Archaeology, Supp. Series no. 35, Portsmouth, Rhode Island, 1999, pp. 169-178.

Tsatskin, A. "The petrography of hydraulic and other building materials in Caesarea", op. *cit.*: 418-430.

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 towards 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 ^{14}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)

Fig. 2. Dor 2001/1. View of the midship section (Photo: N. Sheizaf)

eral Institute of Technology, Zürich. All the dates obtained were in the range of 3rd to 6th centuries CE, which is the late Roman-Byzantine era in this region.

Based on these results, it was decided that one of the main goals of this year's excavation would be to try and locate the suspected wreck, since the DGPS instrument was claimed to have an accuracy of "less than one meter". At first it seemed that we had failed, since after 2 days of searching at the reported wreck position and depth, no wood was found, only some pottery sherds typical of the lagoon, which were probably not *in situ*. Additional water-jet probing on the third day, on the southern and eastern sides of the excavation trench, resulted in more wood chips. This fruitful trial led to the dredgers being relocated about three meters from the center of the trench, and soon the ship began to appear. In retrospect we understood that we had initially been excavating at a DGPS position about 1.5 m from the actual hull.

The ship is orientated roughly North-West/South-East, about 70 m offshore, in sand, 2-3 m south-east of the lagoon's navigable channel, at a water depth of 1 m, buried under 1.5 m of sand. The total length of the find is 11.2 m, and the maximum width is 2.7 m. The hull remains include: keel, false keel, keelson, 32 frames with limber holes, planking, ceiling planks, chine beam, stringer and part of the mast step assemblage (Fig. 2). Although the southern end did not survive, its location can be extrapolated according to several indications: the general shape of the hull as shown by the frame edges; the hull convergence towards the south, indicated by the ceiling drop-strakes in this direction; and the outer surfaces of the frame closest to the edge, which were at an angle corresponding to the convergence of the hull. On the northern edge there are remains of a keelson, very close to the edge, probably about 1m being missing. Thus the total length of the hull was probably close to 13.5 m.

The ship was built 'frame-first' or maybe even 'skeleton-first', since we have not only the frames, but also the rest of the skeleton components – keel, false keel, keelson - which were constructed before the planks (Fig.3). First, the frames were attached to the keel by rectangular metal nails (4-8 mm each side), with room and space of about 24 cm. Then the planks were attached to the frames and the other skeleton components by what seems to be the same type of metal nails. The ship's shell planking was nailed to the frames from the outside, and the ceiling planking was similarly fixed from the inside. This gave two layers of planking, with the frames locked between them. No mortises or tenons were found. It seems that most of the frames were made in one piece, and only a few were a combination of floor timber and futtock scarfed together. However, this feature has not been fully investigated, since many frames are hidden under the ceiling planks.

The hull seems to be short and flat-bottomed. This form of vessel was evidently suited to carrying building stones. In the site were found 24 stones, some still *in situ*, piled in two layers of three rows, one next to the other. The stones are probably *kurkar* (coarse calcareous sandstone), with average dimensions 57 x 28 x 18 cm. Their origin is not known, and petrographic analysis will be made of the few samples which were taken.

As is usual in the Tantura lagoon, much pottery was found during the excavation, but its exact context is not yet clear. However, due to the nature of the lagoon it is impossible to say that it originated from this ship. A few large fragments of amphorae, some of the 'Yassi Ada 7th century' type, could belong to the ship.

This ship, with *Tantura A* and *Tantura B,* provides further important evidence that the transition from 'shell-first' construction to 'frame-first' orientation or 'skeleton-first' con-

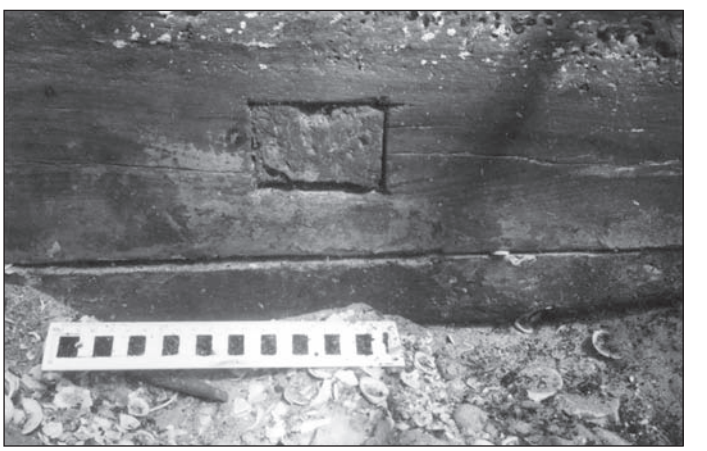

Fig. 3. Dor 2001/1. Details of keel and false keel (Photo: N. Sheizaf)

struction, without mortises or tenons, occurred in the middle of the first millennium CE.

Due to the short season, we only have preliminary data on the hull construction. Samples taken for ^{14}C and dendrochronology analyses will extend our knowledge, and at least two more seasons of excavation are required on the site.

Hadas Mor

THE *DOR (TANTURA) 2002/2* WRECK

A piece of wood emerging from the sand at the shoreline of Dor Lagoon after one of the winter storms caught the eye of Kurt Raveh, who came to the conclusion that it might be part of a wreck. The wreck was designated *2002/2* and excavated during one week of the 2002 excavation season (Fig. 1). The site is on the shoreline, about 30 cm below sea level.

Fig. 1. View of the Dor 2002/2 wreck (Photo: N. Sheizaf)

This posed the question of the excavating method: should it be a marine underwater excavating method or a land excavation one? What kind of equipment should be used in order not to damage the finds and to make this excavation a successful one?

To answer these questions Stephen Breitstein, of RIMS maritime workshop, was consulted, and he recommended conducting an underwater excavation using dredgers. All that was left was to figure out what would be the most efficient diving technique. Even though there was little time, it was decided that the first day would be 'trial and error day' in order to find the best way to excavate the site. Snorkelling, which was the first option, turned out to be impractical; using diving equipment turned out to be a better option. The weight of the divers' gear helped to stabilize them, in spite of the shallow water and the waves. Despite the initial concern regarding the excavating method and the content of the site, this turned out to be a good underwater shipwreck training excavation.

The excavated wreck is made up of two parts: what seems to be a stem or sternpost, and part of a hull. The stem is made of a reddish wood, possibly oak, and the hull is made of some sort of soft wood, possibly pine, and is covered with black sealing material, probably tar. The stem (or sternpost) assemblage is made of four components joined by a long iron nail. It is connected by a scarf with what seems to be the remains of the keel. At the scarf there is a 9 cm long stopwater or a wedge. The so-called keel is about 160 cm long and 7-10 cm molded. The longest element, designated W-1, is about 216 cm long and has a 100 cm long rabbet, which is 5 cm deep and 1-3 cm wide, where measuring was available. Another element, designated W-2, has three rectangular recesses. The length is about 10 cm, the width is about 6 cm and their depth 4-6 cm (Fig. 2).

The hull is constructed from planks nailed to frames using square-headed iron nails. The frames were set in pairs connected to one another by wooden treenails. The shortest frame was 50 cm long and the longest one 180 cm. The frames sided and molded measurements are pretty much alike, with small variations: the sided ranging from 7 to 12 cm and the molded ranging between 8 to 12 cm. The planks are partly broken off at their western end and covered with some kind of iron concretion at their eastern end. The longest plank measured about 4.5 m while the shortest one was only 1.5 m long. The planks are of different widths, but two of them are relatively narrow and might be patches, stealers or drop strakes. All the planks are 2-3 cm thick. The fact that no limber holes were found reinforces the assumption that this is indeed a part of an upper section of the hull rather than of the bottom.