

coast, between the amounts of *Glycymeris* fossils found today at the waterline and embedded in archaeological sites, and the almost total absence of live specimens on the shallow shelf.

The research aims to answer the main question regarding the origin of the *Glycymeris*: where and when they live, and why they accumulate along the Israeli coast. The research will attempt to reveal if the phenomenon is the result of extinction, due to environmental or ecological changes, or possibly that the *Glycymeris* today live in deeper or more distant areas and are swept towards the Israeli coast by currents.

Samples were taken from 13 coastal sites (Fig. 4). Assemblages from different historical periods, at different archaeological layers, from three ancient coastal sites, and 7 samples representing different depths along 13 intersect cross-sections (91 samples) along the shelf were also sampled systematically, taxonomically identified and analyzed statistically.



Fig. 4. Sampling *Glycymeris* assemblages in one of the study areas (Photo: I. Potasman)

Preliminary results indicate:

1. South of Haifa bay, from Ashkelon to Dor, *Glycymeris* comprise 89% to 100% of the total fossil mollusks, while north of Haifa bay, only 0 to 4.5% (with an exception of 19.5% at Betzet, north of Nahariyya). In Shikmona, located between these two sectors, 71% of the total mollusk assemblages are *Glycymeris*.
2. The proportion of the *Glycymeris* in archaeological layers from the Middle Bronze age to the Byzantine period is similar to that of the present along the coastline. At Ashkelon and Dor the *Glycymeris* are 75-90% of the total mollusk assemblages, while on the present coastline they are 100% of the total.

3. All shells in the southern sector, up to and including Haifa bay, were identified as *Glycymeris insubrica* (the common species) while in the northern sector most are *Glycymeris pilosa*. At Shavei Zion and Nahariyya they are 46-66% of the total, while at Achziv they are 100% of the total.

4. Although, up to Haifa bay the majority of the total species are *Glycymeris*, they are in the minority at the shallow shelf at depths from 3 m up to 30 m.

5. The few live specimens found were all *Glycymeris pilosa*, and no *Glycymeris insubrica*, (the common species that makes up almost 100% of the total assemblages, from Ashkelon to Haifa bay) were found alive.

The results of <sup>14</sup>C dating from six samples were incorporated with data previously obtained from 5 samples. The dates obtained in this research are all earlier than 2,300 BP (uncalibrated). In previous research they were revealed to be more than 1,150-1,500 years old. These dates substantiate the theory that the *Glycymeris insubrica* is probably extinct.

This research project is supported by a Recanati research grant of \$4,500.

**Dorit Sivan**

## THE UNDERWATER EXCAVATIONS AT CAESAREA MARITIMA 2002

The 2002 Caesarea underwater research field season took place between June 2<sup>nd</sup> and June 13<sup>th</sup>. Although there were only 8 underwater working days, work kept to schedule and the majority of the pre-planned tasks were properly completed (Fig. 1).

The expedition, whose base was the 'Old Caesarea Dive Shop', consisted mostly of staff from the Recanati Institute for Maritime Studies, with a total of 16 volunteers offering additional assistance, among whom were students from the University of Haifa (mostly from the Graduate Department of Maritime Civilizations).

The following staff participated in the 2002 excavations: Director — Avner Raban, Recanati Institute for Maritime Studies, University of Haifa (RIMS); Co-director — Eduard G. Reinhardt, McMaster University, Canada; Field Director — Areas CO, K and G — Gregory Votruba, RIMS; Field Director — Areas W1-4, Beverly Goodman, McMaster University; Survey Architect — Christopher Brandon, London, RIMS; Geomorphological studies — Krista Chomicki, McMaster University; Registrar — Karen Shokar, McMaster University; Operations Manager — Stephen Breitstein, RIMS; underwater

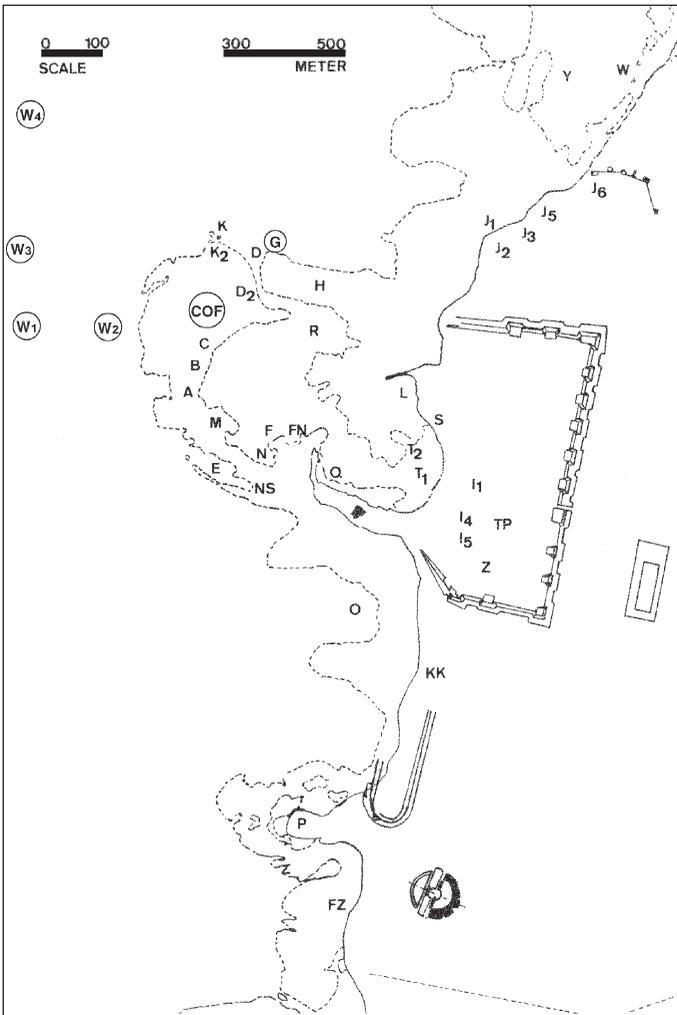


Fig. 1. Caesarea Harbor. General plan of excavation areas (Drawing: A. Yamim)

technology and photography — Amir Yurman, RIMS; Administrator and logistic backup — Yossi Tur-Caspa, RIMS.

**The field work**

The underwater work comprised two main research topics: 1. Sampling cobbles, timbers and hydraulic concrete — *pozzolana* — in order to determine their provenience and to establish whether these components are those which Josephus referred to when indicating “the remarkable thing about the construction was that he (Herod) did not use any local supplies suitable for so great a project; but it was brought to completion with materials imported from afar, at enormous expense” (AJ.15.332).

2. During the 2001 field season, a team of geologists from McMaster University of Hamilton, Canada, led by Joe Boyce, carried out both underwater and land surveys in Caesarea, using a digital proton magnetometer, calibrated by a very accurate DGPS, in order to detect any possible magnetic ‘anomalies’. The data have now been processed and plotted

on a series of maps where a number of the preliminary interpretations of ‘anomalies’ appear on the seabed as man-made features (Fig. 2). This year we attempted to probe some of the more promising ‘hot-spots’, in order to define their actual characteristics. Four such sites have been probed.

**Preliminary results and finds**

**COF** — the site, which was excavated during the 2001 season, is located along the northern side of the base of one of the larger blocks of *pozzolana*, towards the western end of area CD (see 2000-2001 Seasons’ reports). During last year’s excavations it was noticed that the concrete block lies over a cushion of rather large well-rounded cobbles of what seem to be calcareous rocks of highly compacted lower Cretaceous breccia, with various small plutonic particles. Preliminary visual observation suggested non-local types of rocks and the extensive size of the riverine cobbles do not match the size of those found along the Mediterranean coastline of Is-

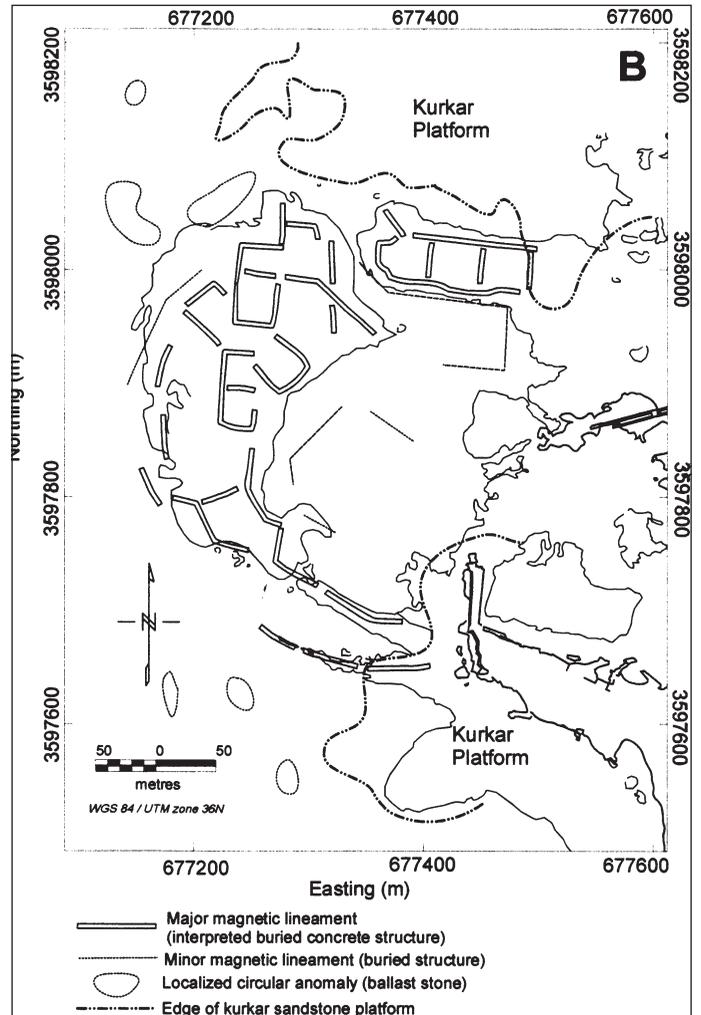


Fig. 2. Preliminary interpretations of magnetic anomalies following the survey carried out at Caesarea, using a digital proton magnetometer (Boyce et al.)

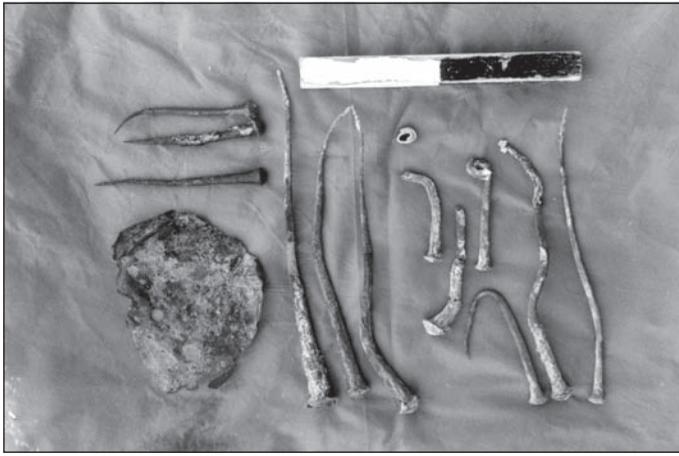


Fig. 3. Ship's nails and lead sheathing found in Area COJ, possible remains of a wreckage site (Photo: A. Raban)

rael. This year we extracted a selection of 20 cobbles from the re-opened probe, plus some additional ones from the southern side of the block (Area COG), just to verify that these stones are not a later post-Herodian period intrusion, such as ballast of a wrecked merchantman.

Such remains of a wreckage site were located this year at Area COJ, some 10 m west of COF and the concrete block. These remains comprise a number of pieces of detached lead sheathing and corroded ship's nails (Fig. 3) — the more durable components of an alleged ill-fated vessel that was found at the external face of the main western Herodian mole. The Tyrian silver half-shekel coins, dated to the late 20's and early 30's of the first century CE may allude to the presence of pilgrimages to the Jewish Temple in Jerusalem.

**K/2** — the northernmost concrete block at the tip of the main western mole of Sebastos. This block was exposed and studied by CAHEP and CCE during the late 80's and early 90's, the results of which were published in several scientific books. This year we again took samples of various components, both of the wooden caisson and of the hydraulic concrete, in order to determine their characteristics and probable provenience.

The results of tests carried out to verify the composition of the hydraulic concrete, should re-confirm earlier analyses made in Haifa and England. As for the wooden components, the various samples were sent to the archaeobotanic laboratory at Tel Aviv University to be studied by Nili Liphshitz, who has identified them as follows:

- \*Tenon fitting between two strakes — *Quercus coccifera* (oak)
- \*Treenail for the tenon — *Quercus coccifera* (oak)
- \*Corner upright post — *Cedrus libani* (cedar of Lebanon)
- \*Planking strake — *Pinus brutia* (Calabrian pine)

**Area G** — the wood-formed rectangular caisson at the NW tip of the northern mole of Sebastos, which was discov-

ered, excavated and studied by CAHEP during the early 80's. The special type of *pozzolana* from between the double walls has been analyzed before, but we sent some additional specimens for another set of analyses, using new techniques.

Samples of the wooden components were previously analyzed by Liphshitz *et al.* The strakes were then identified as "some type of non-local pine" (most probably a European type); the upright poles — as "unidentified conifer"; the chine (sleeper) beam — *Abies* (silver fir); a tenon fastening the lower strake to the chine-beam — as of "some kind of evergreen oak"; and its treenail — as "made of poplar".

Of the six additional samples that were retrieved and analyzed this year, two, from the chine-beam, one from the upright post and one of a strake, all proved to be *Pinus nigra* (Corsican pine); while a tenon and its fastening treenail were identified as *Quercus cerris* (Turkey oak). The partial discrepancies between the two series of tests, which were carried out at the same lab, demand further consideration.

### The trial probes outside Sebastos

Within the rather restricted time frame allocated for the field season we managed to carry out only a very preliminary series of four test probes, at sites designated as 'hot spots' or of excessive magnetic anomalies as recorded during Joe Boyce's 2001 magnetometric survey. Each spot was located by the DGPS and marked by buoys. Then, a series of air-jetting and water-jetting probes were carried out around each buoy. Wherever the probe rod encountered a coarse or impenetrable formation, we attempted a restricted trial dredging in order to expose and sample whatever was exposed.

**W/1** and **W/2** — are the western and eastern sides of an alleged circular feature, the diameter of which measures about 80 m. Our working hypothesis was that this feature is of dredged sediments from the nearby power station settling basin, which are regularly dumped in the open sea. Being aware of instances when the dredging within the basin had reached sub-bottom depositions, where archaeological remains (pottery, building stones and jettisoned ballast) may be found, we were not surprised to find quantities of worn sherds of amphoras, mostly of Late Byzantine date (late 5<sup>th</sup> to early 7<sup>th</sup> centuries CE).

**W/1** — found to contain only rather scattered rubble and some body sherds of 'Late Roman 2' and 'Gaza' jars.

**W/2** — the actual sandy seafloor at a depth of 10.4 m. Just below the seafloor there is a considerable quantity of worn body sherds of jars and amphoras of Late Byzantine dates. Below this, at a depth of 10.8-11.2 m, there is a concentration of partially exposed stone slabs covering a rather large area. The majority of the slabs are either *kurkar*



Fig. 4. Pottery sherds found in Area W/3.  
 1. Hellenistic East Greek bowl, 2. Herodian period 'Proto-Gaza' jar,  
 3. Lower part of a Cnidian amphora, 4-6 Cypriot cooking pot, Early Roman period (Photo: A. Raban)

or limestone, and a few are basalt. These slabs are laid in a rather compact, articulated manner with a fairly even horizontal surface. Some of the slabs are over 0.7 m long and the entire deposition can hardly be considered as having been jettisoned from a ship. The extensive coating of vermetides over all the slabs indicates lengthy exposure in shallow backwater, protected from the abrasive affect of shifting sands. This formation overlays a thick deposition of coarse sediments (pebbles, shells and shingle), devoid of artifacts and typical of a near-shore, high-energy environment.

Further excavation is necessary to give us a better understanding of this feature and its date. One possible explanation might be that it is the *in situ* remnants of articulated ballast, from the lower hold of a wrecked vessel, of which nothing else has survived.

At this point we considered the possibility that the 'hot spots' may indicate anchorage locations, where merchantmen would ride at anchor in the open sea, in an attempt to keep clear of the risky area of the submerged Herodian mole, as was probably the preferred practice during the Byzantine era (as attested to by Procopius Gazeus). In order to verify this assumption we moved on to check two additional 'hot spots' further north.

**W/3** — about 120 m NNW of W2, at a water depth of 10.6 m, under about 0.3 m of clear sand, the probe exposed a thin dark layer of a partially oxidized organic substance, probably recently covered seaweed. Below this, amongst a concentrated spill of rubble and some large slabs of schist, there were considerable quantities of pottery, comprising angular sherds of Early Roman containers and a complete carinated bowl of Cypriot type, all extensively reduced to a

deep grey color. Among them were the lower half of a Cnidian amphora, a 'Riley 1a' bag-shaped jar, Herodian 'Proto-Gaza' or 'Torpedo' jar, the upper part of an 'Eastern Sigillata A' Laginos, and three pieces of a cooking pot, probably of Cypriot origin (Fig. 4). Further expansion of the trench westwards exposed scattered wave-worn body sherds of 'Late Roman 2' and other 5<sup>th</sup>-7<sup>th</sup> century CE containers. To the east there were wave-worn sherds of 4<sup>th</sup> century CE amphoras, including 'Gaza', 'Egyptian', 'Cypriot' and a couple of 'African Red Slip' (ARS) bowls.

**W/4** — some 140 m further north of W/3, at a depth of 10.8 m. The sea conditions only permitted half a day of probing and preliminary dredging at this site. The casual and rather scattered finds (we missed the main part of the 'hot spot') comprised a few worn body sherds of the Late Byzantine era and large stone slabs (ballast?) of granite, grey porphyry, and black gabbro — no doubt the remains of jettisoned ballast.

Among the casual finds there were three metal objects: A bronze mini-bucket, with a mostly detached flat base; a bronze spoon; a rectangular slab of lead, most likely a standard balance weight, weighing 1,160 g.

### Suggested Reading

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**Avner Raban**

## DOR (TANTURA) 2002 SEASON

The 2002 excavation season at Dor (Tantura) was one of the most fortunate seasons ever at the lagoon. A very ambitious research program was planned but, as usual, all depended on the sea, which in fact turned out to be in our favor, with only one working day lost due to unsuitable sea conditions.

Three sites were excavated during the 2002 season: *DW2*, which was excavated for the third and probably the last time; Dor *2001/1* and *2002/2* were both excavated for the first time.

The *Dor 2001/1* wreck appears to be one of the most important finds to date, containing information that promises to make a major contribution to our knowledge of ship building technology of the period and of the transition in ship construction. Following the 2002 season, at least two additional excavation seasons are planned as part of a detailed research program concentrating on this wreck with wider social and economic scopes.

The *Dor 2002/2* wreck was naturally exposed just on the shoreline. Whether these are the remains of an unfortunate modern vessel, or of an earlier one, is yet to be determined. Meanwhile the wreck served as an excellent training site for underwater archaeologists. Excavation at this site began only when the working time-frame permitted the relocation of equipment from the *DW2* site. The latter, apparently an Ottoman wreck, was only partially reopened this year, in order to answer a few specific questions. Following a week of excavation, the wreck was covered with sandbags.

This project is part of a long-term cooperation held under the auspices of the Leon Recanati Institute for Maritime Studies (RIMS), University of Haifa, with Christopher Brandon, of the Nautical Archaeology Society of Great Britain (NAS), Kurt Raveh, of the local diving club Aqua Dora, and Ya'acov Kahanov of RIMS. The expedition was financed by the generous support of Lord Jacobs from London, with further contributions from the President, the Rector, the Research Authority and the Dean of the Faculty of Humanities of the University of Haifa, to whom all we are very grateful.

Following are detailed reports from three students: Hadas Mor, who has completed her M.A. studies and is looking to-

wards her Ph.D. program, which will focus on the *2001/1* wreck; Idit Yovel and Deborah Cvikel, who are both second year M.A. students, and are responsible for the *DW2* and *2002/2* wreck reports respectively.

**Ya'acov Kahanov**

## THE DOR (TANTURA) 2001/1 SHIPWRECK A PRELIMINARY REPORT

A water-jet probing survey was carried out in the Tantura lagoon in November 2001 by students of the Department of Maritime Civilizations. During the work, fragments of wood of at least two different species surfaced, indicating the possibility that a wreck had been located (Fig. 1).

The wood was sent for dating to the <sup>14</sup>C laboratories of the Weizmann Institute and the accelerator at the Swiss Fed-



Fig. 1. View of the Byzantine wreck (*Dor 2001/1*) at the end of the 2002 excavation season (Photo: N. Sheizaf)