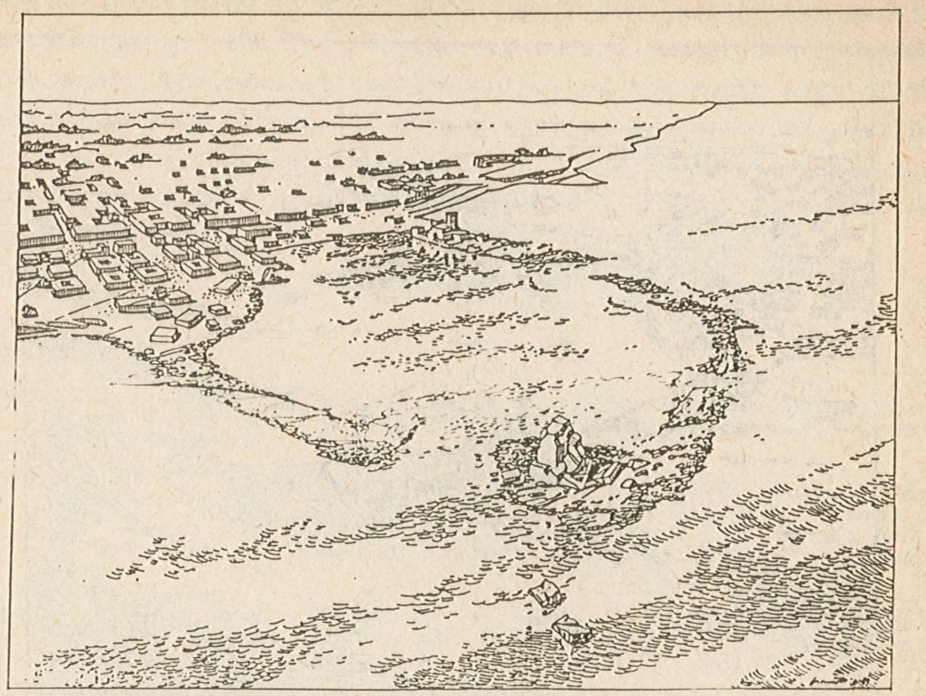
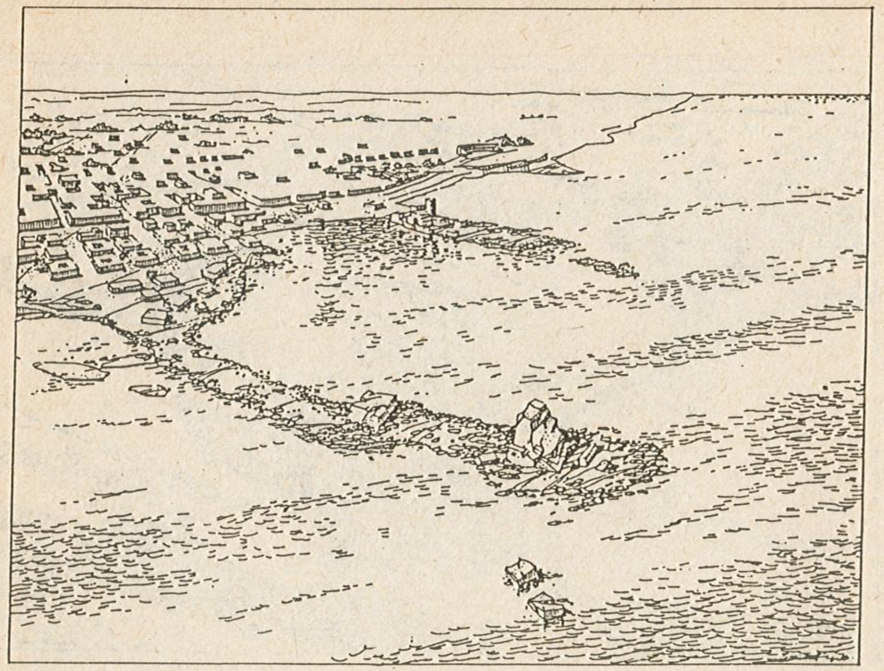


Figure 17. Suggested reconstruction of Sebastos: around 200 A.D.

struction of Jerusalem and its temple, we hear no more about Caesarea being "next to Sebastos", instead we have the municipal entity of Caesarea present itself with a new type of Tyche associated with maritime symbols and the genius of a harbour god (*Ringel*, 1988: 65-8). At that time Caesarea had gained a status of a Roman colony (*Ringel* 1975: 84-5) and it is quite obvious that former Sebastos was then part of it and could be used for local municipal sea-borne activities. The south bay with its less protected mooring area was abandoned, but the alternative one was already in a decaying state (Fig.17). As long as the partially submerged tumbling breakwaters of Sebastos offered reasonable protection for mooring merchantmen during the summer sailing season it was still better than the south bay and was used in a manner common to most municipal harbours of the Later



BYZANTINE PHASE

Figure 18. Suggested reconstruction of Sebastos: Anastasius' renovation.

Roman Empire (see e.g. *Schmiedt*,1978,*Scranton et al*.1978, *Rickman*,1988). It was probably an additional submergence during the fifth century that necessitated a large scale attempt to renovate the harbour. Such an event may have been a combined factor of eustatically raising of the sea level and a tectonic Paroxysm (*Pirazzoli*, 1986). Judging from the remains of the rampart that was identified through CAHEP studies as the one built by Anastasius, this Byzantine renovation was not a complete one - there was no effort to regain a close basin with still water in it the year round. Only the northern breakwater was hightened and the additional spill filled in the original harbour channel, reaching the relatively prominent debris of the lihgthouse (?) that once adorned the tip of the western breakwater (Fig. 18).

Such a protecting line was good enough for keeping the mooring merchantman at the lee of the prevailing summer North-Westerlies (much the same as the promontory on the south side of Sebastos was good enough for summer mooring in the south bay),but in no way was there a chance for wintering in Anastasius' haven during the winter spell of south-western storms (*Carmel et al*. 1985).

BIBLIOGRAPHY

Carmel, Z., Inman, D.L. and Golik A., 1985. Characteristics of Storm Waves Off the Mediterranean Coast of Israel. -Coastal Engineering, 9, 1-19.

Flemming, N.C., Raban A. and Goetschel, C., 1978. Tectonic and Eustatic Changes in the Mediterranean Coast of Israel in the Last 9 000 Years. - In: J.C. Gamble & R.A. Yorke (ed.) Progress in Underwater Science, vol. 3, London, Plymouth, 33-94.

Flemming, N.C. and Webb, C.O., 1986. Tectonic and Eustatic Coastal Changes During the Last 10 000 Years Derived From Archaoelogical Data. - Z. Geomorph N.F., suppl. - Bd. 62, 1-29.

Hamburger,H., 1955. Minute Coins From Caesarea Maritima. - Atiqot, 1, 118-119.

Hamburger, A., 1986. Surface Finds From Caesarea Maritima -Tesserae. - In: Levine & Netzer, 187-204.

Hohlfelder, R.L., 1985. Byzantine Coin Finds From the Sea: A Glimpse of Caesarea Maritima's Later History. - In: A. Raban (ed.) Harbour Archaeology, B.A.R. International Series, no. 257, Oxford, 179-184.

Hohlfelder, R.L., 1987. The 1984 Explorations of the Ancient Harbours of Caesarea Maritima, Israel. BASOR, suppl. 25, 1 -12.

Hohlfelder, R.L., 1988. Procopius, De Aedificiis, 1.11, 18-20: Caesarea Maritima and the Building of Harbours in Late Antiquity. - Mediterranean Historical Review, 3.1, 54-62.

Holum, K.G., Hohlfelder, R.L., Raban, A. and Bull, R.J., 1988. King Herod's Dream: Caesarea On the Sea, W.W. Norton & CO. New York - London.

Kadman, C., 1957. The Coins of Caesarea Maritima. Tel-Aviv - Jerusalem.

Kraft, J.C., et al.,1981. Clastic Depositional Strata in Transgressive Coastal Environment: Holocene Epoch. Northeastern Geology, 3, 268-277.

Levine, L.I., 1975. Roman Caesarea, An Archaeological-Topographical Study. - QEDEM, 2, Jerusalem.

Levine, L.I. and *Netzer, E.*,1986. Excavations at Caesarea Maritima, 1975, 1976, 1979 - Final Report. - QEDEM, 21, Jerusalem.

Migne, J.P., 1865. Patrologia Graeca. 87.3, Paris.

Neev, D., et al., 1978. The Young (Post Lower Pliocene) Geological History of Caesarea Structure. Israel J. of Earth Sciences, 27, 43-64.

Nir, Y., 1982. Asia, Middle East, Coastal Morphology:Israel and Sinai. - In: M.L.Schwartz (ed) The Encyclopedia of Beaches and Coastal Environments, Encyclopedia of Earth Sciences, vol. XV, Hutchinson Ross Pub., Stroudsburg Pen., 86-98.

Oleson, J.P. et al., 1984. The Caesarea Ancient Harbour Excavation Project (CAHEP):Preliminary Report on the 1980-1983 Seasons". - Journal of Field Archaeology, 11, 281-305.

Pirazzoli, P.A., 1986. The Early Byzantine Tectonic Paroxysm. Z. Geomorph. N.F., Suppl. - Bd. 62, 31-49.

Raban, A., 1983. Recent Maritime Archaeological Research in Israel. - IJNA, 12.3, 229-251.

Raban,A., 1985. Caesarea Maritima 1983-1984. - IJNA, 14.2, 155-177.

Raban, A., 1987. The City Walls of Straton's Tower:Some New Archaeological Data. - BASOR, 268, 71-88.

Raban, A.,1988. Coastal Processes and Ancient Harbour Engineering. - In: A. Raban (ed) Archaeology of Coastal Changes, B.A.R. International Series, no. 404, Oxford, 185-208.

Raban,A., et al.,1976. Marine Archaeological Study at Caesarea: Centre for Maritime Studies, University of Haifa, Final Applied Report no. 2/76 (Hebrew).

Raban A. and *Stieglitz, R.R.*, 1988. Caesarea Maritima, 1987. Israel Exploration Journal, 38.4 (in press).

Rickman, G.E.,1988. The Archaeology and History of Roman Ports. - IJNA, 17.3, 257-267.

Ringel, J., 1975. Cesarée de Palestine, Strasbourg-Paris.

Ringel, J., 1988. Literary Sources and Numismatic Evidence of Maritime Activity in Caesarea During the Roman Period. - Mediterranean Historical Review, 3.1, 54-62.

Schmiedt, G., 1978. I porti italiani nell'alto medioevo. La Navigazione Mediterranea nell'Alto Medioevo, Sellimane di Studio del Centro Italiano di Studi sull' Alto Medioevo, 25, 129-259, Spoleto.

Scranton, R., Shaw, J.W. and *Ibrahim, L.*, 1978. Kenchreai,Eastern Port of Corinth, vol. I, Topography and Architecture, Leiden.

Stieglitz, R.R., 1987. Caesarea Ancient Harbours Excavations Project, 1986: Shore Investigations. - Notes and News, Israel Exploration Journal, 37.2, 187-188.

PALYNOLOGY OF SUBMERGED ARCHAEOLOGICAL SITES IN ISRAEL

Mina Weinstein-Evron

Laboratory of Palynology,Institute of Archaeology, University of Haifa, Mount Carmel, Haifa 31999, Israel

In many archaeological sites in Israel pollen grains are not preserved at all,due to oxidation.In those cases where pollen grains are found,however,paleoenvironmental interpretations should be made with great caution. It has been shown (*Bottema*, 1975; *Weinstein-Evron*, 1986) that, in many cases, pollen assemblages which are found in archaeological layers are the result of a combination of recent contamination (e.g., through cracks in the soil) and selective preservation. Therefore, rather than representing ancient vegetation, these pollen spectra should be seen as the result of recent accumulation.

Unlike terrestrial sites, the unaerobic conditions in submerged sites favour pollen preservation.

Pollen analyses were performed on samples from two kinds of sites.The first consists of Neolithic and Chalcolithic sites of the northern Carmel coast and the second is the ancient port of Caesarea (Fig. 1).

The prehistoric sites were found embedded in the upper part of a dark, compact marshy clay which fills the trough between the coastal aeolianite (kurkar) ridge and a presently submerged ridge, some 1000-1500 m west of the norhtern Carmel coast. The clays were formed between ca. 11500 and 8000 BP. The earlier date was obtained from the base of a similar clay at Dor, south of the study area, and is thus subject to local variations. The