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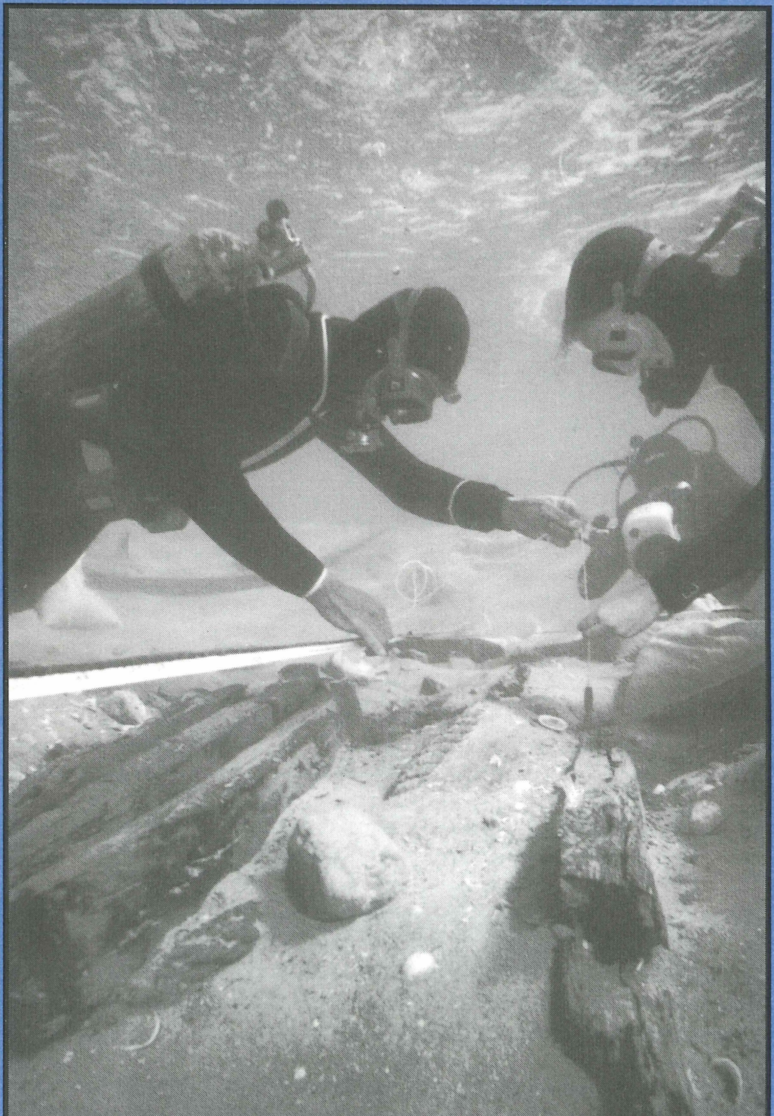

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On the cover: Members of the 1995 INA/CMS Joint Expedition to Tantura Lagoon record loose timbers and other organic remains in Trench VII. Photo: S. Wachsmann.

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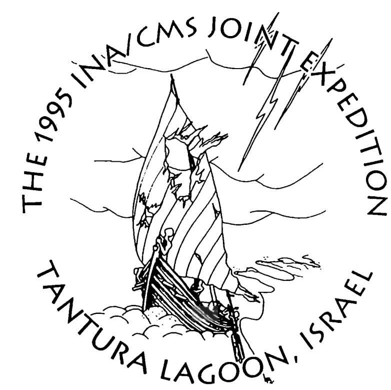
Shipwreck Fall:

The 1995 INA/CMS Joint Expedition to Tantura Lagoon, Israel

by Shelley Wachsmann and Yaakov Kahanov



Tantura is a little harbour which is in the dominion of the Emir Turabey. We had just arrived, when, because of the stormy weather a big Greek vessel ran ashore on a sandbank. It was loaded with Cyprian wine and cheese and was on its way to Egypt. As soon as it struck, it was broken into pieces by the waves...

THE CHEVALIER D'ARVIEUX'S DESCRIPTION OF A SHIPWRECK AT TANTURA IN 1664[1]

In fall 1994, we went searching for a shipwreck in Tantura Lagoon, located south of Haifa on Israel's Carmel coast.

What we found was an enigma wrapped in a mystery.

Searching under two meters of sand, an expedition consisting of faculty, staff and students from INA and the Nautical Archaeology Program at Texas A&M University, and from Haifa University's Recanati Center for Maritime Studies (CMS) and Department of Maritime Civilizations relocated a "shipwreck" that had originally been found during an Israel Department of Antiquities survey in 1983, and then briefly re-examined in 1985. At both times, only a small portion of the timbers had been revealed. However, they continued into the sand and were surrounded by large quantities of Byzantine-period (A.D. 324–638) ceramics, giving the impression of a shipwreck lying under its cargo. That impression was decidedly misleading.

Opening a large trench, our fourth of the season, in the sand blanket that covers the cove's floor, we were disappointed to discover that the timbers consisted of only a few charred hull planks lying upside-down over some frames. We were a shipwreck excavation without a shipwreck to excavate. The team's mood—not to mention its collective ego—was deflated.

Where was the shipwreck? Serendipitously, we had some clues. In two previous trenches (I and III), cut while searching for the 1983 "shipwreck," we had uncovered a layer of Byzantine-period ceramics "floating" in the sand to the north of the timbers. This layer seemed to flow in a north-south direction.

Might the timbers and pottery be the remains of a ship, and its cargo, that had wrecked on entering the lagoon? Perhaps its shattered hull and cargo had been smeared across the cove and then buried under a blanket of sand by the hand of the strong north-to-south current that sweeps through the lagoon during storms. The Chevalier d'Arvieux, in his eye-witness account of a seventeenth-century shipwreck at Tantura, seems to be describing a similar situation. If this hunch was correct, then the ship, or at least part of it, might lie somewhere to the north of Trench IV.

[1] Wachsmann and Raveh 1984: 231. Translation from the eighteenth-century German by Ms. Marianne Habrichs. See Dahl 1915: 124–126.

We could not, however, continue excavating time-consuming trenches indiscriminately in hopes of locating the hull. Therefore, we began a systematic hydraulic probe survey. The hydraulic probe is a narrow-diameter three-meter long pipe attached to a fire pump by a flexible hose. In this method, a moveable base-line is tied at either end to heavy weights and placed on a defined compass bearing. The probe is then drilled into the sand at short regular intervals along the base-line. This process is repeated by moving the base-line in narrow parallel increments. The pressure of the water moves the sand and other sediments, permitting the pipe to penetrate down to the virgin clay substrata beneath the sand. If, during its voyages through the sand, the pipe hits waterlogged wood, small fragments of it are broken off and float to the surface, thus indicating a buried timber anomaly.

This "retrograde technology" works surprisingly well. In the course of searching for the shipwreck, we twice located timbers that, upon further examination, were revealed to be lead-filled wooden stocks of wooden anchors. Finding these stocks—barely twenty centimeters across, and about two meters in length—under two meters of sand, is the archaeological equivalent of finding a needle in a haystack.

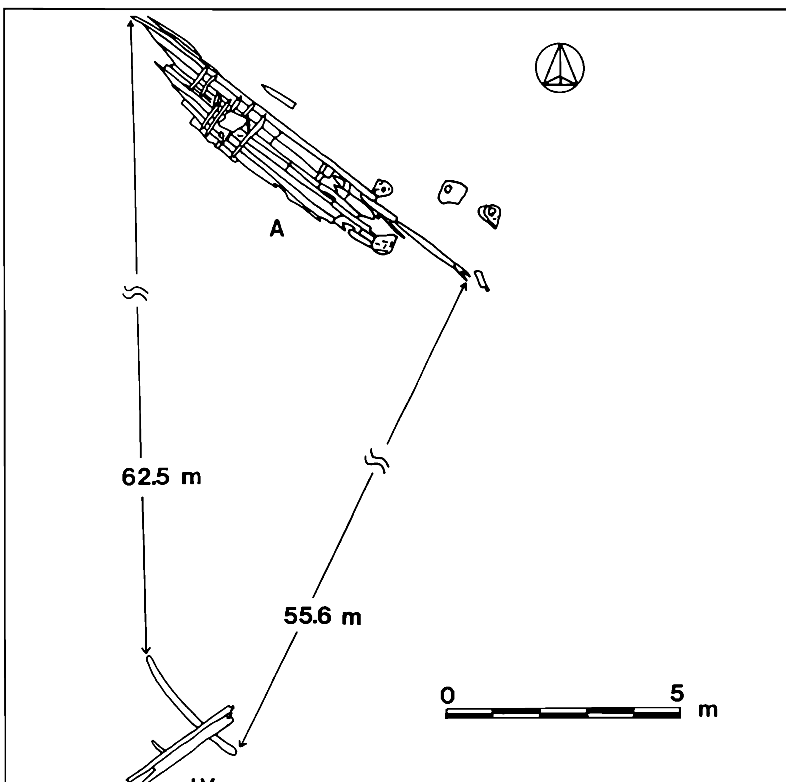
Then, one day the probe team located two adjacent wooden anomalies, situated about sixty meters north of the Trench IV timbers. Enlarging this area (Trench VI), revealed a significant part of a shipwreck (fig. 1; see also *INA Quarterly* 22.2, 3 [figs. 1–2], 4 [fig. 3], 10 [fig. 1]).

The hull had been badly damaged—literally ripped apart—when it sank. Almost the entire northern half of the hull was missing, as was most of the southwestern quadrant. Most of the frames (together with the cargo?) had been ripped out of the surviving planking when the missing parts of the hull disengaged from them. Some planking bore evidence of charring, similar to that on the Trench IV planking. Had the ship sunk due to a fire on board?

Most perplexing, however, was the consideration that, despite the fact that we found Byzantine-period ceramics overlying the hull (fig. 2), our preliminary study did not reveal any evidence for mortise-and-tenon joinery. We knew, from the later, seventh-century A.D. Yassıada shipwreck, that unpegged tenons were still being used at that time to align some planks. The earliest documented Mediterranean vessel built entirely without mortise-and-tenon joinery was the eleventh century A.D. Serçe Limanı hull.

Why did our hull lack mortise-and-tenon joints? Perhaps, we conjectured, the Byzantine period ceramics that we found on it had come from a nearby, earlier, shipwreck, and had been subsequently washed into the hull by the current.

Unfortunately, at this point Poseidon decided to complicate matters even further. Weeks of continuous bad weather followed, preventing us from diving on the site. The 1994 season ended with many perplexing questions,



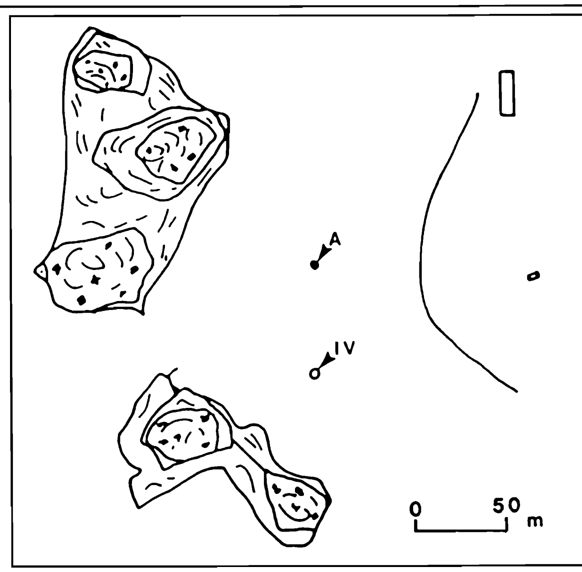


Fig. 1. *The Trench IV hull fragment consisted of several planks and frames, mixed together with Byzantine-period ceramics. Now believed to be part of the hull and cargo of* Tantura A, *from which it is separated by a distance of about sixty meters.*

Drawings: P. Sibella

but few answers. Subsequently, a set of three radiocarbon tests carried out on a single large splinter removed from an outer edge of the ship's keel supplied a date ranging from the mid-fifth through the mid-sixth centuries A.D. (see *INA Quarterly* 22.2, 12). Thus, the ceramics and the radiocarbon tests seemed to indicate a Byzantine-period date for the hull, while the construction techniques appeared to place it centuries later.

Our second season of exploration took place in the fall of 1995, from mid-October to mid-December. We now call the Trench VI hull the *Tantura A* shipwreck. During the expedition, team members logged over 600 diver-hours during 217 recorded field-related tasks. The team recorded over 250 points on the hull and associated artifacts, by measuring them from six fixed points, each known as a datum. We employed a three-dimensional computer program (WEB), specifically designed for use in nautical archaeology, to process this information. Additionally, team members took many direct measurements, and copied some constructional details, at 1:1 scale underwater, on mylar. We also generated a black and white photographic record of all timbers, with fifty percent overlap, from an average distance of 30 centimeters (about 12 inches) with a Nikkor 15 mm lens. Particular emphasis was placed on collecting numerous macrobotanical and palynological samples for analysis.

Photo: S. Wachsmann

Fig. 2. *Byzantine-period sherds were found "glued" to the hull planking with resin. This is conclusive archaeological proof of the ship's Byzantine date.*

The expedition accomplished its main objective: completing *in situ* study of *Tantura A*. Additionally, a hydraulic survey in its immediate vicinity revealed remnants of other hulls.

About twenty-five percent of *Tantura A's* hull bottom is preserved (fig. 3). The keel is preserved for a length of 5.2 meters; it has a rectangular cross-section, 11 centimeters sided (wide) and 18 centimeters molded (high). Except for the preserved post, the keel does not have a rabbet. Bolts had connected the frames to the keel.

Eight frames survived. The longest is 1.31 meters (9 centimeters sided and 9.5 molded). There is evidence for seventeen additional frames. The situation is eight framing timbers in seven stations, twenty staining patterns in seventeen stations, all together twenty-four frame stations.

Tantura A's eight partially preserved strakes are, on average, 2.5 centimeters thick, and vary in width from 3.8 to 26 centimeters. The southern garboard, which is the longest surviving strake, is 8.78 meters. Iron nails—driven from outside the hull—connected butt-scarfed planks and drop strakes to the frames. Despite a meticulous search, no mortise-and-tenon joints were found on any of the visible planking edges, nor on the sides of the keel.

All these timbers, which have a total length of 9.02 meters, suggest that the vessel was originally about twelve meters long and approximately four meters at its widest point.

Taking a "forensic pathologist's" view of *Tantura A's* demise, one notes that the preserved part of the ship must have come to rest in its present position before it broke up entirely. Otherwise, it would be difficult to explain the near-perfect alignment of the surviving strakes, despite the fact that almost all the frames holding them together had been ripped out when the missing section(s) separated from the hull. This event also apparently caused the dispersion of the ship's cargo.

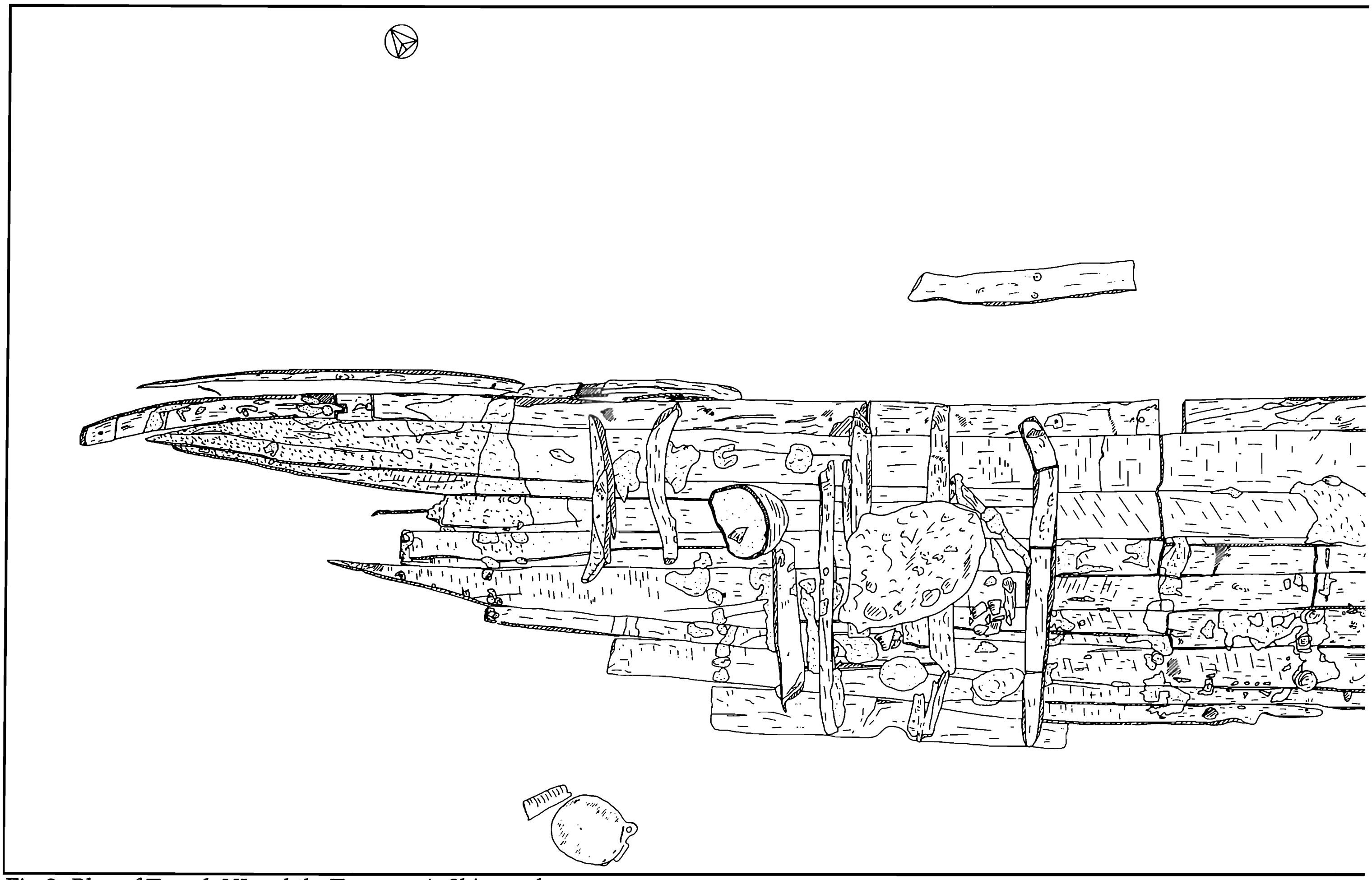


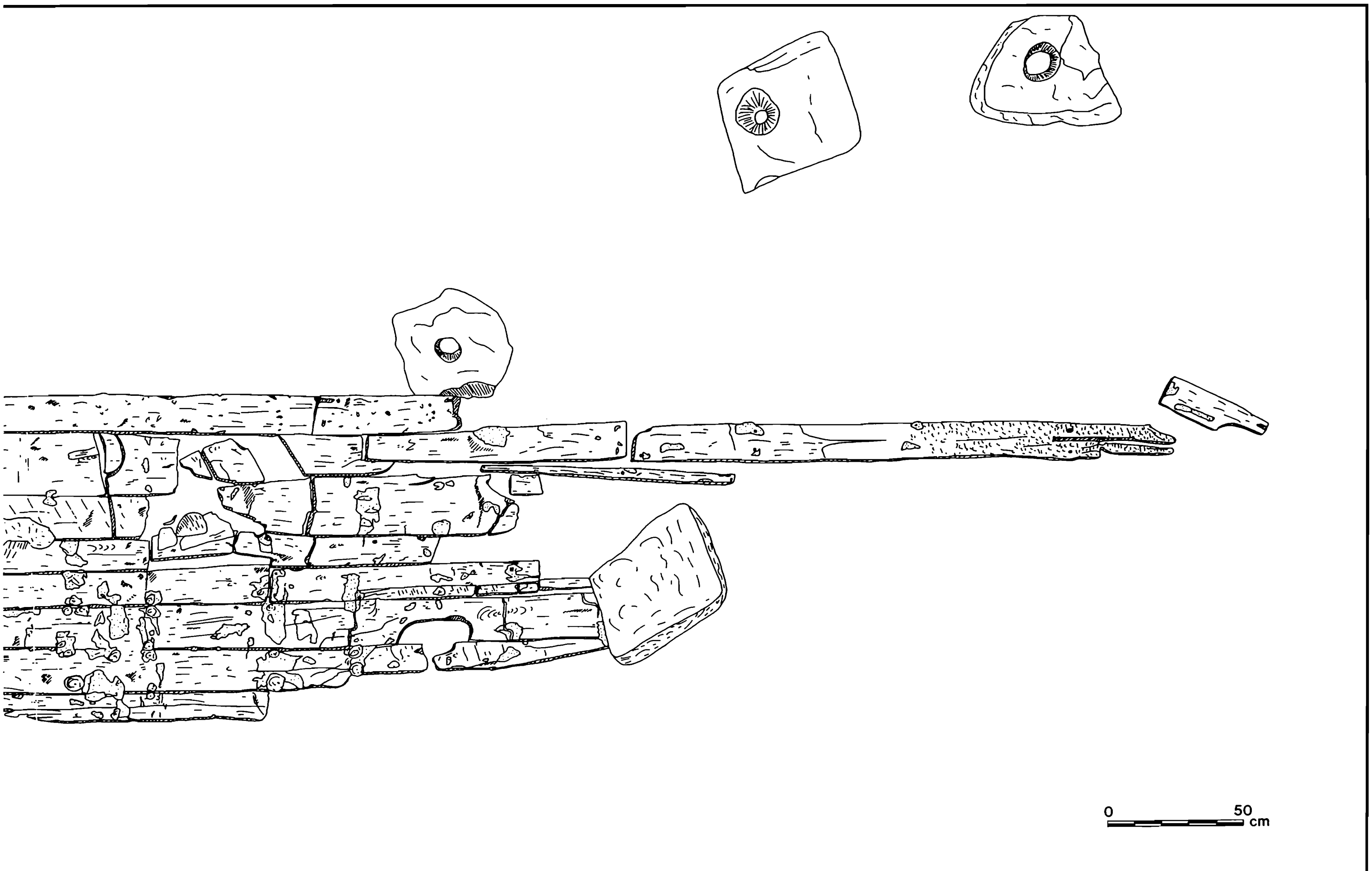
Fig 3. *Plan of Trench VI and the* Tantura A *Shipwreck.*

We also found Byzantine-period sherds glued fast with resin to the planking amidships, thus confirming that the pottery does indeed belong to—and date—the hull (fig. 2). Cordage was preserved in several locations near the post, *beneath* the hull. Apparently, the ropes belonged to the ship, which became entangled in them when it sank.

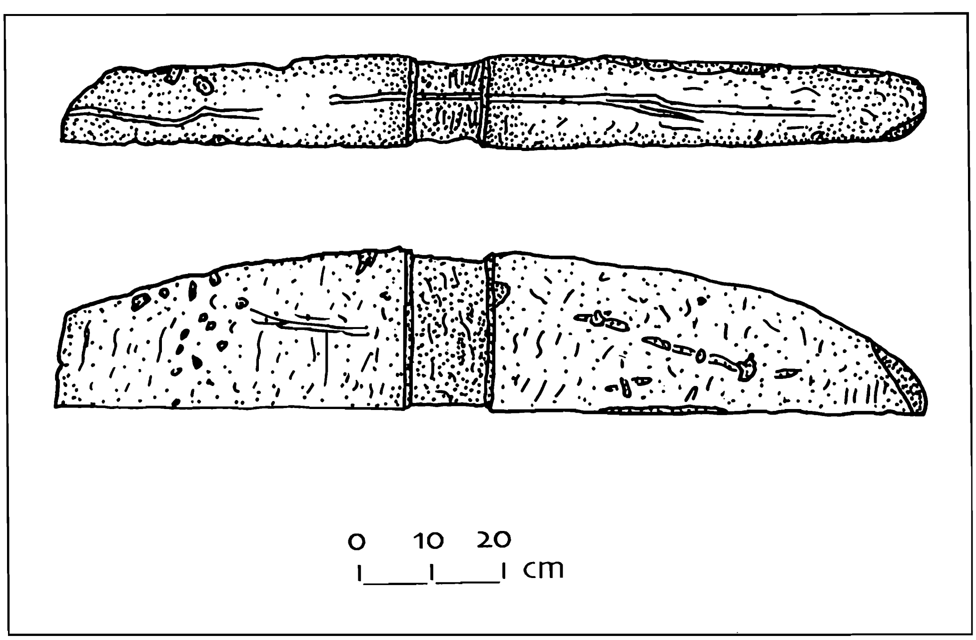
We discovered that the charring on *Tantura A* continued *beneath* the frame stations near the post, indicating that the burn marks are not the result of a haphazard blaze, but rather that the planks were charred *prior to* their attachment to the frames. Furthermore, the charring was localized to the extremities of the strakes: in the northwest, where they join the surviving post, and at the southeast end of the southern garboard. These considerations led J.R. Steffy to conclude that the burn-marks are the result of "char-bending," a process in which water-soaked planks are bent to shape as they are heated over a fire. Thus, the reason that charring was located specifically at the ends of the hull was because that is where the strakes receive their strongest curvature, bending inward to meet the posts. This is the earliest recorded evidence for this process on planked-hull ship construction.

Thus, at present this modest little coaster is the earliest recorded Mediterranean hull in which mortise-and-tenon joinery was no longer employed. As such, it signifies an important transition point in the gradual evolution of Mediterranean hull construction. The vessel was built with the innovative methods that were to evolve more fully and to become standardized during medieval times. Steffy notes that this change was likely to have taken place first on small vessels, like *Tantura A*, which required lighter timbers, allowing the shipwrights to do away with the mortise-and-tenon joints that by then were used solely to align some planking on larger contemporaneous ships, such as the seventh-century A.D. shipwreck from Yassıada.

Rarely is stratigraphy encountered while excavating shipwrecks. Tantura Lagoon, however, is so abundant in antiquities, that we repeatedly found meaningful stratigraphical configurations. For example, the keel of *Tantura A* came to rest on two stone anchoring devices that had



Drawing: P. Sibella



Drawing: P. Sibella

Fig. 4. *The stone anchor stock found beneath* Tantura A's *keel.*

reached the seabed before it. In the northwest, the hull landed on an upside-down 52 kilogram stone anchor stock, used to trip a wooden anchor. The stock predates the hull by about a millennium (fig. 4; see also, *INA Quarterly* 22.2, 6, fig. 7). Three pierced stone anchors were found in the south-eastern portion of Trench VI (fig. 3). These vary in shape and material; whether they were deposited as a group remains unclear. One limestone anchor is rounded, and partially underlies the keel (fig. 5). A second anchor, made of an as yet unidentified green stone, weighs 83.5 kilograms and has an asymmetrical shape generally associated with Bronze Age (*circa* 3000–1200 B.C.) anchors: it lay, however, *upon* Persian period (586–332 B.C.) pottery (fig. 6). Thus, the anchor cannot predate that period, and requires us to reconsider the generally early date assigned to stone anchors of similar shape and size found on the seabed without archaeological context.

Photo: S. Wachsmann

Fig. 5 (above). *The round stone anchor situated partially beneath* Tantura A's *keel.*

Photo: S. Wachsmann

Fig. 6 (left). *An asymmetrical anchor rested upon Persian period sherds, which are partially visible near the centimeter stick.*

The 1995 hydraulic probe survey was carried out in search of missing sections of the *Tantura A* hull, in its immediate vicinity. No additional parts of *Tantura A* were located. Nevertheless, the results were far from disappointing. We discovered remnants of at least four, and possibly five, additional shipwrecks.

Immediately northwest of *Tantura A* , in Trench VII, the probe revealed a deposit of ten disarticulated frames and a single plank at a depth of only 1.5 meters beneath sea level (fig. 7 and cover). This site also contained fragile organic materials, including long spans of rope, basketry, and even some dyed cloth. One of the ropes ended in an eye-splice, while another was knotted. It appears that all these artifacts derive from a single vessel. Radiocarbon testing of one of the Trench VII timbers assigns this assemblage a relatively recent date, probably to the eighteenth century A.D.

West of *Tantura A*, in Trench VIII, the team revealed a large hull, situated along a southeast to northwest axis, the limits of which were determined on the northwest side, where the ship had been broken and the keel ripped apart (fig. 8). In the southeast, however, we did not reach the full extent of the preserved hull. The vessel has a large keelson with a rectangular mast-step cut into it. At the southeastern end of the excavation, a smaller centerline timber is secured above the keelson.

This hull lacked datable artifacts, but a radiocarbon test places it *circa* A.D. 680-850. Its date makes this vessel a particularly important discovery, as it may fill the gap in our knowledge of Mediterranean hull construction between the early seventh-century A.D. Yassıada shipwreck and the early tenth-century A.D. vessel currently being excavated at Bozburun, Turkey.

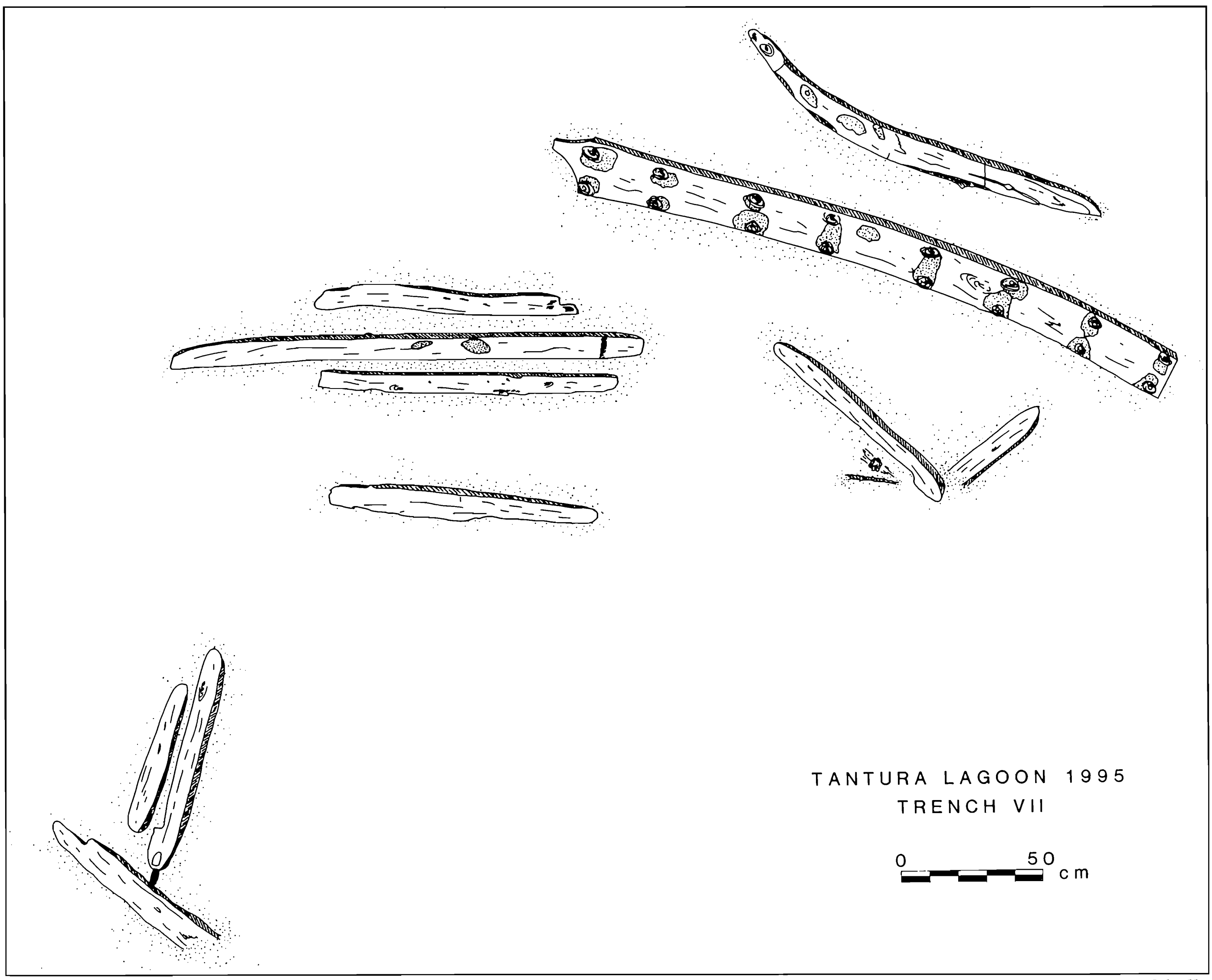


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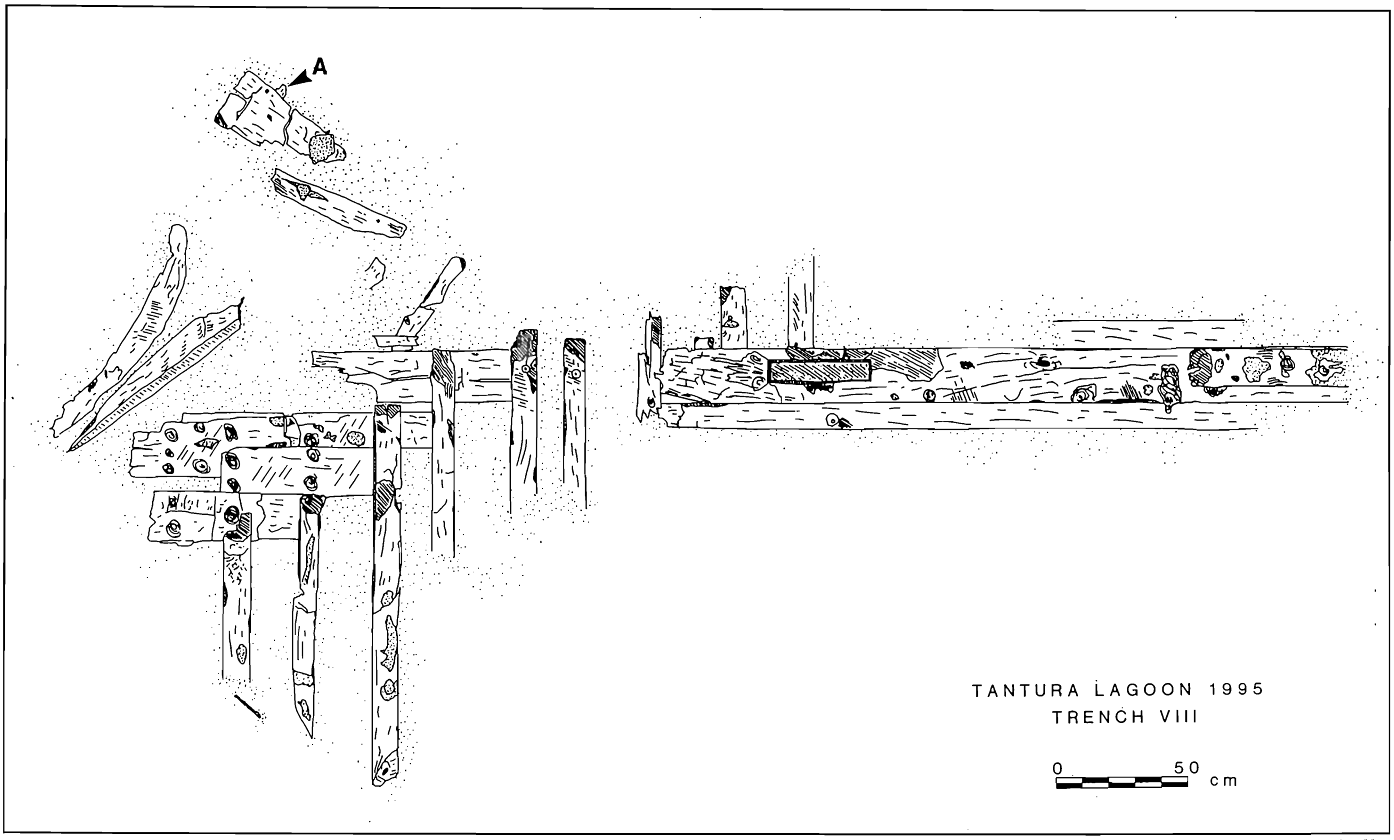
Fig. 7. *Plan of Trench VII.*



Drawing: P. Sibella

Fig. 8. *Preliminary plan of the shipwreck in Trench VIII. One plank (A), bears two pegged mortise-and-tenon joints and is associated with third- or fourth-century A.D. pottery; it suggests the existence of another, earlier shipwreck located near Trench VIII.*

A single short plank bearing two pegged mortise-and-tenon joints was situated at the northwest corner of the trench (fig. 8: A). Associated with the plank were quantities of third- or fourth-century A.D. Roman-period ceramics, some in mint condition. These artifacts strongly suggest the existence of yet another, earlier shipwreck and cargo nearby.

At the very end of the season, another large shipwreck was discovered east of *Tantura A* in Trench IX (figs. 9–10). As this hull was situated in an area often deepened by the channel that runs through the lagoon, the uppermost surviving timbers had been badly damaged by teredo.

We uncovered one extremity of the keel. A false keel continues forward of the keel and is then slotted back into its end (fig. 11). There are numerous, heavy stringers, most of which are only roughly finished. A transverse timber situated above the frames and stringers has a groove along the length of its upper surface and, therefore, may be the seat for a removable bulkhead (fig. 12).

Much of the area of this hull that we revealed is covered by ceiling planking. Between the end of the keel and the transverse timber the planking is laid longitudinally. Beyond the timber, towards amidships, however, the ceiling planking is placed perpendicular to the keel. Two graffiti were noted—a cross covered with an arc, and a delta—carved into ceiling planks. Two large well-cut ashlar stones, clearly still in their original alignment, sit upon the ceiling planking.

The Late Byzantine-period pottery found lying upon, and between, the timbers is undoubtedly associated with the hull and, therefore, dates it. The date is confirmed by a single radiocarbon test result of A.D. 553–645. This makes the Trench IX hull roughly contemporaneous with the Yassı Ada seventh-century A.D. shipwreck, although the Tantura vessel appears to be better preserved.

Some areas that we examined beneath the sand cover of Tantura Lagoon are remarkably homogenous in terms of the artifacts located in them. In others, items of a wide-range of dates are found mingled together. This is the case of a minor sondage, designated Float 2, in which we found a single frame (fig. 13). Preliminary study suggests that this frame does not conform to any of the other ships/timbers discovered. This site also contained a potpourri of pottery of a varying date, all mixed together. Of particular interest is the upper portion of an Early Iron age (late-eleventh to early-tenth centuries B.C.) amphora, the third example of this jar-type to be surrendered by the lagoon.

During the 1995 campaign we returned to study the anchor stock discovered in 1994 in Trench IA (fig. 14). The oak stock is broken at a quarter of its 2.10 meter length. It is loaded with four lead weights. Four square holes are cut on the stock's upper and lower sides opposite the centers of the weights and its center is recessed for attachment to the anchor's shank (fig. 15).

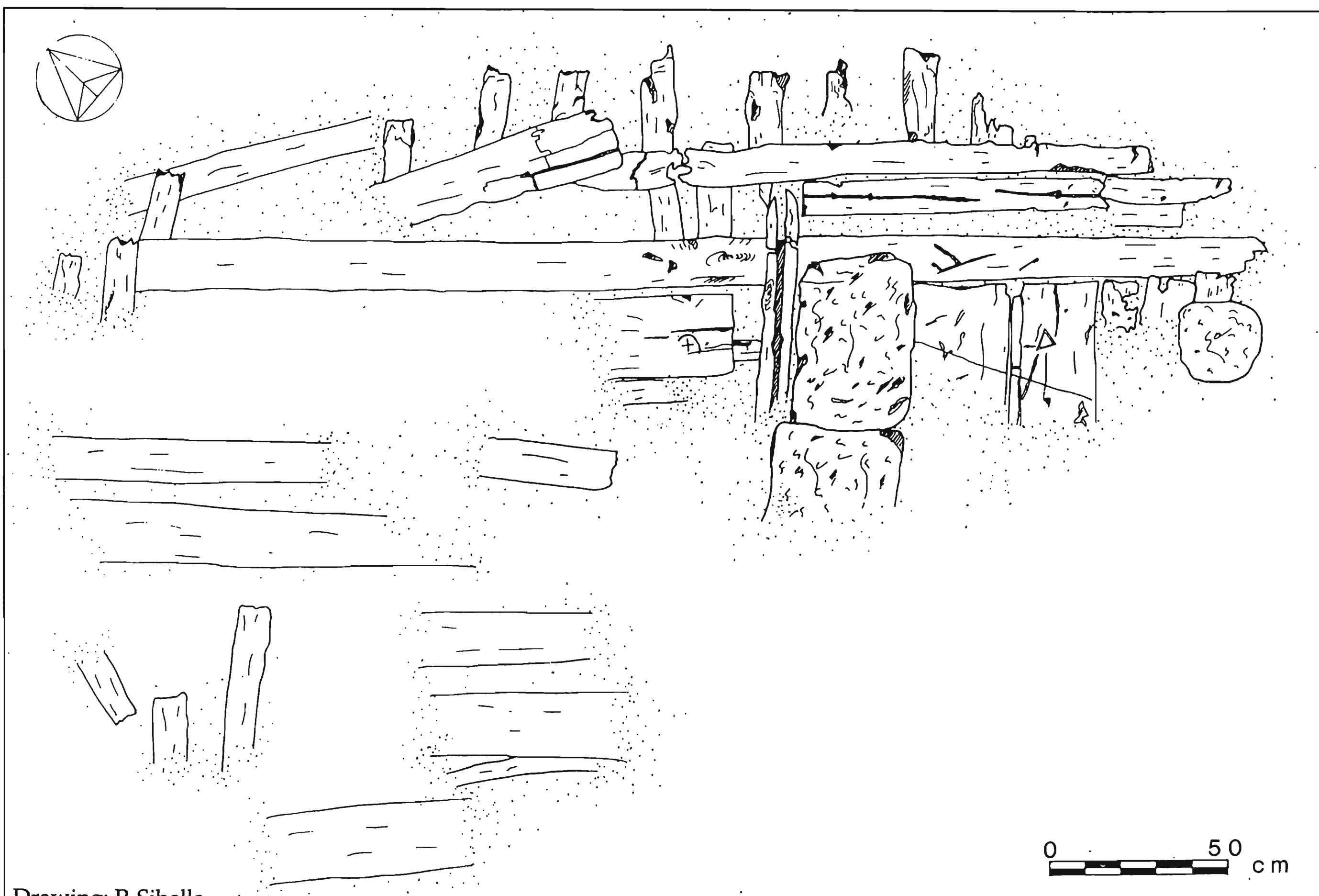
This stock is associated with smashed jars of Persian-period (586–332 B.C.) vintage. The contents of one jar had flowed over—and now adhere to—part of the upper surface of the stock, indicating that the jars and stock probably reached the seabed together.

Lead isotope analysis carried out by S. Stos-Gale (Isotrace Laboratory, University of Oxford) on lead from the stock indicates that it is consistent with ores mined in the Troad, specifically from the deposit at Altinoluk on the Aegean coast. A second possible source is the eastern Rhodpi Bulgarian deposit of Madjarovo.

Photo: S. Wachsmann

Fig. 9 (right). *The Trench IX Byzantine-period shipwreck. View towards the northwest.*

Fig. 10 (below). *Plan of Trench IX.*



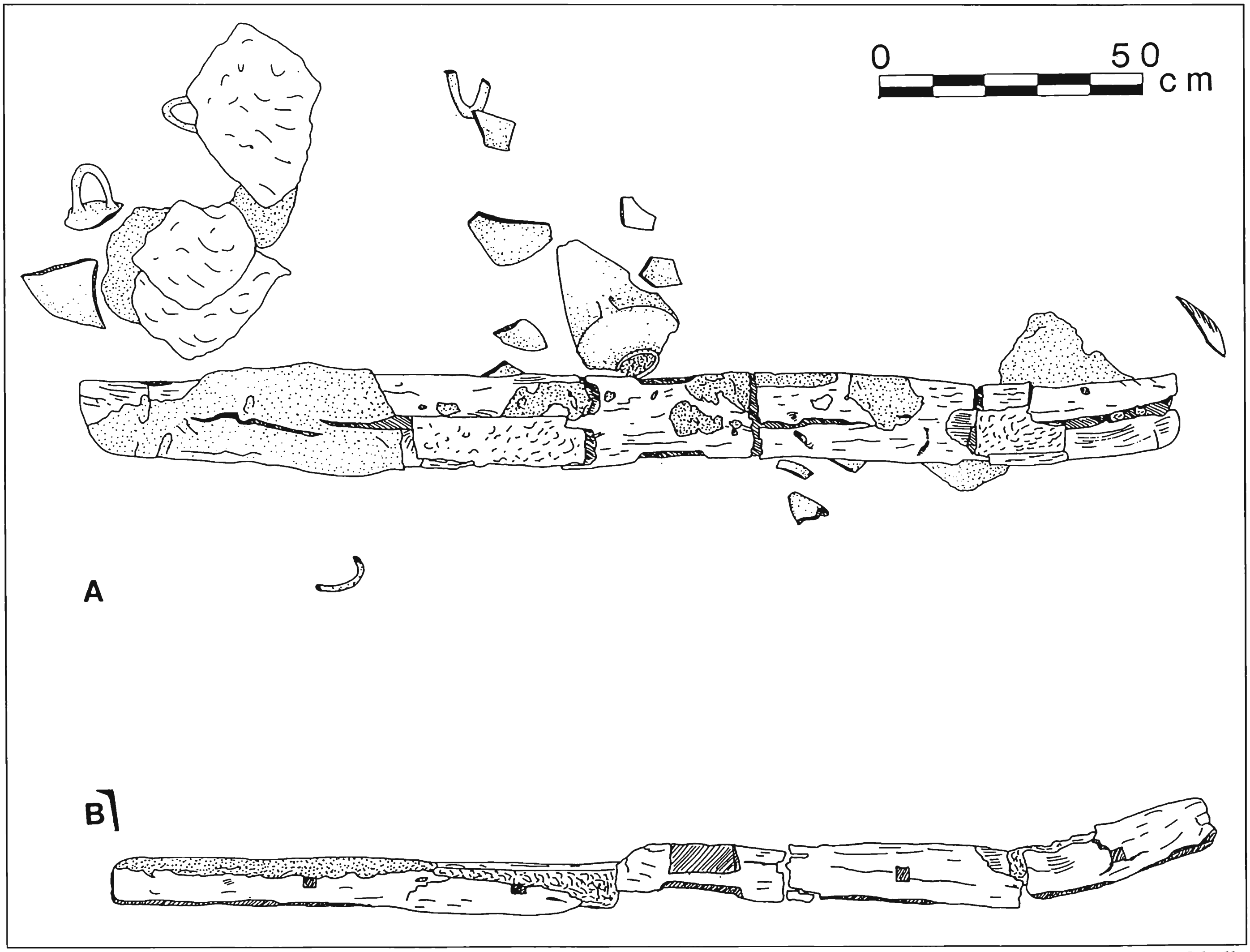
Drawing: P. Sibella

Fig. 11 (above). *The keel/false keel attachment at the northwest end of Trench IX. Note the rabbet at the top of the keel. View facing northeast.*

Fig. 12 (right). *Trench IX. The grooved transverse timber.*

Fig. 13 (below). *The frame found with a potpourri of pottery of varying date at the Float 2 sondage.*

Photos: S. Wachsmann



Drawing: P. Sibella

Photo: S. Wachsmann

Fig. 14 (above). *The Trench IA lead-filled wooden anchor stock in plan (A) and profile (B) views.*

Fig. 15 (left). *The recessed central part of the Trench IA anchor-stock's upper surface, where it attached to the anchor's shank.*

We can learn much about the Tantura shipwrecks, their cargoes, and crews, as well as the diet and hygiene—or lack thereof (!)—through paleoethnobotanical study. Twenty-five kilograms of organic-rich materials—from bilge mud, resins and other residues—were collected during the 1995 expedition and brought back to Texas A&M University's Paleoethnobotanical Laboratory for study (fig. 16). These will form the basis for an MA thesis by S. Butler, a graduate student in the Nautical Archaeology Program. While Butler's research is still in a preliminary stage, it has already begun to supply us with an additional dimension of life aboard the ships that we are excavating.

One sample of bilge mud removed from near the keel of *Tantura A* contained a potpourri of fossil pollen from nineteen taxa, while other types remain unidentified. Olive (*Olea europaea*) is the most common domesticated plant represented, with cereal pollen second in quantity. Other significant fossil pollens include grape (*Vitis* sp.), hazelnut (*Corylus*), sumac (*Rhus*), terebinth (*Pistacia* sp.), and palm (*Areacaea*), as well as several species of umbels, a family that includes many spices, such as caraway, celery, cumin, and dill.

The sample also contained three hemp (*Cannabis sativa*) pollen, which perhaps came from the vessel's cordage. The only pollen grain identified from a sample of rope comes from cordage compressed between the keel and the anchor stock. The grain is of wild grass.

The most common seed type was wine grape (*Vitis vinefera*).

Photo: S. Wachsmann

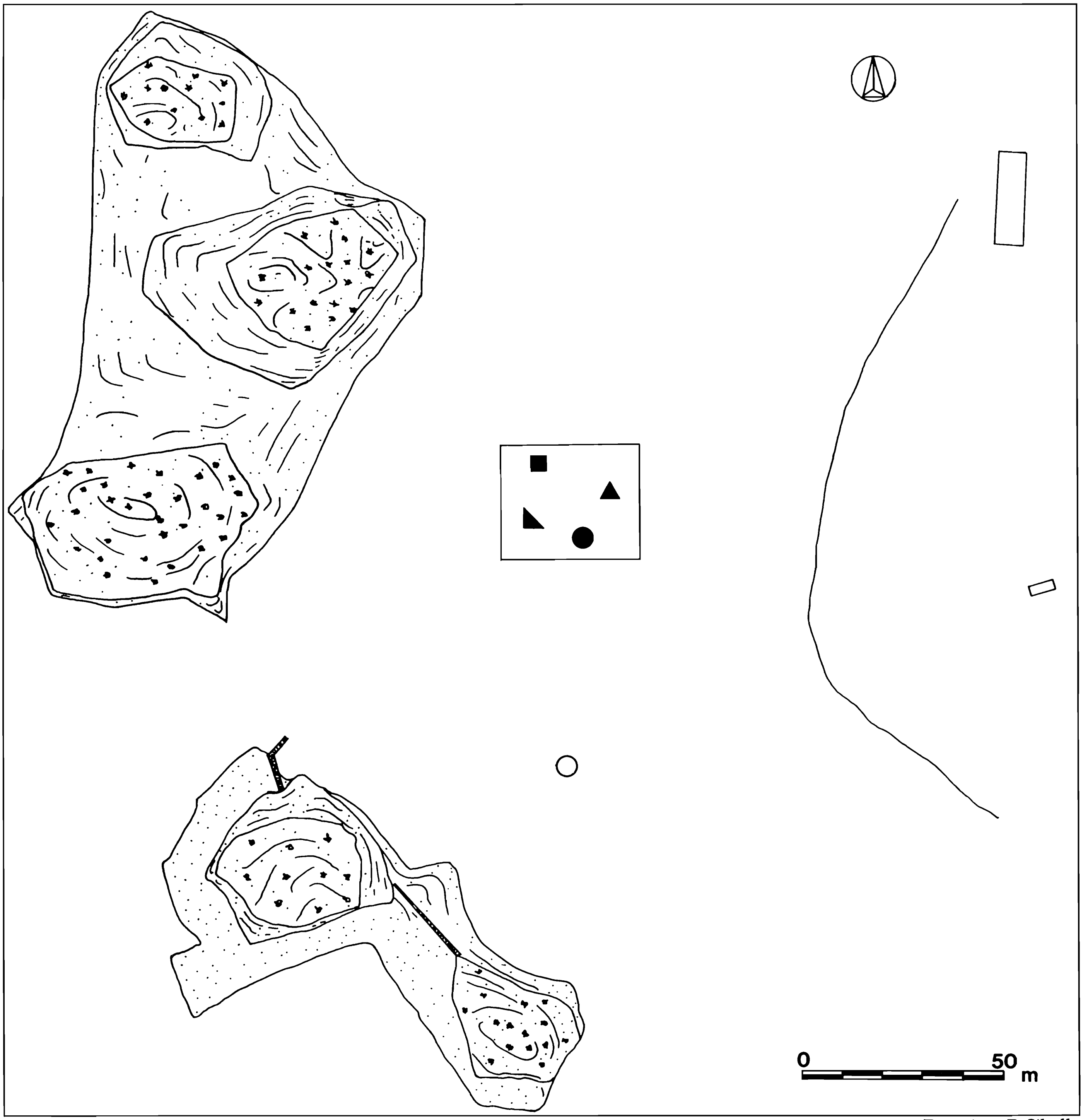
Fig. 16. *Team member Andrew Lacovara collects organic-rich sediments from* Tantura A's *bilge for paleoethnobotanical study.*

All the shipwrecked remains described above are located in a remarkably small area. This concentration of shipwrecked remains in the negligible portion of the cove surveyed to date, when taken spatially, looks like nothing so much as the underwater equivalent of a massive turnpike pile-up (figs. 17–18). Taken chronologically, however, these vessels—or parts thereof—stretch over nearly two millennia.

Clearly, Tantura Lagoon is a remarkable ship graveyard. And, just as clearly, we have barely begun to reveal the cove's abundance. Pottery recovered from the lagoon includes materials dating to some periods for which we know virtually nothing at all about the ships in use. If these pottery remains are wash-off from shipwrecks still buried under the cove's shifting sands, as in the case of *Tantura A*—which seems likely—then they suggest a treasure trove of archaeologically and historically significant shipwrecks. As the area adjacent to Tantura Lagoon has been inhabited for at least four millennia, there are few Mediterranean ports that are likely to contain within them remains from such a wide swath of history.

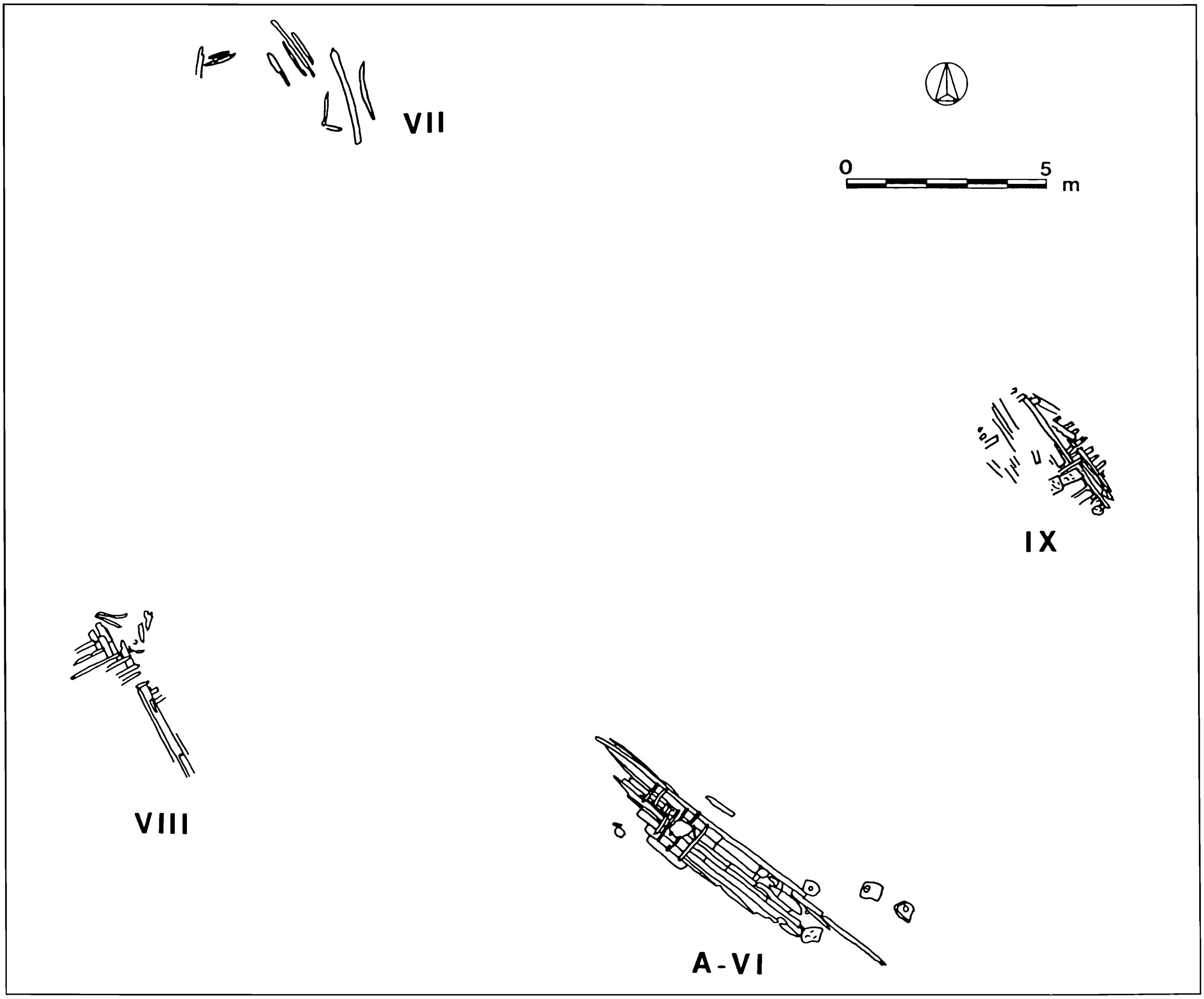
The earliest pottery found in the cove dates to the Middle Bronze Age IIA (*circa* 2000–1750 B.C.). Nearby, Dor, a tel or artificial mound that contains occupation levels fifteen meters (nearly fifty feet) thick, was founded at this period. While other nearby, less-protected coves also may have served shipping, there can be little doubt that Tantura Lagoon was a primary—if not *the* primary—reason for the site's establishment at this location.

In 1075 B.C. Wenamun, an Egyptian priest on a mission to bring cedar wood from Byblos in the Lebanon for the barque of the god Amun, visited Dor and was robbed in its harbor (Tantura Lagoon?). Wenamun reports that in his time the city was inhabited by the Sekels, one of the groups of Sea Peoples who had invaded the Levant, bringing an end to the Bronze age cultures. (In the Bible, the Sea Peoples who eventually settled along this coastal area are known collectively as the "Philistines," after the largest group of invaders.)



Drawing: P. Sibella

Fig. 17. *Map of the southern portion of Tantura Lagoon. The symbols inside the rectangle represent the locations of shipwrecks and collections of timbers studied during the 1995 excavation season. For more detailed maps of these, see below, pp. 6–7, fig. 3 and p. 16, fig. 18.*



Drawing: P. Sibella

Fig. 18. *"...like a massive turnpike pileup." Map of shipwrecks in Tantura Lagoon studied in 1995 by the expedition.*

During the Persian period (586–332 B.C.) the Phoenicians—considered the quintessential seafaring traders of antiquity—ruled this coast. Dor was a Sidonian port city. Our discovery of a large "flow" of Persian period artifacts—ceramics and, perhaps, the anchor stocks as well—suggests that a ship from that period came to grief inside the port, possibly quite near the area currently under study.

During the Hellenistic period (332–37 B.C.) Dor was besieged by land and by sea at least twice—in 219, and again in 139–138 B.C. This raises the fascinating possibility of uncovering remains of Hellenistic war ships and their equipment, similar to the Athlit Ram found nearby.

In the Roman period, Tantura Lagoon could not compete with Herod the Great's newly constructed harbor-works at Caesarea and, by the mid-third century A.D., occupation on Tel Dor had ceased. By the mid-fourth century A.D., however, a church was constructed on the skirt of the tel. It continued in use until the seventh century and appears to have been a focal point of Christian pilgrimage during the Byzantine period.

In medieval times, the Arab village of Tantura sprang up directly opposite the lagoon to which it gave its name. There are numerous records of visitors to the cove. None, however, was as illustrious as Napoleon Bonaparte who visited Tantura during his disastrous retreat from Acre on May 21st, 1799 (fig. 19). He expected to rendezvous with his fleet in the lagoon. When they did not arrive, Bonaparte was forced to jettison into the sea a score of cannon. Two of these were found by K. Raveh during Israel Department of Antiquities and Museums underwater surveys.

In the nineteenth century the cove continued to function as a port, primarily for the trade in watermelons and charcoal. Since the establishment of the State of Israel in 1948, two Jewish settlements, Nahsholim and Dor, have continued the long history of habitation of this area. Today the cove is one of the most popular beaches in Israel, while also serving as a harbor for local fishermen.

Slowly, this history-rich cove is beginning to reveal to us her archaeological abundance.

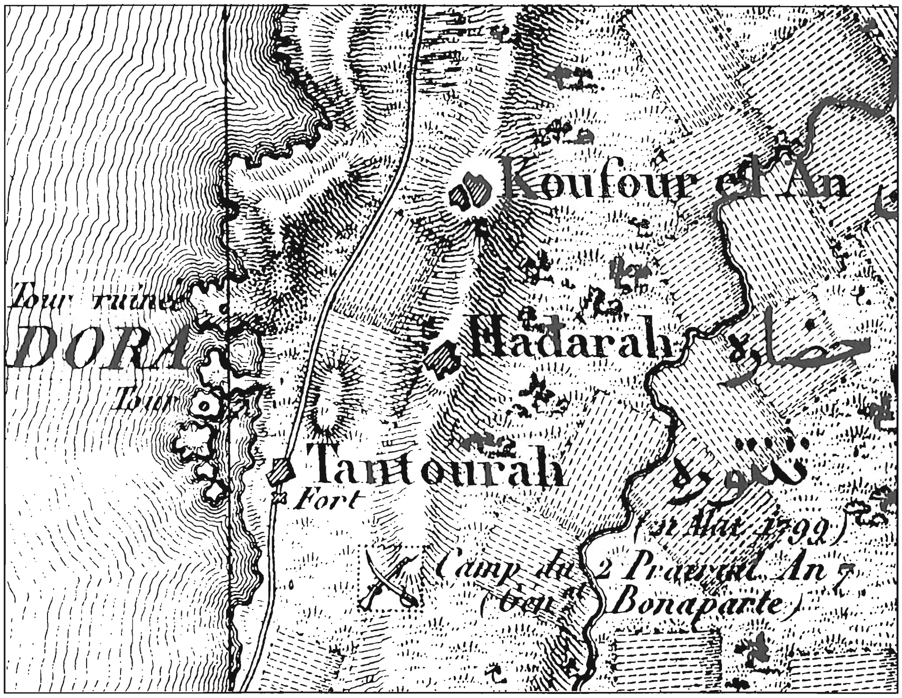


Fig. 19. *Jacotin's map showing the environs of Dor, Tantura and Bonaparte's encampment on May 21st, 1799. From M. Jacotin,* Carte topographique de l'Égypte et de plusieurs parties des pays limitrophes, levée pendant l'expédition de l'armée française. In: Description de l'Égypte, ou recueil des observations et des recherches qui ont été faites en Égypte pendant l'expédition de l'armée française *VIII. 2ème éd. Publiée par C.L.F. Panckoucke. (Paris: 1820-30) pl. 46.*

Acknowledgements: The 1995 season of exploration was made possible by generous grants from the National Geographic Society, Texas A&M University's (TAMU) College of Liberal Arts and by the support of the following individuals: Mr. and Mrs. Stanley Chais, Mr. and Mrs. Ted Halpern, Mr. and Mrs. Harry Kahn II, Mrs. Norma Kershaw, Dr. and Mrs. Leon Riebman, Mr. and Mrs. Peter Skinner, and Mr. and Mrs. John Stern.

Our special thanks go to J. Richard Steffy for joining the expedition and helping with the interpretation of the *Tantura A* hull, and to Lucien Basch and Sean McGrail for their valuable comments.

Senior expedition staff consisted of INA and CMS faculty and staff, as well as independent professionals: Shelley Wachsmann (Project Director and Principal Investigator; Underwater Still Photography); Michael Halpern (Assistant Director); J. Richard Steffy (Advisor on Hull Reconstruction); Stephen Breitstein (Director of Operations); Yaakov Kahanov (Hull Reconstructor); Patricia Sibella (Ceramicist and Illustrator); Andrew Lacovara (Hydraulic Probe Coordinator).

Additionally, students from TAMU, and the University of Haifa, as well as local high schools participated in the excavation, making this expedition a truly international

cooperative educational experience. Some graduate students were assigned important responsibilities within the framework of the excavation. Participants included the following: Karim Abu-Moach; Michael Aizenberg; Miriam Belmaker; Sheera Baroz; Joe Breman; Aaron Brody; Steven Butler (Paleoethnobotany; Video Photography; Dark Room); Jaynie Cox (Land Photography); Bella Davidson; Eyal Glick; Daniel Goldstone; Eli Haddad; Tali Kan-Tzipor; Hadas Mor; Vered Romeo; Mira Roditi; Jeff Royal (Assistant Hull Reconstructor); Nimrod Shay; Maya Shemla; Claude Tibi (Studio Photographer); and Yishai Wachsmann.

Suggested Reading

The Summer 1995 issue of the INA Quarterly (22.2) is dedicated in its entirety to the 1994 campaign at Tantura Lagoon.

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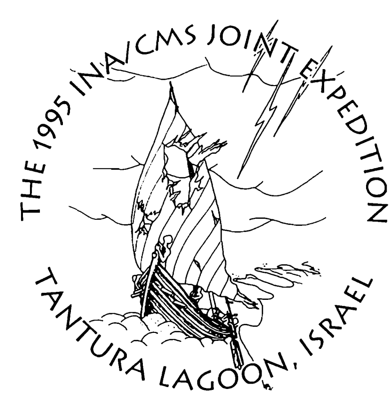


Tracking Professionalism in Sixteenth Century Scandinavian Boatbuilding

by Jan Bill

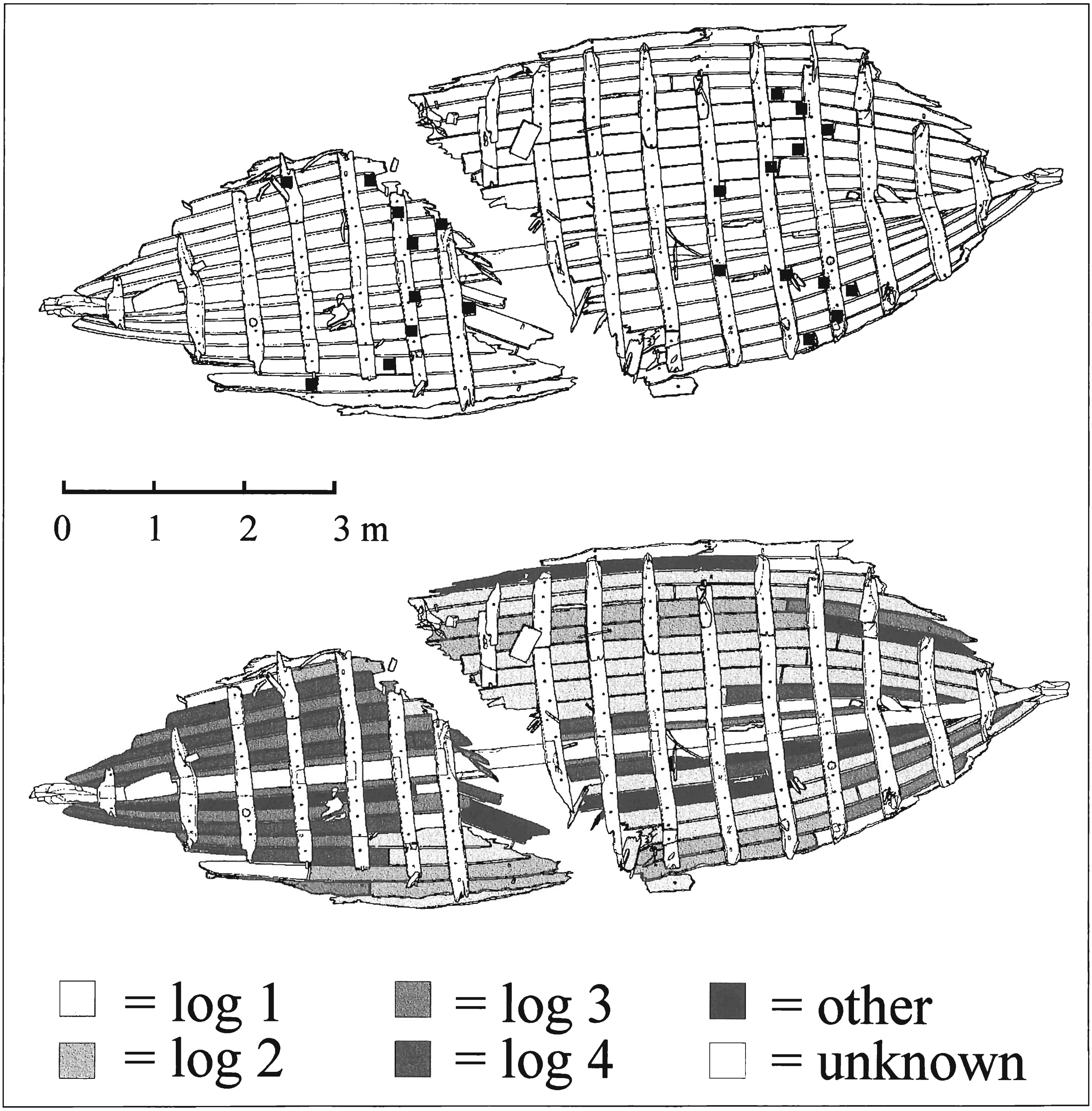
Professionalism is an everyday word and something we expect to be present in many aspects of our lives. However, this was not always so, and the birth of professionalism in specific trades often marks their entrance into the modern economy. In this article, Jan Bill, recently visiting scholar at Texas A&M from the Centre for Maritime Archaeology in Denmark, investigates the hidden secrets of a sixteenth-century cargo vessel from the Western Baltic, and shows it to be the oldest example of a specific type of professionalism so far found in traditional Scandinavian shipbuilding.

Traditional Scandinavian shipbuilding has its roots in the rowed longships predating the Viking Age, but many of its characteristics can still be found in living boat building all over the Nordic countries. Up to the High Middle Ages, ships built in this tradition formed the backbone of any military or civil fleet native to Scandinavian waters, and the way these ships were built certainly had an impact on shipbuilding all over Northern Europe. The economically—rather than militarily—competitive environment later created by the large towns of the southern Baltic and North Sea coasts placed Scandinavia firmly in the backwater of European economy. The major developments in shipping and seafaring from the thirteenth century on took place elsewhere. Cogs, and later caravels, became the large ships of Scandinavia as they did in the rest of Northern Europe. Native traditions were reduced to fulfill the needs mostly of local and regional seafaring. Though unglamorous, this function was still of critical importance for the economies of the Scandinavian countries, as they depended on seafaring for internal communication due to their geography.

For this reason, it is of interest that there is a clear discrepancy between Continental and Scandinavian practice in the production of planks. On the Continent, ships from the thirteenth century onwards tended to be built from sawn planks. In Scandinavia, planks made from split logs—a technique employed by the Viking boat builders and their predecessors—were still dominant in the building of traditional vessels at least up to the mid-sixteenth century (fig. 1). With only human power available, the production of planks represented a significant part of the total labor in the construction of a ship. A difference in such an economically important aspect of shipbuilding is likely to reflect a more fundamental difference between the societies than simply a variance in shipbuilding traditions.

Fig. 1. *Miniature from the Saint Louis Psalter, produced in England c. 1200. After being instructed in building the Ark, Noah himself is shown dressing a plank with a large, T-shaped broadax. The whole scene, and even more the ax itself, is typical of North European representations throughout the Middle Ages of the building of the Ark, while depictions of the saw in this context are late and rare. Courtesy of Leiden University Library, Ms. BPL 76A, fol. 10v.*

Written sources give some clues that shipbuilding perhaps met different demands in Northern Continental Europe and in Scandinavia during the High and Late Middle Ages. The earliest record of a shipbuilders' guild is from Dordrect in 1365. Before the end of that century, shipbuilding was an established urban trade in the coastal Continental towns of the North Sea and the Baltic. In Scandinavia, shipbuilders are not mentioned in towns before the late 15th century, and no shipbuilders' guilds are known at all from the Middle Ages. The sixteenth century saw the development of specialized shipbuilding industries outside the towns, in Scandinavia as well as on the Continent—but certainly on very different levels. In the Netherlands, Zaanstreek shipbuilding became a major



Drawings: Centre for Maritime Archaeology, The National Danish National Museum

Fig. 4a (top). *The distribution of the lengthwise joints (scarfs) of the planking in the Bredfjed ship. The stem is to the right, and each scarf is indicated with a square. Within a few decimeters, all the scarfs are placed exactly symmetrical in the preserved portion of the hull. A similar phenomenon can be observed in older, small cogs, but not in vessels built from split planks.*

Fig. 4b (bottom). *The distribution of planks from individual logs in the Bredfjed ship. The perfectly symmetrical pattern of the scarfs is only partially reflected in a symmetrical distribution of planks from the same log. While the scarf pattern was necessary because of the building method, the parent log pattern reflects only concerns of wood quality and economy; there is no indication whatsoever that attempts were made to orient the planks according to any specific pattern.*

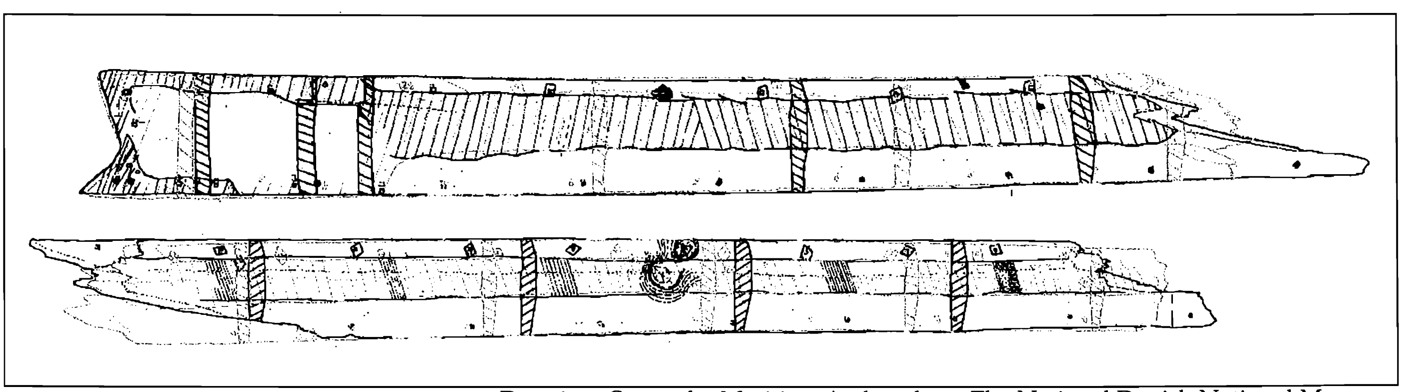
Scandinavian vessels, but it can be found in some smaller cogs excavated in the Netherlands, two of which have been published by former students of the Nautical Archaeology Program at Texas A&M University, Aleydis van der Moortel and Frederick Hocker. Both ships are built from sawn planks and date probably from the Late Middle Ages. The same feature also occurs in two Scandinavian boats from the early seventeenth century, excavated in Kvarteret Hästen, Stockholm. Those boats, however, were the only ones referred to in this study that were built from pine planks. It is not known whether these were sawn or split.

The observation of the scarf symmetry gave a first indication that sawn-plank vessels might have more in common than just being built of the same material. In order to investigate the problem further, samples for dendrochronological analyses were taken from most of the planks in the Bredfjed find, and the cell orientation in each plank was recorded. The basic question to be answered was: would the symmetrical scarf pattern be related to the specific qualities of sawn planks, and thus derive from the change in material? Alternatively, would both the change in material and the scarf pattern have their explanation in another, more professional, way of building ships, as implied by the growing number of references to shipbuilders in the written records? Radially split planks are normally superior to sawn ones, as they follow the grain better. Radially split planks are therefore stronger and less prone to warping and rot than their sawn counterparts. However, they are also more time-consuming to produce, and demand logs of a better quality than do sawn planks.

The analyses of the planking showed that the material available had been used in a very conscious manner in regards to quality. Planks cut almost radially from the logs were used mainly in the bow portion of the ship and along the turn of the bilge, while the weaker, tangentially-cut planks were predominant in the stern. The strong planks also showed up in analyzing the lengths of the planks. The bow planks are short (less than 3.6 m long), while the bilge planks are the longest ones in the preserved part of the hull (more than 5 m long). Obviously the most radially-cut planks have been selected for the parts of the hull that demanded the most from the material.

In contrast to the Almere cog, the heartwood side of the planks was haphazardly put to the inside or the outside of the hull in the Bredfjed ship. This practice is due to the fact that many of the planks had been sawn from very thick logs, and had consequently been split lengthwise before use. This observation ruled out the possibility that the planks were actually placed in the hull according to their position in the log from which they were sawn—a configuration that is otherwise suggested by the dendrochronological analyses. These ascribe most of the planks to four different parent logs and show that planks from each log normally are placed symmetrical to each other. One log has only provided four planks in the preserved part of the vessel, but these are the four long almost radially-cut ones in the bilges. The short high-quality planks in the bow come from all of the three remaining logs, while the rather poor planks in the stern come from only two of the logs.

The analyses thus showed that quality and function were carefully considered before the position of each plank was decided upon. No rigid pattern of symmetry was enforced, but the scarfs were kept symmetrical to each other, and the use of the planks, which were often longitudinally divided into two boards, resulted often in a symmetrical distribution of planks from the same log in the hull (fig. 5). The difference in quality between split and sawn planks is certainly taken care of in the construction of the hull, but there is no reason to claim the scarf symmetry to be related



Drawing: Centre for Maritime Archaeology, The National Danish National Museum

Fig. 5. *An example of the symmetry of the planks. The lowermost, aft plank to the port side is shown in black; the mirrored image of the facing, starboard plank is grey. Note also the symmetry in cross-sections, indicating that even the beveling of the planks in order to adjust their angle to the previous strake was copied off. The gain was a speedy construction process and a certain amount of control over the symmetry of the finished hull.*

thereto—nor does the lack of interest in the orientation of the heartwood side of each plank indicate such a relationship. Instead, a comparison of the actual shape of the planks in both sides of the hull gave a perfect explanation of the observed features.

By comparing 1:1 scale drawings made of the individual planks in the hull, it was demonstrated that planks in equal positions in each side of the hull were almost exact copies of each other—in spite of the fact that they were curved and varied in width in order to accomplish the shaping of the hull. With more than 50% of the preserved planks compared, the maximum difference in width observed was 15 mm, and the average was much less, about 5 mm. Such accuracy could hardly be expected unless the planks were made in pairs, one being a copy of the other. This method would necessitate symmetry in the positioning of the scarfs, and with the frequent longitudinal dividing of the planks in the Bredfjed ship, it would also tend to create a pattern of symmetry in the way planks from each log were distributed throughout the hull. The method would reduce the work of temporarily mounting and checking the lines and beveling of each plank before final assembly. It implies that the symmetry of the hull was controlled rather by providing symmetry to each pair of planks than by controlling the overall shape of the growing ship. The method definitely could not have been used in the irregularly-scarfed Scandinavian vessels of the previous centuries, but might very well have been used in the Netherlands and elsewhere. It is likely to indicate the import, not only of a new concept of plank production, but also of ship building—one that relied much more on methodology and time-saving production routines than the previous, more sculptural, attitude (fig. 6). The difference between the two attitudes might very well be the difference between a peasant directed to build a ship and a ship carpenter working for his own living. The reason for the delay in the professionalization of Scandinavian shipbuilding might be the difference in an economy directed by the interests of the feudal aristocracy and that directed by urban commerce.

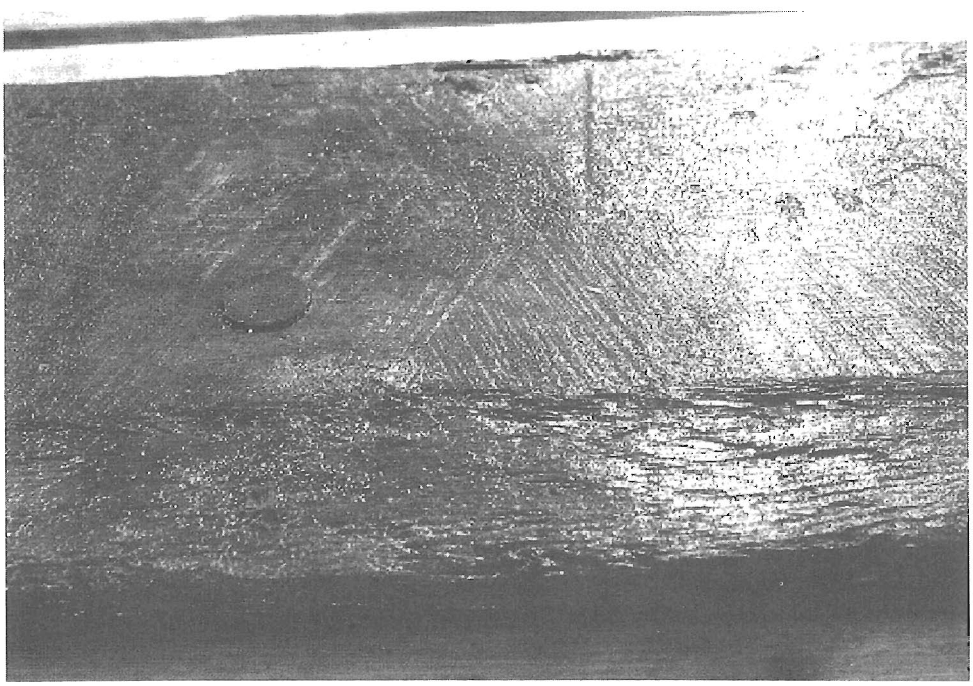


Fig. 6. *The inner surface of a plank from the Bredfjed ship. The two crossing sets of traces from the saw clearly show that the plank has been sawn by hand. Such interfering sets of traces were always found near the end of planks, indicating that the major length of all the planks in the log was sawn from one end, before each plank was released by sawing the last meter of it from the other end of the log. It is possible that the planks in the Bredfjed ship were sawn in regular pits rather than on trestles, as each log weighed 3–4 metric tons. Photo courtesy of Centre for Maritime Archaeology, The National Danish National Museum.*

Acknowledgments: The above study is a summary of some of the research I have had the opportunity to carry out as a visiting scholar at the Institute of Nautical Archaeology. I am grateful to the many members of the INA staff, whose through discussions have been of tremendous help in getting this far. Also, I am thankful to the Centre for Maritime Archaeology and the Danish National Research Foundation for providing me with the means and opportunity to go there. The gradual expansion of the use of sawn planks in shipbuilding in Northern Europe is the topic of an article presently under preparation by George Indruszewski and me and will, when finished, provide a useful foundation for further studies into these aspects of the professionalization of North European shipbuilding.

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In the Lab

Egypt

Two full excavation seasons and two shipwreck surveys later, INA-Egypt researchers expect a busy summer in the laboratory. A study season at the Alexandria Laboratory for the Conservation of Submerged Antiquities will include visiting preservation specialists, Supreme Council of Antiquities conservators, and INA-Egypt staff and volunteers. They will continue cleaning and documenting more than 3,000 artifacts from the porcelain wreck at Sadana Island (see *INA Quarterly* 23.3 and 23.4).

We also look forward to inaugurating a fully equipped darkroom (including a refrigerator for chemicals) this summer, thanks to the generosity of a recent visitor. The lab ultimately will contain a medical x-ray unit, microscopes, and other analytical equipment. It is funded by a consortium of Egyptian and international companies and is a joint project of the Supreme Council of Antiquities for Egypt and INA-Egypt.

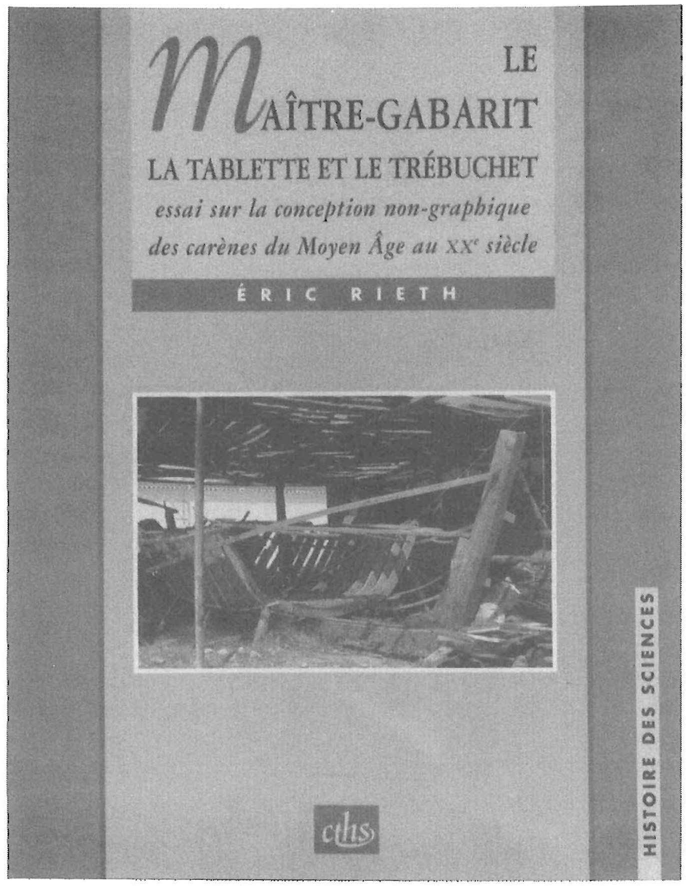
Meanwhile, preparations for shipwreck surveys and further excavation continue. To visit the Alexandria lab, please contact INA-Egypt headquarters (tel./fax 011-203-546-6872; e-mail INA_MISR@acs.auc.eun.eg).

Copies of the INA-Egypt newsletter *El Bahri* ("of the sea") are available upon request from INA-Egypt, P.O. Drawer HG, College Station, TX 77841.

Review

by J. Richard Steffy

Le Maître-Gabarit, La Tablette et le Trébuchet,
by Eric Rieth
Paris Cedex 05: CTHS, 1, Rue Descartes, 75231, 1996.
ISBN 2–7355–0337–2, 225 pages, 136 illustrations,
softcover, 250 Francs.



This is an interesting, well-illustrated study of non-graphic methods of determining hull shapes between the early middle ages and the present century. The process is sometimes called "whole molding" in the U. S. It was an ingenious geometric method of ship architecture, frequently practiced by builders with very limited formal education, who nonetheless could produce fine seagoing ships without the use of lines drawings, construction plans, or additional calculations. It began with the development of the master mold (*maître-gabarit*), or midship shape. By using a variety of ingenious geometric methods and devices, the diminishing fore and aft contours of a hull's bottom and sides could be determined with precision. Eric Rieth has assembled an impressive array of examples of this form of shipwrightery, along with references to the literary, archaeological, and ethnographic sources from which he gleaned them.

The book is divided into four parts. The first chapter of part one is an overview of ancient and medieval shipbuilding, nearly all of which is supplied by archaeological contributions but spiced with interesting comments by the author. Several projects conducted by INA personnel are represented here, including Kyrenia, Yassı Ada, and Serçe Limanı. The second chapter presents terminology and an overview of shipbuilding technology necessary to absorb the following chapters. Part two deals with the methodology, documentation, and details of shipwrightery in the eighteenth century and the shaping of galleys from a slightly earlier period. Chapters 4 and 6 are most interesting; they describe the development and various forms of the three devices in the title, which Rieth calls the constructor's "instruments," and numerous ways in which master molds were used. Much of part three has been published before in one form or another, including a rewrite of the author's excellent work on Oliviera's manuscript in *Neptunia* several years ago. But even here he has inserted some fresh commentary and pointed out interesting facts that were, at least to me, new revelations about popular sources like *Lavanha* and the Venetian constructors. Perhaps the most interesting feature in this section is the way these methods of molding hulls apply to a well preserved archaeological example, *Culip* IV, which was discovered in Spain in 1987. Rieth does an excellent job of illustrating how the interpretation of information derived from hull remains can be taken all the way back to the mind of the shipwright.

The final part deals with nineteenth- and twentieth-century methods of whole-molding in the Mediterranean area, Brazil, and Newfoundland, modern applications directly descended from some of the methods described previously. The conclusions that follow are an excellent summation of the series of processes, and there is a glossary defining the more complex terminology.

Eric Rieth is a leading authority on this form of shipwrightery. Furthermore, he is an outstanding scholar who has the ability to relay his discoveries in a manner that makes even the most obscure details interesting and even exciting. Even if one has difficulty reading French, Rieth's logical writing style is easily interpreted with a good dictionary or computer interpreter.

This book is a "must" for all those interested in reconstructing post-medieval hull remains. It should also benefit historians, technologists, geometricians, model builders, architects, and people who are simply interested in the past. And for those *Quarterly* readers who are serious ship model builders, I suggest trying some of these processes as a starting point. The experience will be most gratifying.

News & Notes

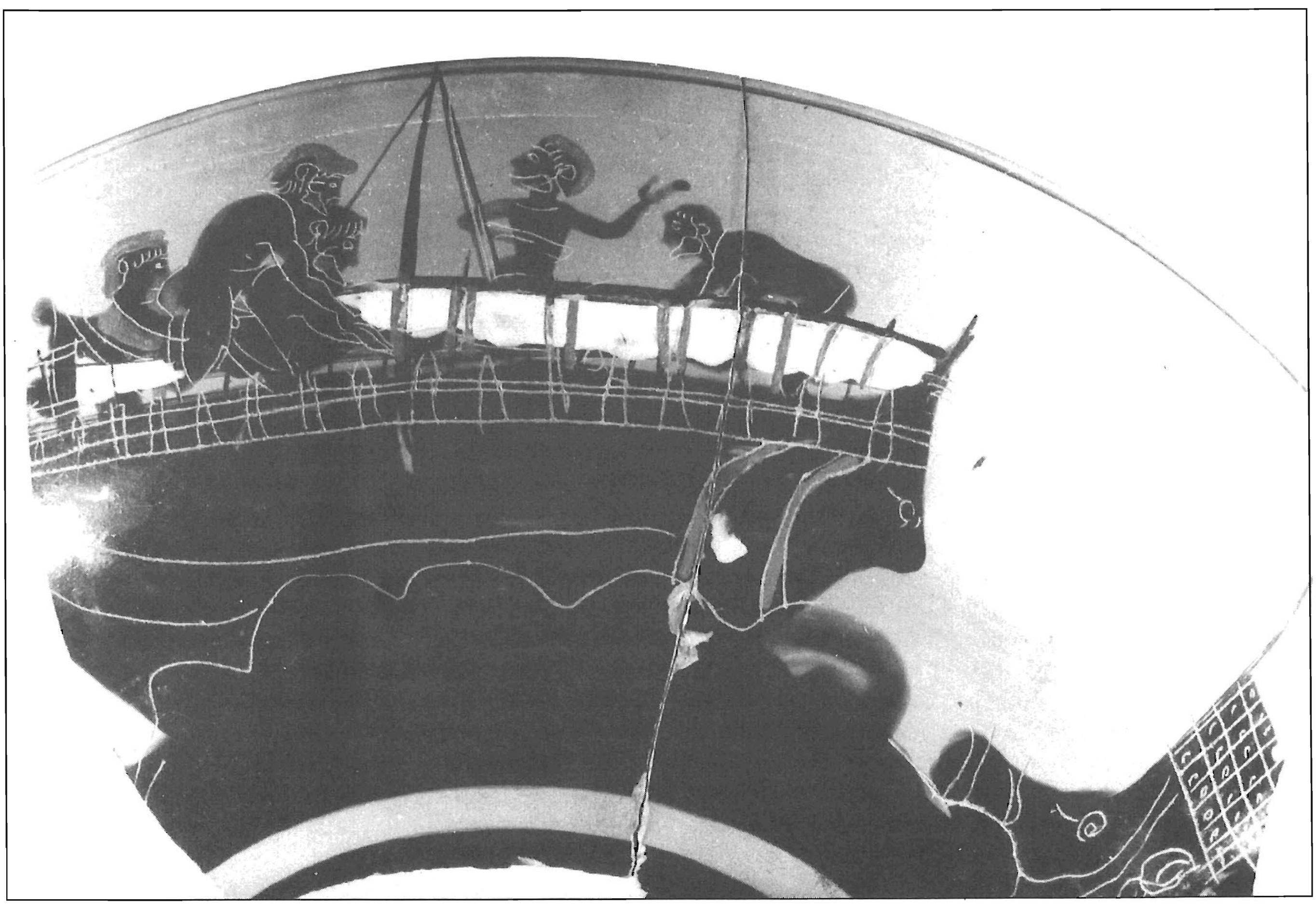
A Rare Representation of a Greek Merchant Ship

In 1995 I visited the University of Heidlberg to give a lecture at the invitation of Dr. Wolf-Dietrich Niemeier, the excavator of the Bronze Age levels of Miletus, not far north of INA's headquarters in Bodrum, Turkey. While there, I was given a tour of the Archaeological Institute's museum by its curator, Dr. Hermann Pflug. I was astonished to see on display the depiction of a Greek merchant ship on a Black-figure vase of the type common in Greece in the sixth century B.C. My astonishment was caused by the fact that I knew of only one such representation, frequently published, and by the fact that I knew of no contemporary representation of a furled sail. Dr. Pflug told me that the vase was published in the *Corpus Vasorum Antiquorum, Heidelberg*, vol. 4, plate 162, 10.11, which meant that it had simply been overlooked by all the world's authorities on ancient seafaring.

He quickly made a photocopy of the published depiction, which the next year I shared with a number of colleagues, including the dean of Greek ship studies, Professor Emeritus Lionel Casson of New York University. He immediately responded that I had hit the jackpot, and provided so much insight into the piece that I recommended that he publish it in the appropriate place, the *International Journal of Nautical Archaeology*, to bring it to the attention of other students of nautical archaeology. This he is now doing, with good prints provided by Dr. Pflug.

I now look forward to showing Wolf and Barbara Niemeier INA's Bronze Age finds in the Bodrum Museum of Underwater Archaeology, and to returning the warm hospitality they showed me in Heidelberg. Meanwhile, with still another print supplied by Dr. Pflug, I thought that readers of the *INA Quarterly* would like one more example of the important finds nautical archaeologists can make without getting wet!

George F. Bass



A black-figured vase from the sixth-century B.C. depicting a Greek merchant ship with a furled sail. Courtesy of the Archaeological Institute Museum, University of Heidelberg.

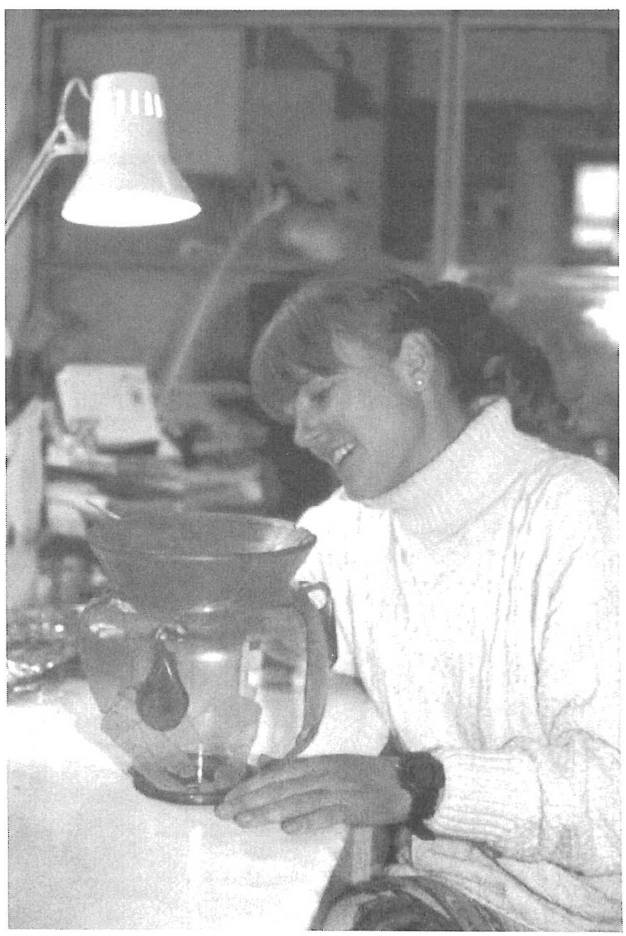
Serçe Limanı Glass Conservation Update

Throughout the summers of 1977 through 1979, over a million shards of broken Islamic glass were recovered as part of the cargo of the 11th-century shipwreck at Serçe Limanı, excavated by the Institute of Nautical Archaeology and Texas A&M University. In the years following the excavations, these shards were cleaned, identified, sorted according to type, and inspected for any possible joins. Visitors to the work area in the English Tower within Bodrum Castle were regularly astonished by the huge amounts of glass, its diversity, and its seemingly nightmarish aspect as a jigsaw puzzle.

Despite the difficulties, however, from 1980 to present more than 300 glass vessels were reconstructed, often with missing areas replicated in resin. Many new shapes emerged. The Bodrum Museum of Underwater Archaeology exhibits one of the finest collections of Islamic glass in the world. Although the restored glass now forms a popular part of the Serçe Limanı display, work on the thousands of remaining shards has continued. These have been studied and yet more unknown shapes, forms, and information about manufacture and trade have been revealed. In some cases, a new vessel may consist of only two or three paper-thin fragments. Many of these have been reconstructed to enable drawing or photography to take place. Notwithstanding the difficulties, several of the more complicated and unusual vessels have been reconstructed in the past year.

The new pieces include a fine mosque lamp, now fitted with a Plexiglas inside 'former' that supports the heavy rim and shoulders and enables the lamp to be displayed the correct way up for the first time. Another is the affectionately called "chip'n'dip dish" consisting of a central bowl surrounded by four smaller bowls. This has been fully restored for display. The glass jigsaw puzzle is nearing its completion, but continues to present us with extra pieces to add.

Jane Pannell



Jane Pannell puts the final touches to the mosque lamp that has been fitted with a Plexiglas 'former' that supports the heavy rim and shoulders, enabling the lamp to be displayed the correct way up for the first time since its discovery. Photo: N. Piercy

INSTITUTE OF NAUTICAL ARCHAEOLOGY