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Artifact Assemblages from Two Roman Shipwrecks off the Carmel Coast

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Introduction

Sea storms in 1990–1998 exposed shipwreckage remains on the shallow seabed off the southern municipal beach of Haifa (Map ref. NIG 1961/7543; OIG 1461/2543; Fig. 1). Treasure hunting by local divers and fishermen called for continued rescue operations by the Israel Antiquities Authority (IAA), including underwater mapping and the retrieval of ancient artifacts.[1] More than 1000 metal objects were recovered, including artifacts from the ships' hull and rigging, such as nails, lead sheathing, anchors and lead rings; fishing gear; equipment for mending fishing nets and sails; figurative art, such as bronze figurines, jewelry and other ornaments; and various other daily implements used onboard. Scores of silver and bronze coins attributable to two distinct hoards were found, indicating that two vessels were wrecked at the site, one from the third and the other from the fourth centuries CE (see Meshorer, this volume; Ariel, this volume). Some intrusive artifacts were excavated as well. All finds were treated in the various IAA laboratories. Altogether, the assemblage sheds light on daily activity aboard ancient sea vessels.

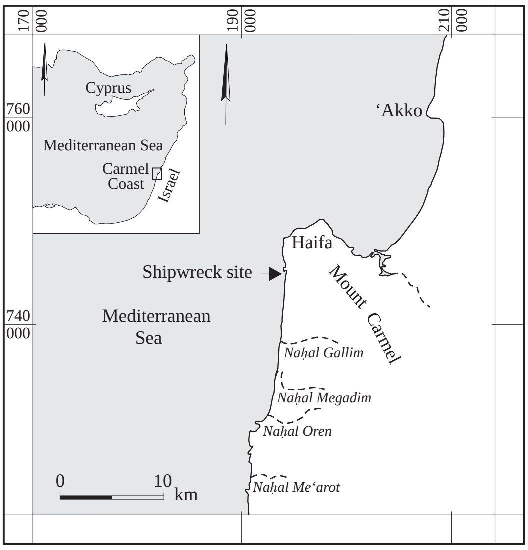

Fig. 1. Location map of the site and sites mentioned in the text.

The wreckage site is located in a small, sandy bay created by an artificial tombolo located 150 m to the site's north. Prior to the deposition of the tombolo, the shoreline had been sandy and straight, oriented on a roughly north–south axis. The sea bottom at the site slopes by a gentle 3% to the west. It is composed of hard fossil clay of a terrestrial origin. When lying substratum, this clay is usually covered with a layer of fine quartz sand up to 2 m thick.

The artifacts were scattered over an area measuring 50 × 50 m and located 75–125 m offshore. They rested atop the clayey seabed at water depths of 2.5–4.0 m. Although the finds were scattered throughout the site, two major artifact concentrations were discerned, corresponding to the two coin hoards mentioned above. The third-century assemblage was mainly distributed in the western, deeper part of the site; while the fourth-century assemblage was concentrated in the eastern, shallower area of the site.

The Finds

The finds are presented typologically. Objects that were part of the hull and rigging are

Table 1. Distribution of Whole and Broken Nails with Intact Heads, according to Size (in cm)

Size / Type	**1** L 23.5–25.0 Th 0.95–1.30		**2** L 8–17 Th 0.8–0.9		**3** L 12.5–15.5 Th 0.7–0.9		**4** L 11.5–13.5 Th 0.70–0.83		**5** L 9.50–11.25 Th 0.54–0.75		**6** L 7–9 Th 0.45–0.60		**7** L 4.8–6.4 Th 0.45–0.58		**8** L < 4.50 Th < 0.45		Total Whole or Broken		Total
	Wh	Br	Wh	Br	Wh	Br	Wh	Br	Wh	Br	Wh	Br	Wh	Br	Wh	Br	Wh	Br	
A	5	9	6	10	36	34	43	72	34	72	20	16	11	8			155	221	376
B							6	7			5						11	7	18
C									8	7							8	7	15
D															1		1		1
E															7		7		7
F			2						2		5						9		9
G			5	1	1	1											6	2	8
H				3		1												4	4
I						3					2	2					2	5	7
Total																	199	246	445

L = length; Th = thickness; Wh = whole; Br = broken

discussed first, followed by the nautical equipment and tools, fishing gear, figurative art and various personal implements. All wooden and textile parts of the ships vanished, as did most of the cargo, including ceramics.

Nails

A total of 911 bronze nails of various sizes, shapes and degrees of wear were retrieved. There were 445 nails with intact heads, 199 whole and 246 broken (Table 1), and 466 nails lacking heads (see Table 2). The nails with heads were classified into nine types (A–I; see below) according to length, cross-section of the shaft and head shape (Fig. 2). Type A nails constituted 84.5% of the nails with heads; Type B nails, 4%; and Type C, 3.4%; the rest of the nail types were represented by fewer than 10 specimens (around 2% each).

Nails with Heads.— The following description of the nail types is divided into nails whose shaft cross-sections are square (Types A–E) and round (Types F–I).

Type A (Figs. 2, 3): Nails of this type have a conical head and a square shaft. It is the most common nail type in the assemblage (see Table 1). Judging by distribution of size, it seems that nails belonging to Sizes 3 and 4 were used for joining the strakes to the frames, as planking required a relatively large number of nails. Shorter nails (Sizes 6–8) could have been used to join deck planks. The longer nails (Sizes 1–2) could have been used for heavy duty joinery, such as the joining of the stern parts and bow, or of the mast step and frames to the keel. Type A is very common in Roman shipwrecks dating from the first to the third centuries CE.

Type B (Figs. 2, 4): These nails also have a conical head and a square shaft, although their heads are smaller than those of Type A.

Type C (Figs. 2, 5): These nails are characterized by their elongated square heads, which are only slightly broader than the shaft.

Type D (Figs. 2, 6): Type D consists of a single bronze tack with a short square shaft. The length of the shaft is about 1.5 times the width

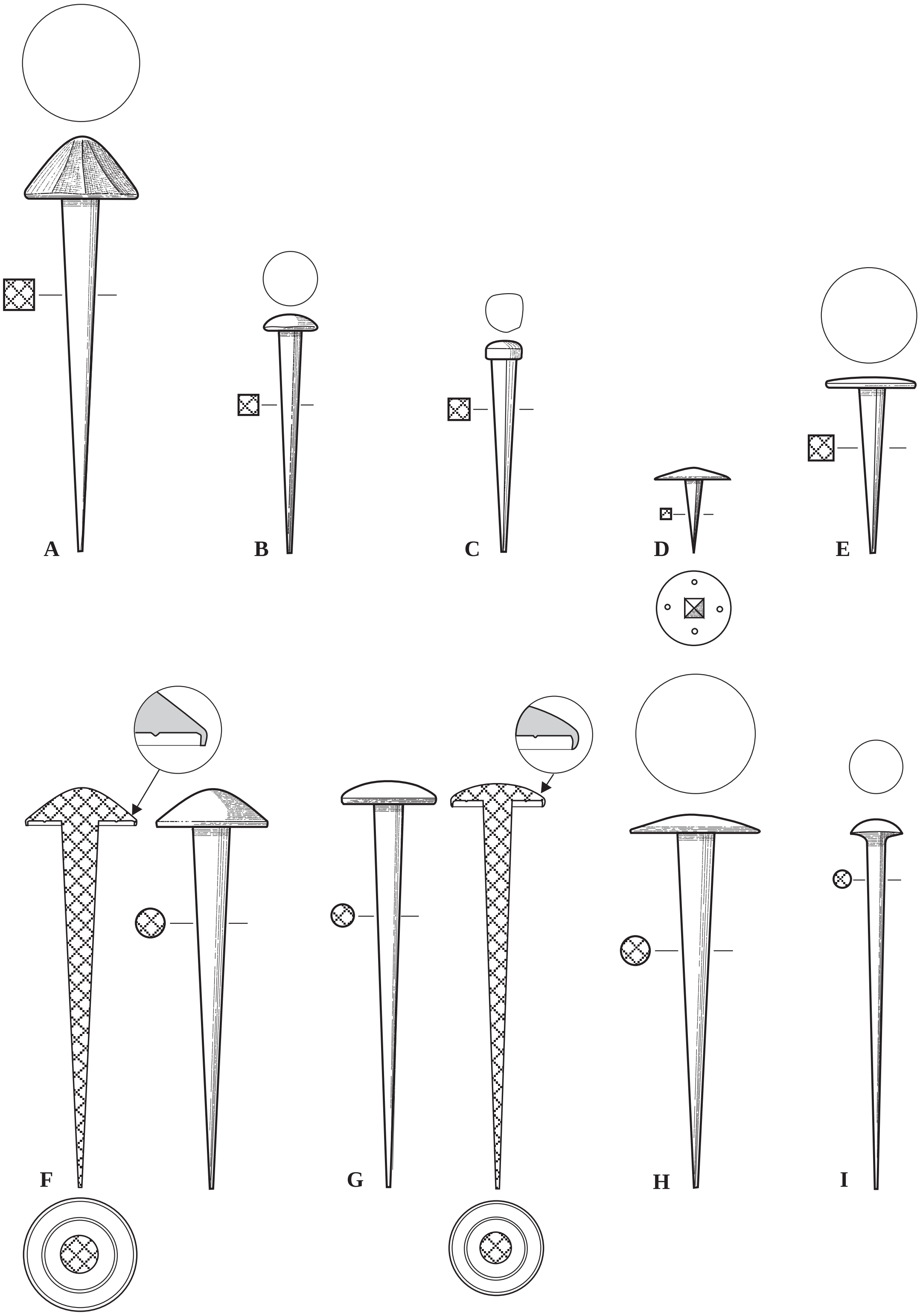

Fig. 2. Typology of the nails.

Fig. 3. Type A nails.

Fig. 4. Type B nails.

Fig. 5. Type C nails.

Fig. 6. Type D nail.

Fig. 7. Type E nails.

of the head. The head is flat and broad, with several protrusions on the underside to improve adherence. This type was probably used for attaching lead sheathing. Similar tacks were recovered from an amphora dating to the end of the second century BCE from the Megadim wreck, used as a container for metal objects (Misch-Brandl 1985:14).

Type E (Figs. 2, 7): These nails or tacks have a square shaft and stem length 2.0–2.5 times greater than the width of the head. Like Type D, they were apparently used for lead sheathing.

Fig. 8. Type F nails.

Fig. 9. Type G nails.

Fig. 10. Type H nails.

Similar items were recovered from a piece of lead sheathing found in the sea near the ‘Akko anchorage (Kahanov 1999).

Type F (Figs. 2, 8): The shaft of Type F nails is round and so is the head, which is broad and high. The rim of the head was hammered inward.

Type G (Figs. 2, 9): Nails of this type have a round shaft and a wide, flat head whose rim was hammered inward, as in Type F. They fall into Sizes 2 and 3.

Type H (Figs. 2, 10): These four specimens have round shafts and a wide, very flat head with a sharpened rim.

Type I (Fig. 2). Type I nails have a small head, rounded on the top and conical on the bottom, and a round shaft. Nails with round cross sections—similar to Types F, G, H and I—were recovered from the Megadim wreck (Misch-Brandl 1985:14).

Headless Nails (Figs. 11–13).— The properties of the headless nails are detailed in Table 2. Nail shafts were either deliberately bent or clinched, to increase gripping power (Fig. 12). Energetic forces occurring during wreckage and hull disintegration processes bent some of the nails as well (Fig. 13). Some of the nails bear signs of usage, such as strike marks on the top of the head, bent shafts and lateral strike or cut marks.

According to the length of the nails used for planking, it is estimated that the two wrecked ships were small to medium in size, roughly 15–25 m long. The deformation (bending and breakage) of the nails indicates a significant

Table 2. Properties of the Headless Nails (Shaft Fragments)

Category Size of Nail by Thickness	Shaft Fragment	Point Fragment	Deliberate Bending	Hook-shaped Bending	Lateral Laceration Marks	Total No. of Fragments
1 (0.95–1.30 cm)	1	1				2
1–2 (0.95–1.80 cm)	4	3			1	8
1–3 (0.70–0.95 cm)	18	18	3			39
2–5 (0.50–0.90 cm)	19	26		1		46
2–6 (0.45–0.90 cm)	184	160	22	4	1	371
Total No. of Fragments	226	208	25	5	2	466

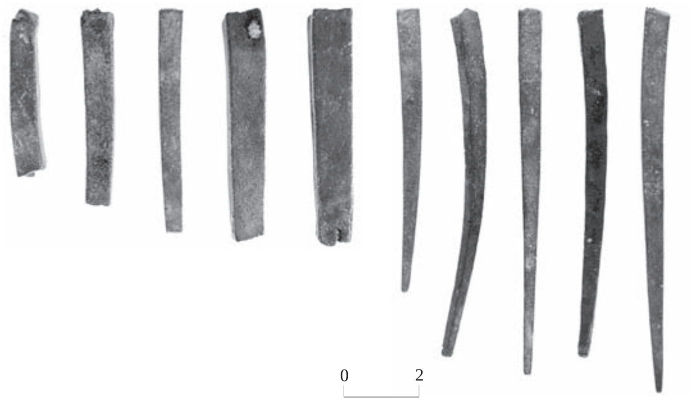

Fig. 11. Headless nail fragments.

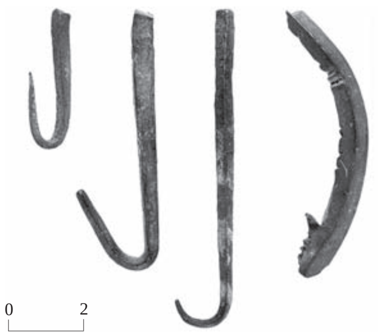

Fig. 12. Deliberately bent nails.

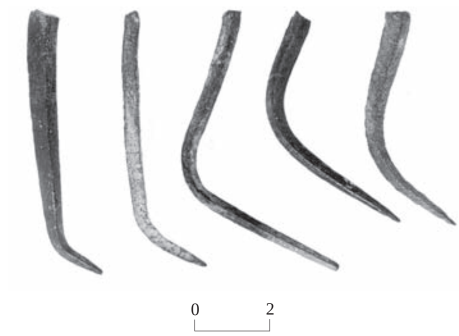

Fig. 13. Nails bent by a wreckage event.

pattern (Fig. 14). Numerous nails of Sizes 3 and 4, probably used for planking, are bent or snapped at a distance of about 3–4 cm from the bottom of the nail head. Assuming that during the wreckage event, shafts of nails were subjected to great strain at the area of conjuncture of the planks and frames, it is suggested that the average thickness of the planks was 3–4 cm. The lateral cut marks on some of the nails indicate that at some stage

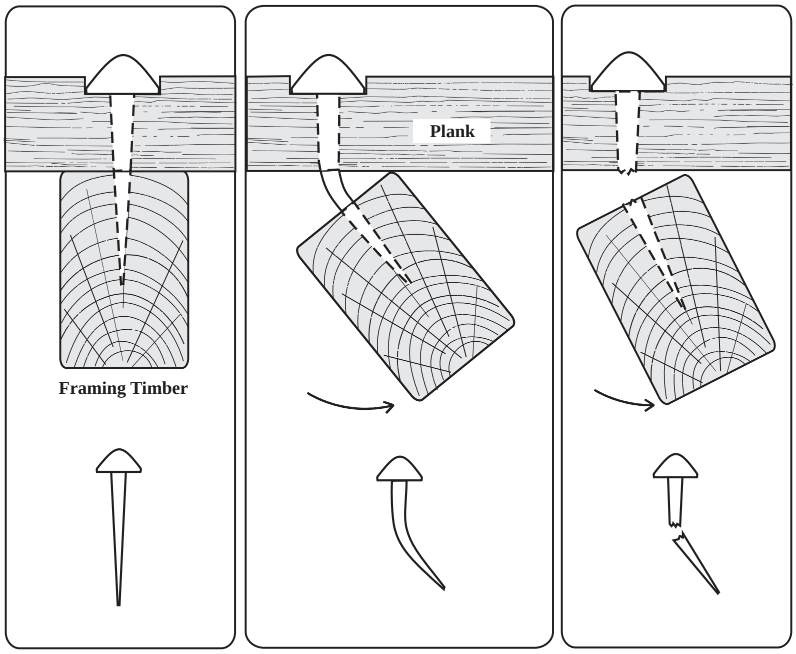

Fig. 14. Patterns of nail deformation.

the nails were extracted and reused. Similar marks were reported from a fifth-century BCE shipwreck at Tektash Burnu in Turkey (Van-Duivenvoord 2005). It has been proposed that a relationship exists between planking thickness and ship dimensions (Kahanov 1993:258–264). According to Kahanov, planking about 3 cm thick would have been used on a medium-sized ship weighing about 25 tons.

Lead Sheathing (Table 3)

The wreck site yielded 21 fragments of lead sheathing—a thin layer of lead (average thickness 1.25 mm) affixed to the outer surface of ships with wooden hulls to improve sealing and enhance the ship's strength and stability. The sheathing was fastened from the keel upward to the first or second strake above the water line. In some cases, textiles soaked in waterproofing substances were inserted between the lead sheath and wooden strakes (Black 1999). The lead sheaths overlapped each other; they were joined to the hull by small copper tacks with large heads, enabling water to flow smoothly over the hull from bow to stern. The use of lead sheathing lasted from the mid-fourth century BCE to the second century CE (Kahanov 1999:219). During the period when lead sheathing was commonplace, two-thirds of all ships were protected and covered in this manner.

Some of the lead fragments in our assemblage have perforations (3–5 mm), either round or square, depending on the type of nail once hammered into them. Twelve pieces have one hole and eight are not perforated. One fragment (No. 18; see Table 3) has three holes arranged in a triangle at distances of 46, 36 and 17 mm from each other. Impressions of tack or nail heads, 16–23 mm in diameter, appear on some of the fragments; the head of a metal tack, 23 mm in diameter, is still inserted into one (No. 6; see Table 3). The thickness of the sheets varies between 0.2 and 0.3 mm. On one sheet there is an incised grid pattern beside a nail perforation and impression (No. 1; see Table 3; Fig. 15); on another, is a nail head imprint with three small depressions (diam. 2 mm) within it and

Table 3. Properties of Lead Sheathing Pieces

No.	Thickness (mm)	Length (mm)	Width (mm)	Hole Shape	Hole Size (mm)	Diameter of Nail Head (mm)	Number of Holes	Comments
1	2.5	170	40	Rectangular	5 × 4	23	1	Incised grid pattern, nail head imprint
2	1.0	150	115					
3	1.0	120	105	Round	D = 2.5		1	
4	1.0–1.3	110	110	Rectangular	4 × 4	19	1	Strike marks on outer surface, nail head imprint
5	1.0	145	90	Rectangular	4 × 5		1	
6	1.0	55	55	Rectangular	3 × 3	2	1	Nail head is preserved in the sheet
7	1.0	115	50	Elliptical	4.5 × 6.5	18	1	Nail head imprint
8	1.5	60	55	Round	D = 5	17	1	
9	1.0	110	65					
10	0.6	100	40					
11	1.0	89	40	Rectangular	3.5 × 3.5	17	1	Nail head imprint, tack indent
12	0.4	70	40	Rectangular	4 × 4		1	
13	1.0–1.2	290	200	Rectangular	3		1	Especially large piece with folded rim, function not definite
14	1.0	265	130					Especially large pieces, no holes, raw material?
15	0.3	45	35	Rectangular	5 × 5		1	
16	1.0	42	28	Rectangular	5 × 5	21	1	Nail head imprint
17	1.0	90	90					
18	1.0	100	80	Rectangular Rectangular Elliptical	4 × 3 3 × 3 3 × 5	17	3	Three nail holes positioned in a right-angled triangular formation; in one of them there is a nail head imprint
19	1.0	64	45					
20	1.0	53	32					
21	0.5	53	21					

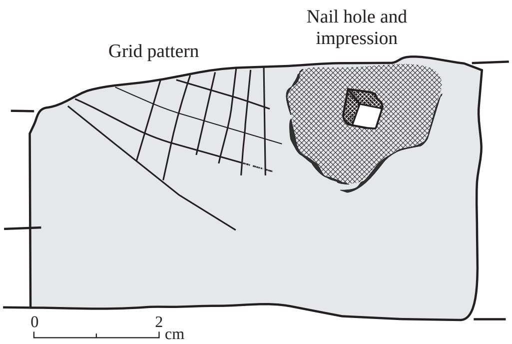

Fig. 15. A grid-shaped incision and a nail perforation and impression on a piece of lead sheathing.

around the hole (No. 16; see Table 3). These are the imprints of round protrusions often found on the underside of nail or tack heads. Tacks with similar features were recovered from the Albenga (Lamboglia 1952), Lake Nemi (Ucelli 1950) and Megadim (Misch-Brandl 1985) shipwrecks. Most of the lead sheets recovered from the site are probably fragments of hull sheathing; however, some may have had other purposes. One relatively large fragment (No. 14; see Table 3), lacking tack holes, could have been raw material for lead patches; another

(No. 13; see Table 3) has a single rectangular nail perforation and a folded rim. The above-mentioned fragment with the incised grid pattern (see Fig. 15) is too thick to be used for hull sheathing and it probably had some other purpose.

Lead Patch (Fig. 16)

A rectangular lead patch (16.5 × 26.5 cm), cut on three sides and torn on the fourth, was found. Along the rim of the patch are perforations made by nails with square shafts (3–7 mm) and impressions of the nail heads (diam. 20 mm). Some of the perforations are torn and there is one deep depression where a nail head was snapped off, probably due to forces during the wreckage event. The underside of the patch is smooth, the topside marked with scratches and traces of hammering. The patch could have been used to seal leaks in the ship hull and protect the ship timbers from natural deterioration.

Anchors (Figs. 17–20)

Several stone and metal anchors were recovered from the vicinity of the site. The stone anchors have one, two or three holes. The small stone anchors weigh between 2 and 15 kg; they could have served as end sinkers of fishing nets (see below). The large stone anchors with one hole are typical of the Late Bronze Age, and are thus not to be associated with the Roman shipwrecks.

The remnants of two small metal anchors were recovered. One is a removable lead stock of a composite wooden anchor (Fig. 17). It weighs 5.65 kg and is shaped like a rectangular lead bar with a rectangular protrusion across its center. A hole was pierced in the bar at a distance of about 5 cm from the protrusion. Before usage, the stock was inserted into a rectangular groove in the upper part of the anchor shank, with the protrusion acting as a stopper, assuring the crosswise position of the bar in the anchor (Fig. 18). A wedge could have been inserted into the hole to fix the bar tightly against the

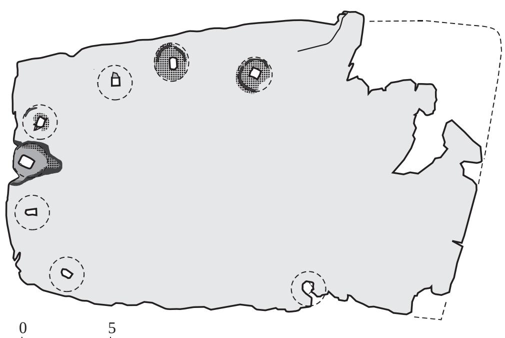

Fig. 16. Lead patch.

Fig. 17. Removable lead stock of a composite wooden anchor.

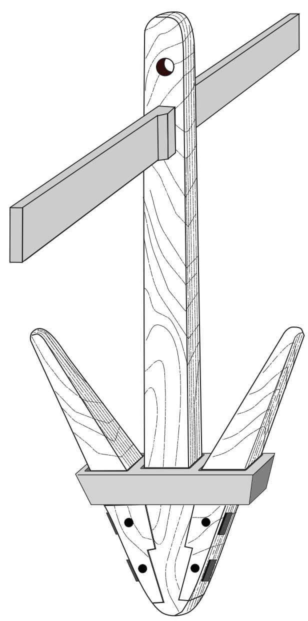

Fig. 18. Reconstruction of the composite wooden anchor with removable stock.

wooden shank; alternately, a rope tied to the shank could have been passed through the hole. The lead stock was used to weigh down the wooden anchor and help it grip the seabed properly. Such anchors were used from 150 BCE to 300 CE. They have been classified as Type 4A anchors by Haldane (1984:4, 13).

The other specimen is a two-armed composite iron anchor (Curryer 1999:29). The shank, arms and half of the stock have survived intact, weighing 5.4 kg and all with rectangular cross-sections (Fig. 19). Approximately one half of the ring hole was preserved. The weight of the remaining stock is 0.75 kg. It was still inserted into the shank when recovered (Fig. 20). This suggests that the anchor was in use during the wreckage event, as anchors stored onboard usually had their stocks placed separately alongside them. Yet this small anchor would have been unsuitable for a medium-sized merchant ship, and, therefore, could not have been the main anchor. It falls into Kapitan's Type B anchors (Kapitan 1984), used during the Early Imperial period (first to third centuries CE), a date that suits the chronology established by the earlier coin hoard from the site (see Meshorer, this volume).

Lead Circles (Fig. 21)

Eight flat, round lead circles with a dividing bar in the middle were recovered from the wreck site; three are complete and four fragmentary. There are two kinds of decorations on the circles. Two have embossed ridges circumscribing the inner and outer rims of the circles and smaller embossed ridges on the edges of the middle bars (Fig. 21:1, 2). In addition, there are two inner ridges circumscribing the circles. These two specimens bear the same casting defects and seem to have been cast in the same mold.

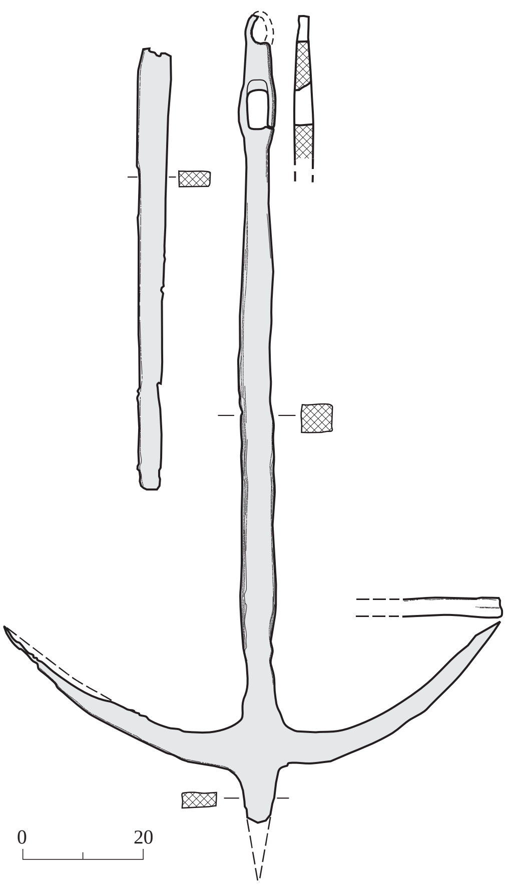

Fig. 19. Iron anchor.

Fig. 20. Iron anchor as found.

Fig. 21. Lead circles.

No.	Reg. No.	Weight (g)	External Diameter (cm)	Thickness (mm)	Width of Middle Bar (mm)	Shape of Nail Hole and Dimensions (mm)
1	30/97-84/208	146	11.30–11.35	2.5	15.0–15.5	Round, 4
2	30/97-84/209	126	11.10–11.45	2.5	15.0–15.5	Round, 4
3	29/98-61/1	82	11.20–11.12	1.5	14.7–16.4	Square, 2.5 × 2.5

A third item bears only low ridges on the edges of the central bar and an additional ridge circumscribing the middle of the circle (Fig. 21:3); it also has three small protuberances on the circle and in the center of the bar. Each lead circle has three nail holes, either round (Fig. 21:1, 2) or square (Fig. 21:3), and one positioned at one end of the bar.

While studying the assemblage, a fourth lead circle, identical in all respects to Fig. 21:1, 2, was located. This circle was retrieved somewhere off the Carmel coast by a fisherman. Judging by its striking similarity to Fig. 21:1, 2, it seems to belong to the same assemblage. The clean and precise decorative patterns on the artifacts and their uniformity of dimensions indicate they were cast in a professionally engraved, open stone mold. Numerous similar devices have been recovered from various sites along the Carmel coast. Some have geometric decorations. On one specimen, the opening is blocked by a screen formed by a lead net with irregular square holes (Oleson 1988). All the lead circles recovered so far have three holes, always in the same position; one hole is positioned opposite the end of the crossbar and the other two are equally placed around the ring. They are always associated with Roman shipwrecks, with up to ten such devices found in one shipwreck.

The function of these lead circles is not yet clear. It is obvious that they were fixed by three nails to the hull or to wooden objects onboard. Their thin and delicate nature suggests they were not designed to withstand significant forces. The decorations show that they may have been a visible attachment (Oleson 1988), although we have observed that ships were fitted with decorative metal fittings hidden underwater, such as the ‘Atlit ram (Linder 1991; Murray 1991). Among the various proposals for their function are the following: (1) covers for ventilation holes to prevent entry of vermin; (2) covers of scupper holes on deck to prevent loss of items; (3) filters for the suction opening of bilge pumps; and (4) draft marks, or marks around the water line of the ship, to delineate the trimming line for loading cargo. Oleson (1988) has stated that no satisfactory explanation for the function of these circles is yet available.

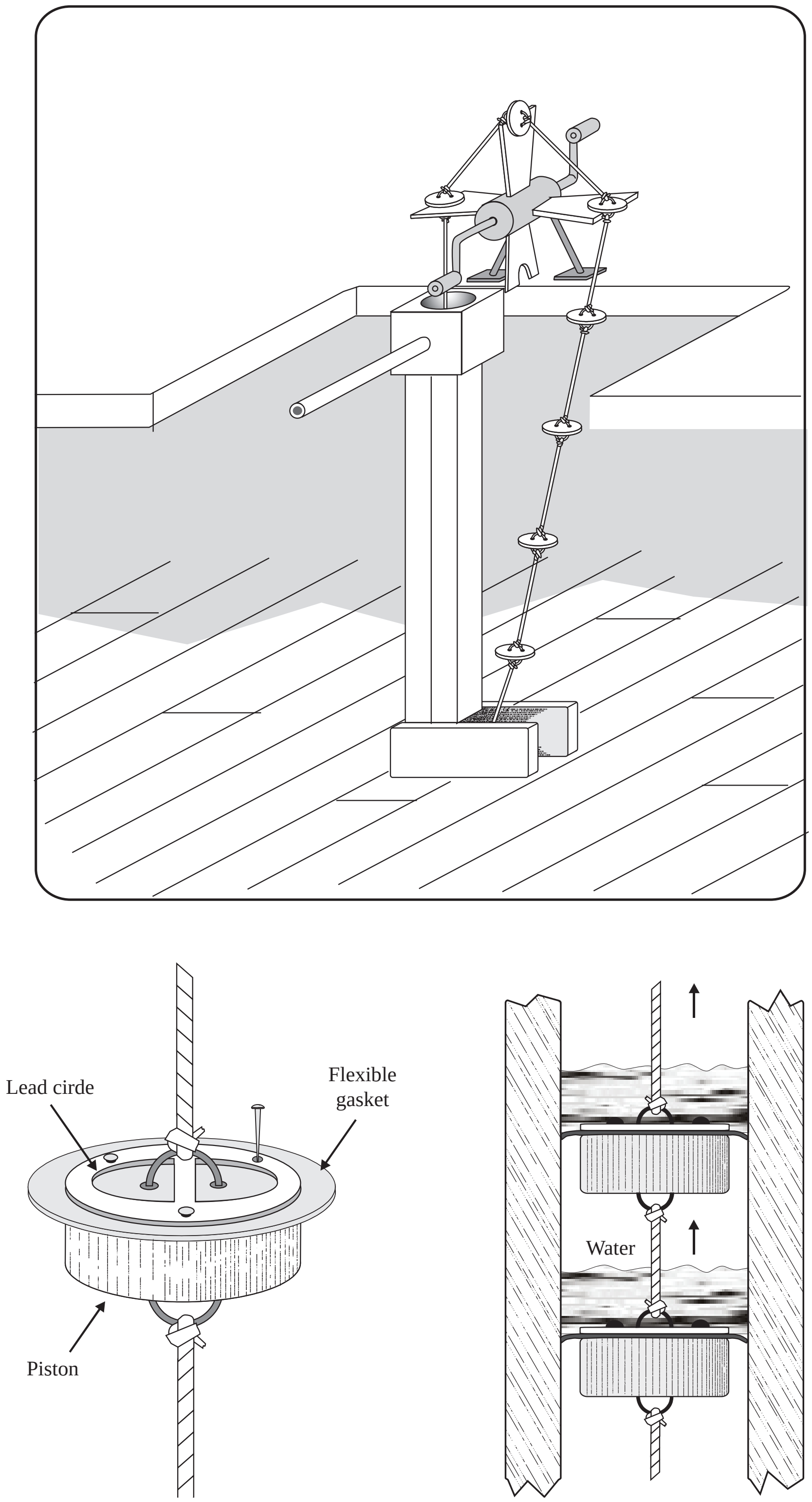

Fig. 22. Hypothetical reconstruction of a chain bilge pump where lead circles are used to attach a flexible gasket.

We suggest that the circles could have been part of a bilge pump system, as gasket holders of some sort. An endless chain bilge pump is operated by a set of numerous pistons tied one behind the other on a rope or chain. When these pistons are pulled through a pipe they lift up water. A flexible gasket is required to facilitate a seal between the piston and pipe walls. It is possible that these circles were used to attach a leather or felt gasket to wooden pistons, as reconstructed in Fig. 22. Alternately, the lead circles could also have been used as gasket holders for one-way flapping valves of a double-piston bilge pump. These one-way flexible valves could have been attached to the bottom intake orifice of the pump or to the piston, as shown in Fig. 23.

Lead Strips (Fig. 24)

Seventeen elongated lead strips, with plano-convex, V- or U-shaped cross-sections, were recovered. They weigh 70–280 g and are up to 34 cm long. The strips have irregular shapes and bear numerous usage or manufacturing marks that can be divided into three post-casting classes of cold workings: strike marks on both sides of the strip; crosswise hammerings intended for narrowing strip width; and thin long groves on the surface of all the specimens, running parallel to the long axis of the strip. These latter marks were probably made by a chisel and hammer, and were intended to push the strip into a narrow elongated space. On the upper surface of several bars are traces of a white, putty-like substance. The end of one was thickened by folding.

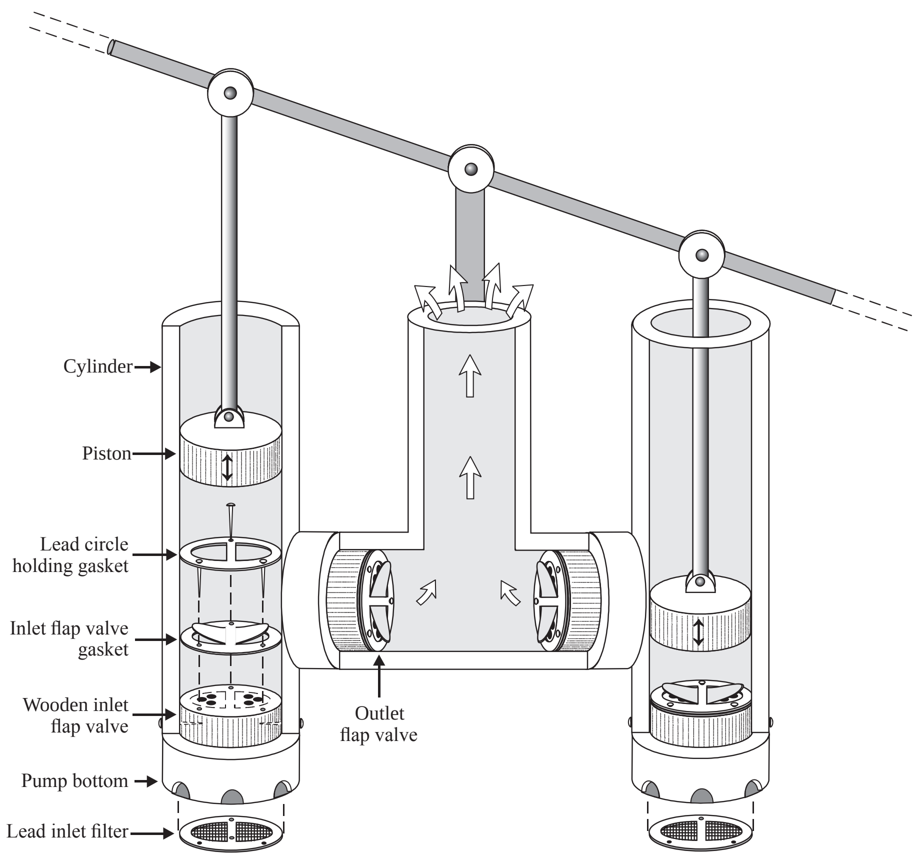

Fig. 23. Hypothetical reconstruction of a double-piston bilge pump where lead circles are used for holding the leather flap valves and as inlet filters.

Fig. 24. Lead strips (a); and a detail of a strip showing imprints of the wood to which it was once attached (b).

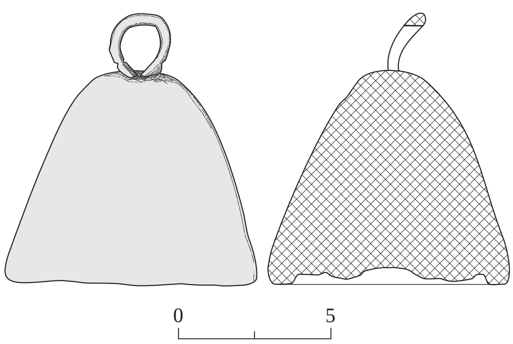

Fig. 25. Sounding lead (Reg. No. 16/37–40/1).

It is suggested that these lead strips served to seal gaps or fill various grooves in structures and installations. Perhaps they sealed large gaps between deck planks or in the hull (Rosen and Galili 2007). No such strips have been reported so far from any other shipwreck site.

Navigation Equipment and Shipwright Tools

Sounding Lead (Fig. 25).— The sounding lead has an irregular conical body, 64 mm high, weighing approximately 2.54 kg. It has slightly concave sides and a rounded apex. The base is circular (diam. 77 mm) with a flat, shallow cup roughly 5 mm deep. A bronze rod, round in cross-section and about 4 mm thick, was bent into a loop (diam. 20 mm) for tying a rope. It was placed at the apex of the body by insertion into the mold before casting.

Sounding leads such as this item were used by sailors to measure sea depth in order to ensure safe passage and anchorage, or to ascertain position when sky and land were not visible (Taylor 1971:35). They were also used by fishermen and sponge divers to explore the nature of the seabed. Adhesive material was inserted into the tallow cup for seabed sampling (Rosen, Galili and Sharvit

2001). Lead is an ideal material for producing sounding devices. It is dense, resistant to corrosion and fracturing, inexpensive and easy to cast. The form of the sounding lead is determined by function: the apex is shaped to enable tying, and the wide base allows for good contact with the seabed. Numerous sounding leads have been recovered from the seabed off the Israeli coast and around the Mediterranean (Parker 1992:29; Galili and Sharvit 1999b; Galili, Sharvit and Rosen 2000; Oleson 2000; Rosen, Galili and Sharvit 2001; Rosen and Galili 2007; Galili and Rosen 2008; 2009).

Most of the sounding leads recovered from the sea lack any patent chronological markers, as they have hardly changed in the last millennia. Their dating can be achieved by inscriptions or figured motifs carved or cast onto their surfaces, or by comparison with similar objects from dated contexts on land or in the sea. Nevertheless, there are some specific sounding lead shapes that can be associated with a certain period, such as the Byzantine type (Galili, Sharvit and Rosen 2000; Galili and Rosen 2009). Our sounding lead, however, does not belong to one of the datable types proposed by Oleson (2000).

Iron Axes (Fig. 26).— Two iron double-sided axes, weighing 2.67 and 2.46 kg, were recovered. They are called axes, but arguably can be referred to as mattocks. Both tools have oval eyes, with parts of the wooden haft extant in both eyes, and both have lost some material due to corrosion.

The axes could have been used for numerous routine tasks onboard and onshore, such as chopping firewood or reshaping a broken ship timber; or, in emergencies, such as storms, for

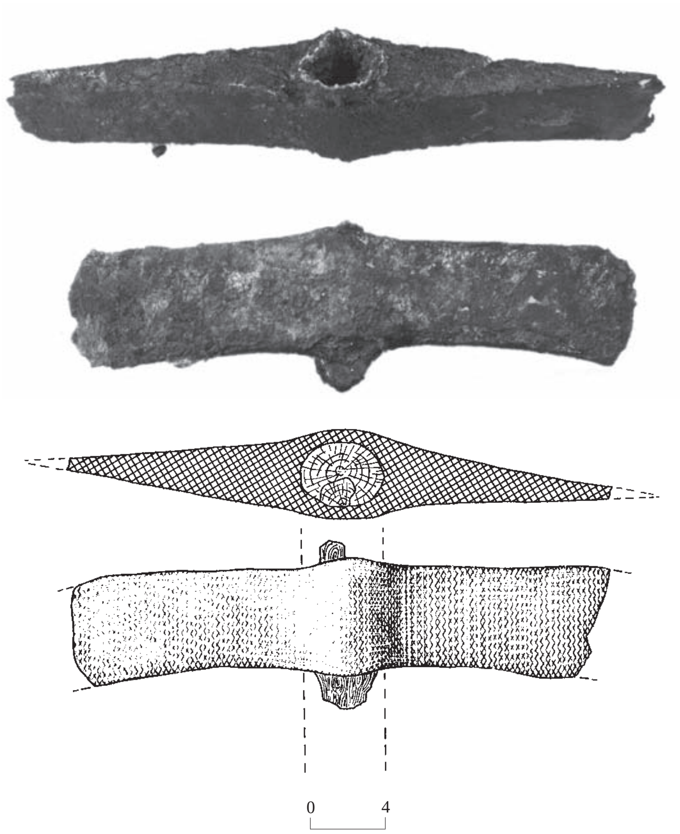

Fig. 26. Iron axes.

cutting or disposing of a broken mast or spar. Axes were also essential for loading amphorae, as they would have been used to collect small timber and brushwood for placing and securing the amphorae onboard. The axes were also used for arranging dunnage in the hold. They were most likely part of the standard equipment kit onboard ships in all periods. Our items can be identified with the Roman *dolabra*, perhaps even *dolabra fossoria* (White 1967:59–64). White (1967:63) agrees with Petrie, who stated that many of the surviving Roman specimens resemble the mattock, as they may have been manufactured for work in woodlands, which may be the case here. White also compared this tool or a similar one to a contemporary forester tool used for 'splitting and shaping logs'.

Plumb-Bob (Fig. 27).— The plumb-bob is a bronze conical object weighing 70.3 g, with concave sides and a flat top. There is a mushroom-shaped tying protrusion pierced thrice through its center—twice horizontally and once vertically—to assure vertical precision. The sides of the cone are decorated with three sets of parallel lines, the tip with a mushroom-shaped knob.

The plumb-bob was an important tool for any shipwright. It was used for erecting, substituting or replacing major ship parts, such as the stem and sternposts, ribs or other timbers that had to be correctly aligned with the keel or the existing hull. When a watercraft was beached for emergency repairs or routine maintenance, the plumb-bob was used for erecting a straight frame in which the craft was placed and aligned. The perpendicularity of the replaced parts was ascertained by stretching a line and dropping a plumb-bob according to the frame. The ancient shipwright often practiced his trade on an open beach lacking permanent benchmarks or reference points, requiring

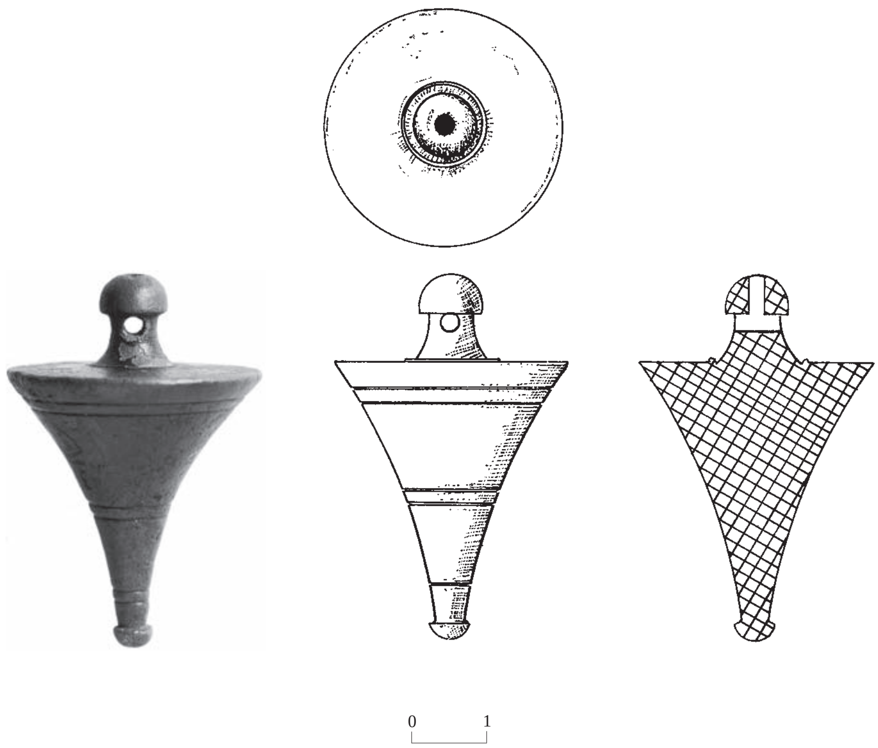

Fig. 27. Bronze plumb-bob.

him to build his own straight frame anew for each project. The plumb-bob was important in ancient times when working with wooden parts that had been minimally precut and were twisted on several planes, making it difficult to create straight lines using the naked eye. The plumb-bob could also have been used to mark the water line when painting a watercraft; today, transparent tubes filled with liquid are used for this purpose. The discovery of this tool corresponds well with the presence of the two axes.

Sewing Needles for Sails (Fig. 28).— Eight sewing needles of a copper alloy, probably bronze, were recovered. Two were broken at the head, the weak zone, where the metal eye wears by the applied strains of pushing, pulling, bending and dragging to free the needle from the textile. Of the six whole needles, five have a single eye. The needle heads were forged and flattened to form the plane in which the eyes were pierced. The lengths of the eight needles range from 10.3 to 18.8 cm; they weigh from 2.5 to 22.5 g; their cross-sections at their thickest

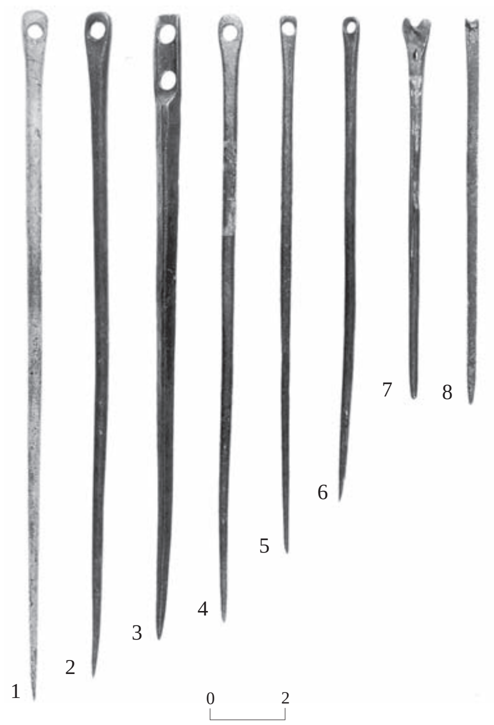

Fig. 28. Bronze sewing needles for sails.

No.	Weight (g)	Length (cm)	Max. Width (mm)	Broken	Whole	Cross-Section of Shaft	Comments
1	19.1	18.8	7.5		+	Round	1 hole
2	18.7	18.0	8.0		+	Round	1 hole
3	22.5	17.0	8.0		+	Lozenge	2 holes
4	15.1	16.5	4.0		+	Lozenge	1 hole
5	8.2	14.6	5.0		+	Lozenge	1 hole
6	9.0	13.1	3.0		+	Round	1 hole
7	6.5	10.3	8.0	+		Round	1 hole, broken and fixed
8	2.5	10.5	3.0	+		Rectangular	1 hole

points range from 3 to 8 mm. Their sizes seem to indicate they were all intended for handling heavy industrial materials, either leather or woven textiles. However, their variation in size would suggest they were meant for different textiles and/or types of stitches.

The majority of the needles (Fig. 28:1–5) in this assemblage have round cross-sections; of these, most have a head area wider than the rod. There appear to have been two attempts to recreate an additional eye in Fig. 28:7 to compensate for its broken eye: one failed attempt in the upper part, near the eye, and another smaller one, below it. It appears to have been used for sewing sails onboard. Figure 28:8 was also broken and not mended prior to deposition in antiquity.

Figure 28:3 is an exceedingly well-made specimen with two aligned eyes framed by parallel ridges along both edges of the head, giving the head an H-shaped cross-section. The purpose of the resulting depression was to shield and conceal the thread, reducing friction and twine wear while threading through tough, abrasive material. Such modification of the penetrating end is seen in modern needles, for both manual use and sewing machines. The exact purpose of the two eyes is not immediately evident. They could have been used for threading two strings together, or for tightening and releasing at will one thread looped through both holes. Several other double-eyed needles have been recovered from Roman shipwrecks off the Carmel coast.

Figure 28:3 has a pronounced lozenge-shaped cross-section from its head downward. Its working tip is somewhat curved. Modern needles for manufacturing sails have a shaft that is distinctly triangular in cross-section. It is claimed that this shape facilitates easy penetration of sailcloth and minimizes damage to the fibers of the woven tissue. The cross-section of Fig. 28:3 can be viewed as two triangles joined at the base, easier to form using a hammer on an anvil than a triangular cross-section would be, unless a specially grooved anvil was employed.

Heating and Lighting Equipment

Iron Tripod (Fig. 29).— A tripod, measuring 15 cm high and 24 cm wide, was recovered from the site. It was made by forging together three bars with rectangular cross-sections into three legs and a flat plane in the shape of an equilateral triangle. The legs were bent slightly outward at the bottom to enhance stability. The tripod could have been used for holding a cooking pot over an open fire or smoldering coals. Similar objects are still used today. Although it is possible that the tripod was used for cooking aboard ship, this is less likely, given the danger of cooking over an open fire on a wooden sailing ship loaded with combustible tackle and cargo.

Our ongoing studies of underwater wrecks have revealed that lead cooking braziers were used aboard Roman ships sailing the coast of Israel (Galili and Sharvit 1999b). Lead braziers using wood or coal were more economical than a tripod over an open fire, which required a large amount of wood. A lead brazier was possibly present on the wrecked ship. The tripod could have been used for various onshore jobs. Such jobs could have included cooking by the crew when the ship was beached or anchoring, or activities associated with ship maintenance. These could have entailed boiling water for

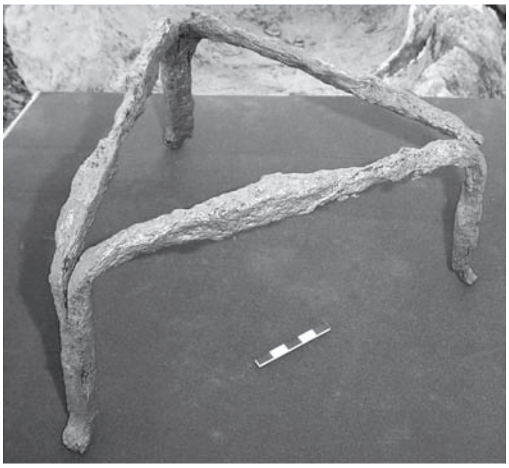

Fig. 29. Iron tripod.

washing, dissolving dyes, melting tar and tallow, and boiling small pieces of timber to shape them into a desired form. The presence onboard of such a device—intended for onshore jobs—coincides well with other findings from the wreck site, such as the woodworking and shipwright tools.

Lantern Components (Fig. 30).— Three components of composite lanterns were recovered; two are nearly identical. They have elongated metal bodies with several functional perforations on their fronts and tops, as well as decorative lateral lines and curves. The metal is a copper alloy, probably bronze, with dark greenish corrosion. The two identical pieces (Fig. 30:1, 2), which most probably came from a single instrument, have on their backsides thin bronze strips attached with bronze rivets. On Fig. 30:1, the strip is attached to the main body with four rivets; on Fig. 30:2, with six. On Fig. 30:3, some of the rivets are still inserted into the holes, but the metal strip is missing. In both of the extant metal strips, there is an additional hole at the end, not intended for a rivet, with a loop made of an elongated metal strip shaped like an omega. The tops of the rectangular parts are perforated (Fig. 30:1 with two perforations, and Fig. 30:2 with one); Fig. 30:1 has a very fine decorative chain and ring attached to it. The elongated metal parts once held a cylindrical shaped transparent parchment that most probably enveloped the sides of the lantern, as shown in Fig. 31. Lanterns of this type were

Fig. 30. Bronze lantern parts.

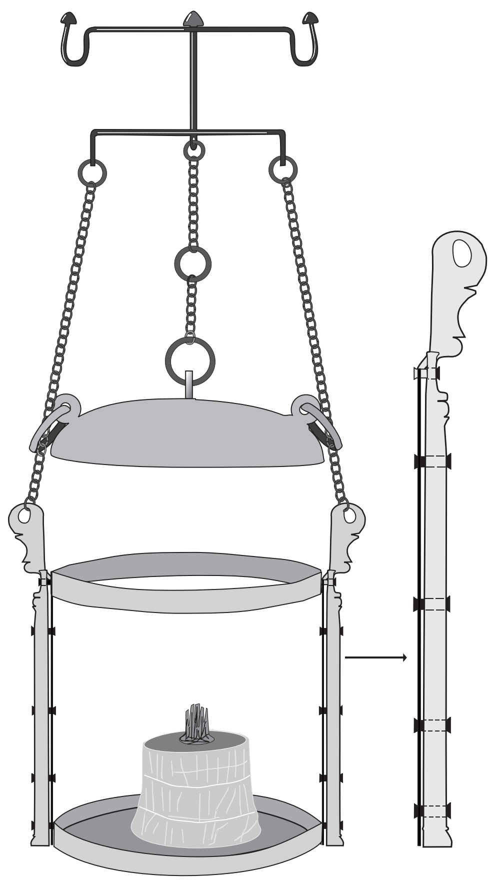

Fig. 31. Reconstruction of a Roman lantern (after Rogers 1981:82).

widely used throughout the Roman period; they have been found in Pompeii. A similar lamp was reported by Rogers (1981:82). Locally, part of a similar lantern was recovered from a Roman wreck located some 3000 meters to the south (IAA unpublished diving report). Such lanterns could have been used as lighting devices on deck or in the cabins, or as navigational aids.

Fishhooks (Fig. 32)

Fishhooks are commonly found in ancient coastal settlements and at shipwreck sites

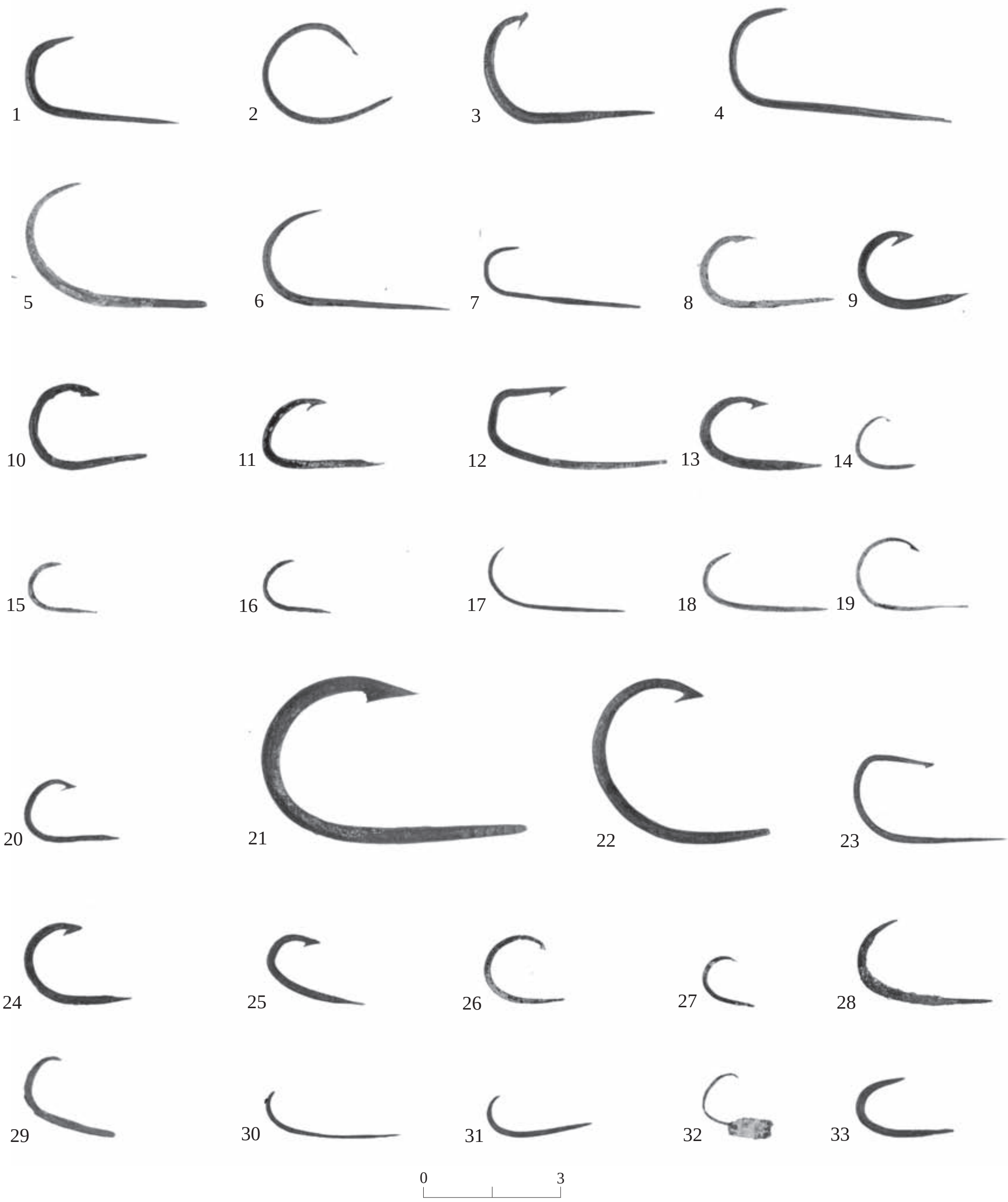

Fig. 32. Bronze fishhooks.

◂ **Fig. 32**

No.	Weight (g)	Length (mm)	Gap (mm)	Ratio (Length Divided by Gap)	Tying-End			Barbed
					Flat	Pointed	Marked	
1	0.20	35.0	15.8	2.2	-	+	-	-
2	0.60	28.0	12.0	2.3	-	+	+/-	+
3	2.20	37.7	21.4	1.7	-	+	+	+
4	1.60	52.0	19.2	2.7	-	+	-	-
5	2.50	42.0	22.0	1.9	-	+	-	-
6	1.30	41.8	18.8	2.2	-	+	-	-
7	0.60	35.7	9.5	3.7	-	+	-	-
8	0.70	34.0	13.1	2.6	-	+	+	+
9	1.25	23.8	14.5	1.6	+	-	+	+
10	1.30	25.3	13.5	1.9	+	-	+	-
11	1.10	27.5	12.0	2.3	+	-	+	+
12	1.30	39.9	15.9	2.6	-	+	+	+
13	0.60	28.0	11.2	2.5	+	-	+	+
14	0.20	14.3	9.0	1.6	-	+	-	+
15	1.30	17.0	8.8	1.9	-	+	+/-	-
16	0.30	16.0	9.3	1.7	-	+	+	-
17	0.30	31.2	11.0	2.8	-	+	-	-
18	0.20	28.2	10.0	2.8	-	+	-	-
19	0.30	24.7	11.5	2.1	-	+	-	+
20	1.10	21.3	10.2	2.1	+	-	+	+
21	9.50	59.5	29.5	2.0	-	+	+	+
22	4.50	45.0	29.0	1.5	+	-	+	+
23	0.80	35.0	14.7	2.4	-	+	+	+
24	0.90	23.8	14.0	1.7	+	-	+	+
25	0.60	23.1	9.8	2.3	+	-	+	+
26	0.20	12.5	10.2	1.2	-	+	+	+
27	0.30	12.8	8.3	1.5	-	+	+	+
28	0.90	30.0	14.7	2.0	-	+	+	-
29	0.50	22.5	11.1	2.0	-	+	-	-
30	0.30	30.0	10?	3.0	-	+	-	-
31	0.20	21.8	7.0	3.1	-	+	-	-
32	0.60	16.0	9.5	1.7	-	+	-	-
33	0.50	22.0	12.0	1.8	-	+	-	-

(Brinkhuisen 1983; Parker 1992:330, 356, 440). The oldest Levantine wreck containing fishhooks is the Ulu Burun wreck from the Late Bronze Age (Parker 1992:439). Fishhooks from Roman-period wrecks have been recovered in groups, as if comprising a kit; some Roman wrecks yielded sets of fishhooks in wooden boxes (Parker 1992:331) or in baskets (Parker 1992:444). In one Roman wreck, a fishhook was found tied to a line (Parker 1992:425).

Oleson et al. (1994:67) described two fishhooks from Roman Caesarea and listed parallels.

A total of 33 fishhooks were recovered from the wreck area. Of these, 32 were identified as copper alloy (probably bronze) and one was made of copper alloy with its shank, partially enveloped by lead (Fig. 32:32). The terminology employed by Mustad, a major modern fishhook manufacturer (*Mustad Cat.*, n.d.), for modern fishhooks, is used here in a somewhat modified form to describe the recovered ancient fishhooks (Fig. 33). These fishhooks can be classified into two major typological groups: those with barbed points (Fig. 32:2, 3, 8, 9, 11–14, 19–27) and without them (Fig. 32:1, 4–7, 10, 15–18, 28–33). They can be further classified according to line attachment method; some have a flattened tying end (Fig. 32:9–11, 13, 20, 22, 24, 25), others have a tapered tying end. Both types are occasionally grooved (Fig. 32:3, 8–13, 20–28).

In a few fishhooks, the barb is nearly detached due to corrosion and sediment abrasion. Had the corrosion advanced further, these hooks would have possibly been classified as lacking barbs. Some may have been corroded by post-depositional processes, although barbs may also be broken or bent prior to deposition by a struggling hooked fish or by getting snagged on a submerged object. Figure 32:3 may have experienced a snagging event; its gap was widened and the barbed point broken, although not detached. Yet, it remains possible that some of the hooks were manufactured without barbs. It is easier to manufacture and unhook a fish from barb-less hooks than from barbed ones.

The recovered fishhooks have no eyes, unlike many ancient and modern fishhooks (Brewer and Friedman 1989:26–31; *Mustad Cat.* n.d.:8–11). In a number of fishhooks it is not clear whether the tapered tying ends were an intentional feature or were induced by post-depositional corrosion and abrasion. In others, however, it is evident that they are not a product of environmental attrition, as they still show clear chisel and file marks intended to improve the grip of the fishing line. The marks also indicate that the tips have not corroded appreciably.

Modern commercial fishhooks are classified according to several criteria and have been given a code name and number. The code name defines general proportions and shape

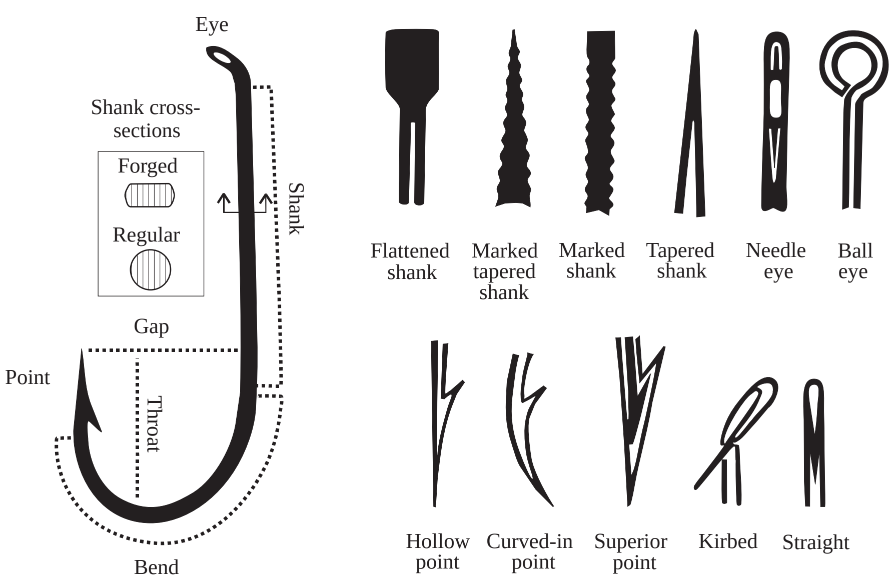

Fig. 33. Typology of fishhook parts (after *Mustad Cat.*, n.d.).

of a given group while the number generally designates size (*Mustad Cat.*, n.d.). Criteria, such as the intended target and local fishing traditions, affect fishhook group properties. Gap size of fishhooks is one of the major classification criteria for hooks. However, total shank length and the ratio of shank length to the gap may vary between hooks with the same code number, but belonging to different groups.

The dimensions of the ancient fishhooks under discussion are varied. The total shank lengths range from 12.5 to 59.5 mm, the gaps, from 7.0 to 29.5 mm, the total length-to-gap ratio, from 1.2 (Fig. 32:26) to 3.7 (Fig. 32:7) mm. Figure 32:14 is a short fishhook, somewhat similar to a modern fishhook (*Mustad Cat.*, n.d.:156, Viking Hook Group No. 7958, Size 8–9). One of the longest fishhooks, Fig. 32:4, is generally similar in gap and bow dimensions to Viking Hook Group No. 7958, Size 4/0–3/0 (*Mustad Cat.*, n.d.:156), although not in total length. The shape of Fig. 32:2 is unusual, reminiscent in form (although not in size) of some hooks in the Mustad Catalogue, such as the wide-gapped hooks of No. 37140 (*Mustad Cat.*, n.d.:161) or the tuna circle hooks of No. 39960ST (*Mustad Cat.*, n.d.:150). Thus, there is notable morphological variety among our fishhooks. Some, particularly a few barb-less ones, are entirely round in cross-section (Fig. 32:1, 2, 4, 5, 8); the rest have varying cross-sections.

The fishhooks were probably manufactured from a thin, pre-manufactured rod. As most signs of manufacturing processes do not remain, little can be said about the production methods. Seemingly, the first stage was the formation of the tip, whether simple or barbed. Afterward, the barbed rod was cut and the tying end, if desired, was formed. Finally, the hook was bent into the desired shape and dimensions. The hooks were probably distributed unbent to avoid entanglement. The flattened tying ends of the shanks of the well-made fishhooks are rounded and quite symmetrical. Some have grooves at the meeting point of the flat tying heads and the shank, to improve the grip of the line (Fig. 34). The bend was the weak zone, always liable to be warped by a caught fish or a snagged object; for this reason the hooks were at times forged into a flattened rectangular cross-section (Fig. 32:9, 11, 12, 13), which increased the rigidity of the alloy in the bending zone and bolstered bow resistance to straightening forces exerted by the hooked fish. Points and barbs of all hooks included in this assemblage were always on one plane with the shank rather than on an angle ('kirbed'), as is the case in some special non-European and modern fishhooks (*Mustad Cat.*, n.d.:90–91). The points of some are barbed.

The final forms of the best-made fishhooks in the assemblage betray deep comprehension of the mechanics of fishing, and demonstrate the

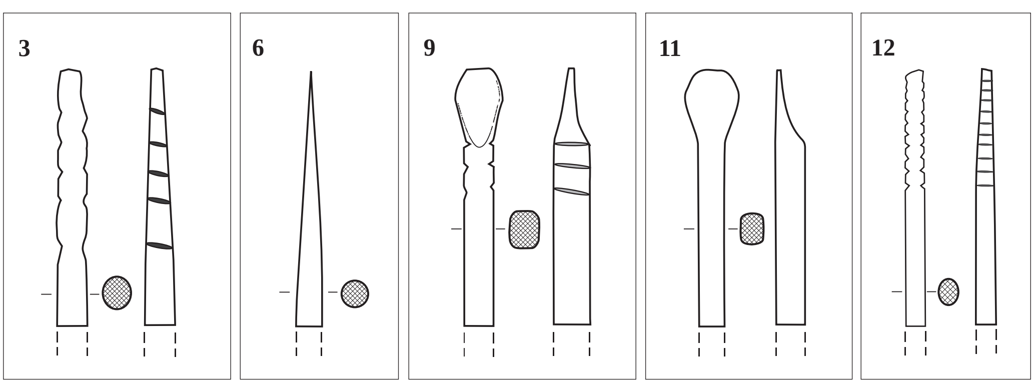

Fig. 34. Tying ends of fishhooks (nos. refer to Fig. 32).

willingness and ability of ancient coppersmiths to study those mechanics and produce hooks accordingly. The fishhooks were cleverly designed and manufactured to facilitate the best attachment to the line, maximize penetration ability and holding power, and strengthen zones liable to failure by bending or breakage, thus minimizing destructive action by a struggling fish.

As mentioned, the Mustad Catalogue was used as a basis for characterizing and ascertaining the functions of our fishhook assemblage. The index devised for the sake of comparison was total length divided by gap. In modern fishhooks, the range of this index varies from about 1.7 (Wide Gap No. 37140; *Mustad Cat.*, n.d.:161) to 5.0 (Best Kirby No. 3134; *Mustad Cat.*, n.d.:54), perhaps even higher. The range of this index in the ancient hooks varies from 1.6 to 3.7. In modern terms, hooks with such low index numbers are termed 'wide gap hooks'. For some reason, the producers of our fishhook assemblage apparently disregarded the advantages of a long shank hook. Such hooks include diminished chances of a hooked fish snapping the line, as most of the hook would be in the fish's mouth, preventing the fish from biting and cutting the line, and more effective penetration, rather than bending, as a result of force exerted by the fisherman.

Other than this general characteristic, the assemblage under discussion is heterogeneous with regard to manufacturing technique, size and typology. Modern commercial inshore fishermen, who regularly fish along the Israeli coast, particularly in the area of the wreckage site, were asked to evaluate the fishhook assemblage. In their opinion, the assemblage includes mostly medium-sized hooks intended for catching fish weighing between 1 to 15 kg, if not as great as 20 kg (Kotzer, pers. comm.). Similar unpublished Roman and Byzantine hooks, small and made of copper alloys, are on display at the National Maritime Museum in Haifa. It is recalled that the shank of Fig 32:32, the smallest hook in the assemblage, was enveloped in lead. According to the modern fishermen, the mass of the small hooks was increased for several reasons, including to prevent it from being entangled on the line while being cast, and to facilitate fast sinking, especially when baited by lightweight material.

The fishermen also commented that in the mid-twentieth century, fishing from the shore at selected locations in northern Israel could have occasionally yielded a considerable catch using a rod, a line and a small hook. A common local species caught with a small hook is the gray mullet. Two large fishhooks (Fig. 32:21, 22), intended for deep-sea fishing of relatively large bottom dwellers or pelagic fish (tuna), are present in our assemblage. Such large fishhooks have been reported in published metal assemblages from archaeological sites in Israel, such as the large bronze fishhook recovered from the Hellenistic town of Shiqmona (Elgavish 1994:103), or the two retrieved from the Roman–Byzantine harbor of Caesarea (Oleson et al. 1994:67).

Judicious analysis of the assemblage may divulge information on its provenance. There is yet no evidence that the ancients used long lines to fish along the Israeli Mediterranean coast, and it is not likely that the assemblage in question represents remnants of long-line fishing. Long-line fishhooks would have produced a more homogenous set of hooks. Our heterogeneous assemblage may derive from one or a number of wrecks, or from a combination of wrecks and fishing activity on the wreck site. The nature of the assemblage would suggest that it accumulated from numerous sources over an extended period, i.e., for fishing in several ecological niches rather than in a specific spatial or temporal niche. According to this premise, the discussed assemblage could have accumulated underwater over time because of snagging events, or been lost when a small-scale fisherman dropped a creel containing his fishing kit. However, these options are unlikely as there are no reefs or rocky patches in the wreck area that could serve as fish shelters, thus attracting fishermen. Although a wreck could have theoretically attracted fish and fishermen, a wooden wreck submerged so close to shore would have disintegrated in a short period and left no long-lasting fish shelter. Consequently, numerous lost hooks were unlikely to accumulate at the site after the shipwrecks occurred.

If the assemblage did not derive from local fishermen, it is to be associated with the shipwrecks. It is not very probable that the owner of such a collection was a transitory passenger aboard one of the wrecked ships. Rather, a more likely explanation is that the owner, or owners, were members of the ship's crew, perhaps merchant seamen who occasionally engaged in fishing from a sailing or becalmed watercraft; or from a beached, moored, or anchored craft. Such practice is still common aboard local merchant ships and yachts. Crew members aboard a small watercraft are often competent fishermen. In ancient times, when ships were more wind-dependent and less capable of sailing against a prevailing wind, they often anchored for an extended period while waiting for a favorable wind. An excellent example of this situation can be found in the contemporary account of Synesius' sea voyage from Alexandria to Cyrene in c. 404 CE. After a storm, five vessels sailing along the Egyptian-Libyan coast found shelter in a deserted bay and relied on fishing for subsistence (Synesius, *The Letters* 4.160A).

Semple (1932:580) concluded the prevailing situation in the Mediterranean: "...sailing vessels for weeks at a time cannot beat against them (the winds) but have to tie up behind islands; and in very ancient times this often endured till the sailors were threatened with starvation because their supplies were small." In these circumstances, fishing for food and thus maintaining assorted fishing gear for all occasions must have been vital and commonplace onboard.

Netting Tools (Fig. 35)

Specialized tools for manufacturing and mending nets have been alternatively referred to

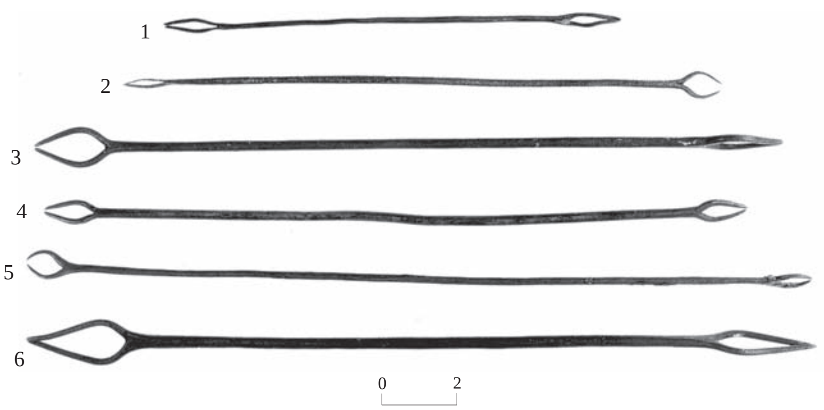

Fig. 35. Netting tools.

No.	Weight (g)	Total Length (cm)	Middle Shaft Diameter (mm)	Tip Length (mm)	Tip External Width (mm)	Tips Twist Angle (degrees)
1	2.30	12.4	1.3	15.8	5.0	40°
2	5.20	16.1	2.1	13.0	6.5	80°
3	12.80	20.3	2.8	21.5	12.0	80°
4	10.05	18.8	2.9	14.0	8.0	70°
5	7.60	21.4	2.4	11.8	8.0	63°
6	16.30	21.5	3.2	28.0	13.0	74°

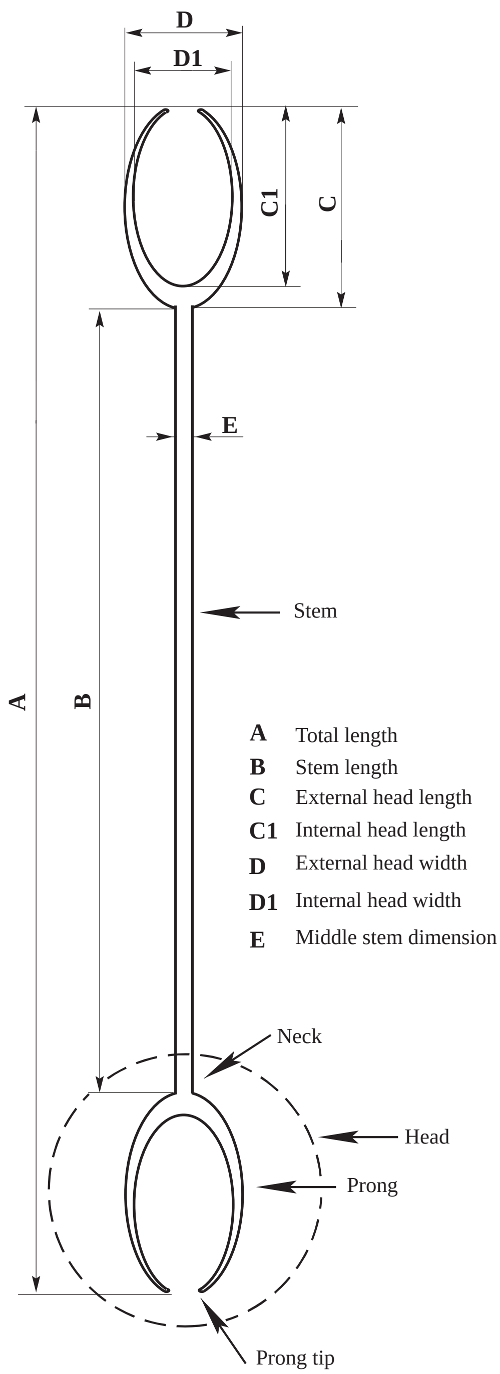

Fig. 36. Terminology of netting tool parts.

as 'netting bones', indicating a probable material used for making them; 'netting needles', although they are not needles, as they do not puncture any tissue; or 'net weaving tools', albeit nets are made from a single string and are definitely not woven. Here they will be referred to as 'netting tools'; terms for the various netting tool parts are described in Fig. 36.

The netting tool is an essential implement when manufacturing or mending nets, although these tasks can be carried out clumsily with non-specialized tools. Their presence assures that a net-maker was in the vicinity. Netting tools have often been neglected or misidentified in archaeological excavations; they are occasionally described as medical tools (Comstock and Vermule 1971:434). They have not changed much since the Bronze Age. Netting tools were discovered in Bronze Age Gaza (Petrie 1952: Pl. XV) and Roman-Byzantine Sarpeta in Lebanon (Prichard 1988:103, 217, 237, 279) and Jaffa (Nun 1964:190). They have been reported from several archaeological sites in Roman Europe (Wild 1970: passim). In all probability, they will be found on Mediterranean shores wherever ancient fishing activities took place. They are still used nowadays worldwide by traditional and modern fishermen for manufacturing and mending nets. While newly shaped netting tools made from new materials have appeared over the generations (Sundstrom 1957:44), present-day net-makers all over the world are still using classically shaped netting tools, which are characterized by a stem terminating on both ends in two prongs (Figs. 36, 37).

Six netting tools were recovered at the site. All were made of copper alloy, probably bronze, and all with stems that are round in cross-section. The stems are somewhat thicker in mid-section, narrowing slightly toward the working head. The total lengths of netting tools in this assemblage vary from 12.4 to 21.5 cm, their weights from 2.3 to 16.3 g. The netting tools in this assemblage are not aligned on a single plane; their heads are twisted onto two different planes, with up to 90° between the two.

The netting tools seen in this assemblage were formed in several ways. It seems that generally a rounded rod of copper alloy was cut to the desired length, or a piece of copper alloy was rounded and forged into a long thin cylinder. The rod ends were then hammered and flattened on divergent planes. The spatula-like heads were then split in the middle with a chisel, forming two equal tongues joined V-like to the stem. The two flat tongues were then formed into horn-shaped prongs, some with rounded cross-sections and others left flat, symmetrically shaped into an open elliptic ring. The ring's narrow opening was placed at the tip of the tool, a continuation of the line of the stem. Finally, the tool must have been annealed, as the extensive flattening, chiseling and other procedures hardened the worked area, making it fragile exactly where flexibility was desired. It is possible that some netting tools were cast into an approximate form, twisted and cold-finished into the desired shape, and finally annealed. Ancient netting tools sometimes bear decorated engravings on the stems, although no decorations are evident in our assemblage. It is a rather limited group with generally similar traits, warranting no further classification into sub-groups. Other netting tools seen in various collections differ from those of the assemblage, whether in the shape of the head, proportion of head dimension, or relative dimension of the head and stem.

The sequence of net manufacture is illustrated in Fig. 37. First, twine is spooled lengthwise on the netting tool, stretching along the stem and filling the open rings. While spooling, the twine is twisted in conformation with the twisted shape of the netting tool, strengthening the 'locked' structure of the twine. After the netting tool is loaded, the loose end of the twine spooled on the netting tool is tied to a preformed net or in a 'starting' knot to form a new net. The loaded netting tool is then brought through a preformed 'eye' of the net, or is made to form a new starting eye. By dexterously manipulating the netting tool, the net-maker produces knots that create new eyes. Fishermen typically keep netting tools either on their person or onboard the fishing boat in order to rapidly mend torn nets. Like hooks, nets may have been kept onboard an ancient watercraft for occasional fishing.

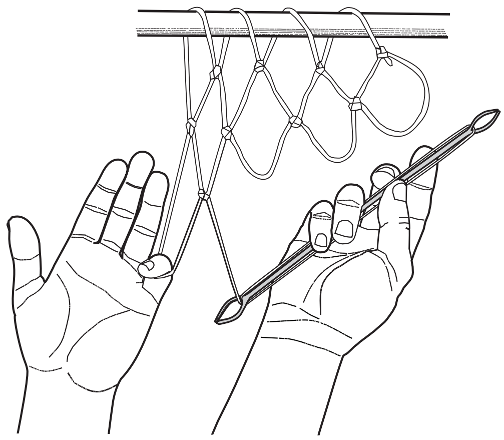

Fig. 37. Use of a netting tool.

The material of the netting tool may reveal something about the relative value of nets. It is generally worthwhile to produce and procure expensive tools to manufacture expensive goods. The dimensions of the netting tools, especially the maximal external diameter of the heads, point to the type of nets they mended or produced. The netting tools recovered from the site were all made of metal and were designed to produce narrow-meshed nets. Even in modern times, prior to the age of plastics, netting tools were fashioned from wood by fishermen, given the expense of metal tools. Wooden netting tools are more flexible and buoyant in water, making them more easily retrieved when accidentally dropped off a vessel. However, fine and thin wooden netting tools for making narrow-meshed fishing nets were hard to manufacture and liable to split or break. Thus, there must have been uses that justified the production and employment of metal netting tools.

The external width of the netting tool head determines the minimum size of the eye of the intended net. It is probable that ancient netting tools for large meshed fishing nets were made of wood, bone, horn or ivory, in that order of likelihood. The netting tools from

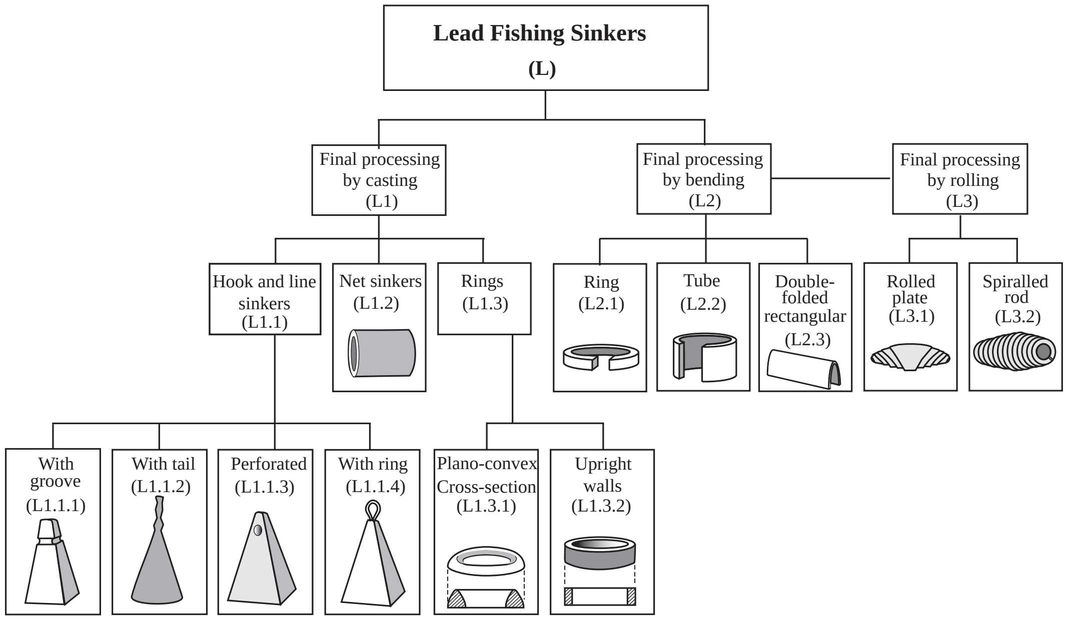

Fig. 38. Classification of lead sinkers.

organic materials perished, with only metal netting tools surviving. The netting tools under discussion indicate that it was worthwhile to produce narrow-meshed nets, which consumed more fiber per net area, in order to retain smaller fish. It was also worthwhile to procure and use metal tools to manufacture and mend narrow-meshed nets. The minimal mesh size of nets produced by this netting tool assemblage varies from 5 to 13 mm. Although it may be argued that netting tools could have been used to make other apparel, as well as nets for hunting, the fact that our tools were recovered from the sea is clear evidence of an association with fishing.

Sinkers

More than 1200 artifacts, identified as fishing sinkers, were recovered from the site. They are classified according to material—lead or stone—as well as shape, mode of manufacture and functional properties (Galili, Rosen and Sharvit 2002). The lead sinkers can be further grouped into items that were cast into their final form (Type L1; Fig. 38; Table 4) or

Fig. 39. Lead hook-and-line sinkers (Sub-Type L1.1).

mechanically reformed after casting (Types L2 and L3; Fig. 38; Table 5), having been bent or rolled. Unfolded lead sheets—raw material for making sinkers—were also recovered.

Lead Sinkers Formed by Casting Only (Type L1; Figs. 38–40; Table 4).— Seventy-seven lead sinkers were cast into their final form (8% of the sinkers). They are morphologically varied, both in dimension and weight. Most lack decorations. The following three sub-types have been outlined: The hook-and-line sinkers (Sub-Type L1.1; Fig. 39) are lead masses with

Table 4. Properties of Lead Sinkers Formed by Casting Only (Type L1)

Sub-Type	Size	No. of Objects	Average Diameter of Hole (Range) (mm)	Average Weight (Range) (g)	Average Thickness of Plate or Ring (Range) (mm)	Average Length/Height (Range) (mm)	Average Width (mm)	Notes
L1.1	Small (24–43 g)	3	2	35 (24–43)	7	32	Diameter 15, 18; width 16 (rectangle)	Two conical, one rectangular; all have holes
	Large (85–154 g)	2		(85–154)		38	(20, 29)	One conical and one bi-conical; both lack a hole
L1.2	Short (L<ext. diam. > rad.)	30	11	(12–38, 76)	3 (2.4–3.8)	16.5 (11–25)		One especially heavy (conical cross-section), part perhaps cast in a mold without a core
	Long (L>ext. diam.)	17	12 (10–17)	38 (21–60)	3 (2.0–5.8)	24.3 (18–30)		Some have inward bends (the direction of pulling is visible)
L1.3	Large, plano-convex	14	26 (22–38)	41 (29–58)	(6.0–10.2)	(4.4–9.0)		Eight rings torn, three incomplete
	Small, plano-convex	2	18	26	8	6.7		One ring torn and lacking a piece; trapezoidal or triangular cross-section
	Upright walls (3 diam. groups)	9	(10–18.5)	(12–42)	(3.0–6.1)	(7–18)		Heights may differ in the same weight
			(23–24)	(41–49)	(6.0–7.2)	(7–18)		
			37	49	7.2	8		

a device for line attachment; there are five of these items, three of which are perforated. The net sinkers of Sub-Type L1.2 are tube-shaped objects. Thirty of them are short and seventeen are long, probably cast into molds with a core. The rings (Sub-Type L1.3; Fig. 40) are objects in which the height is less than half of the external diameter; they are 25 in number. Sixteen have a plano-convex cross-section (Sub-Type L1.3.1); nine have straight walls and were probably cast with a core (Sub-Type L1.3.2).

Mechanically Reformed Lead Sinkers (Types L2, L3; Figs. 38, 41, 42; Table 5).— The mechanically reformed sinkers are made from pre-cast pieces of lead that were cut, folded, bent or rolled into the desired shape. They can be grouped into the following sub-types: rings

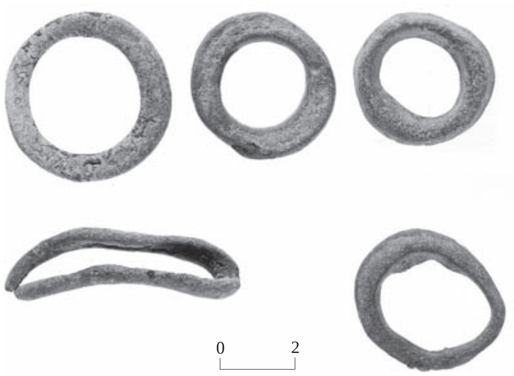

Fig. 40. Lead rings (Sub-Type L1.3).

(Sub-Type L2.1), tubes (Sub-Type L2.2) and double-folded rectangular sheets (Sub-Type L2.3; Fig. 41). The latter is the most common net sinker recovered from the site and from other archaeological sites along the Israeli coast. Their weights are quite varied, apparently a function of the lead line to which the sinkers were attached.

Sub-Type L2.3 can be further divided into three groups according to width. The hole diameter (determined by the width of the lead line) of the wide sinkers is 7–9 mm; of the medium-sized sinkers, 1.5–2.8 mm; and of the narrow sinkers, 0.8–1.4 mm. As the lead line of a cast net is not designed to bear a heavy pulling load, a thinner line can be used, making the net easier to cast. Thus, a sinker with a hole of around 1 mm in diameter would have belonged to a cast net (Galili, Rosen and Sharvit 2002: Fig. 17). Sinkers with holes 2–8 mm in diameter could have belonged to gill nets or trammel nets. Those with holes of about 1 cm in diameter or more could have been used

Fig. 41. Folded rectangular lead sinkers (Sub-Type L2.3).

Table 5. Properties of Mechanically Reformed Lead Sinkers (Types L2, L3)

Sub-Type	Size	No. of Objects	% of Decorated Items	Average Hole Diam. (Range) (mm)	Average Weight (Range) (g)	Average Thickness of Plate or Ring (Range) (mm)	Average Length/Height (Range) (mm)	Average Width (Range) (mm)	Notes
L2.1, Rings	Short	4		31.8 (17.5–36.6)	Large 79; small 9.5	Large 3; small 2.2	Large (H) 15.5; small (H) 2.5		
L2.2, Tubes	Long	3		(8.7–17.0)	38	3.2	25.5 (H)		
L2.3, Wide	Long (>80 mm)	17	100	9	54	2.2	88.0	41	76% with inner decorations
	Medium (60–75 mm)	4	100	7	36	2.0	67.0	41	Three with inner decorations
	Short (35–50 mm)	3	66	8	32	2.0	41.0	36	
	Broken	5							
L2.3, Medium	Long (>58 mm)	47	50	2.8 (2–5)	26	1.3	73.0	30	30% with inner decorations
	Medium (43–57 mm)	17	60	(1.5–5.2)	23	1.5	51.0	31	All lack inner decorations, 10 have very corroded frame decorations
	Broken	6	100						Corroded
L2.3, Narrow	Long (>58 mm)	366	85–90	1.1 (0.8–1.4)	13.8 (8–19)	1.1 (0.8–1.3)	73 (67–75)	(18–20)	35 specimens from the same net; most have frames and inner decorations
	Medium (43–57 mm)	52	80–100	1.2 (1.1–1.4)	10.0 (9–12)	1.0	53 (48–56)	(18–20)	All inner decorations are framed
	Short (24–38 mm)	18	50	1	(6–8)	1.0	30 (42–17)	(18–20)	Some may be broken
	Broken	583	50–80	1		1.0		(18–20)	Most have frames and inner decorations
L3.2, Coils	Rolled coil	2		(17–20)	(1.5–2.8)	(25–28)			One is partly rolled (unfinished); diameter of cylinder 10

for beach seines or similar nets (Galili, Rosen and Sharvit 2002: Fig. 15).

Among the lead sinkers found at the site, nine belong to classes L2.1, L2.2 and L3.2. Seven were produced from lead sheets rolled into tubes, and two, by rolling bands into coils. It should be noted that lead circles have traditionally been interpreted as brailing rings for sails (Wachsman 1998:254; Mouchot 1970:307, 318). Brailing rings recovered from the Kirenia ship have two holes for sewing them to the sails (Galili, Rosen and Sharvit 2002). However, having no such holes, the rings are interpreted here as sinkers, similar to items still used in Russia (Baranov 1970:80–81) and North America (Stewart 1982:86). Ring-shaped sinkers have some advantages over linear ones, as they do not entangle the net by snagging on it, and they are easily tied on and removed without having to disassemble the net (Galili, Rosen and Sharvit 2002: Fig. 18). Dozens of identical rings were recovered by E. Galili from a relatively sheltered area covered by a protective layer of sand at Caesarea harbor. The rings were lying in a row underwater, at a distance of 25 cm from each other. Thus, one

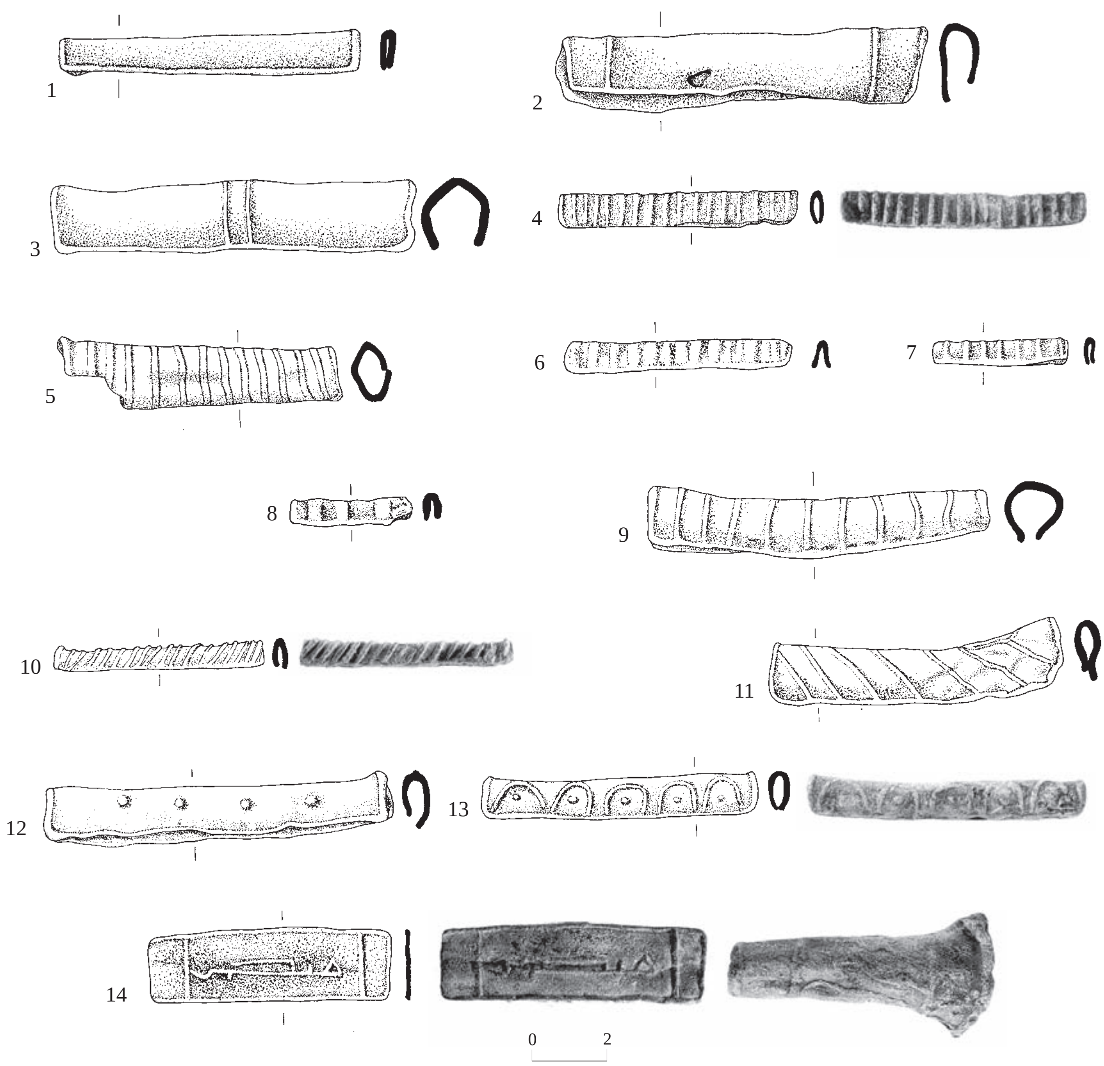

Fig. 42. Decorated or inscribed lead sinkers.

can conclude that their original distribution pattern on the seabed was preserved and that they represent the remnants of nets that were lost and later rotted.

Numerous sinkers have geometric decorations, all formed in molds (Fig. 42). Most of the Sub-Type L2.3 sinkers are decorated. The decorations can be classified as follows: raised frames (e.g., Fig. 42:1); vertical lines parallel to the edges of the sinker (e.g., Fig. 42:2–9); diagonal lines, not parallel to the edges of the sinkers (e.g., Fig. 42:10); drawn motifs, such as sea waves, anchor or herringbone (e.g., Fig. 42:11); and geometrical shapes, such as dots or circles (e.g., Fig. 42:12, 13). The traditional fisherman could easily and rapidly produce decorated sinkers using scrap metal and his own personal molds. Thus, a fishing net could have been individually marked with decorated sinkers, which were easy to produce and difficult to copy. Copying would have required stripping and recasting the original sinkers. Even today, the fishermen at ʻAkko use decorated fishing-net sinkers like our Sub-Type L2.3 for their cast nets. One of the sinkers bears an Arabic inscription and another a Greek/ Latin inscription. The sinker bearing the Arabic inscription (Fig. 42:14) is an intrusive artifact datable to the tenth–eleventh centuries CE (Ariel Berman, pers. comm.).

Lead Sheets for Producing Sinkers (Fig. 43).— Eighteen sheets of raw material for producing sinkers were recovered. It seems that sinkers like our Sub-Type L2.3 could have been formed from them. Some sheets were cast into the correct size for this type; larger items could have been cut to the right size and then bent. Two sheets had been straightened out for reuse. Some have a decorated frame around the rim. Others have at least one side cut off. Seven thin sheets (1.0–1.1 mm thick) bear a decoration

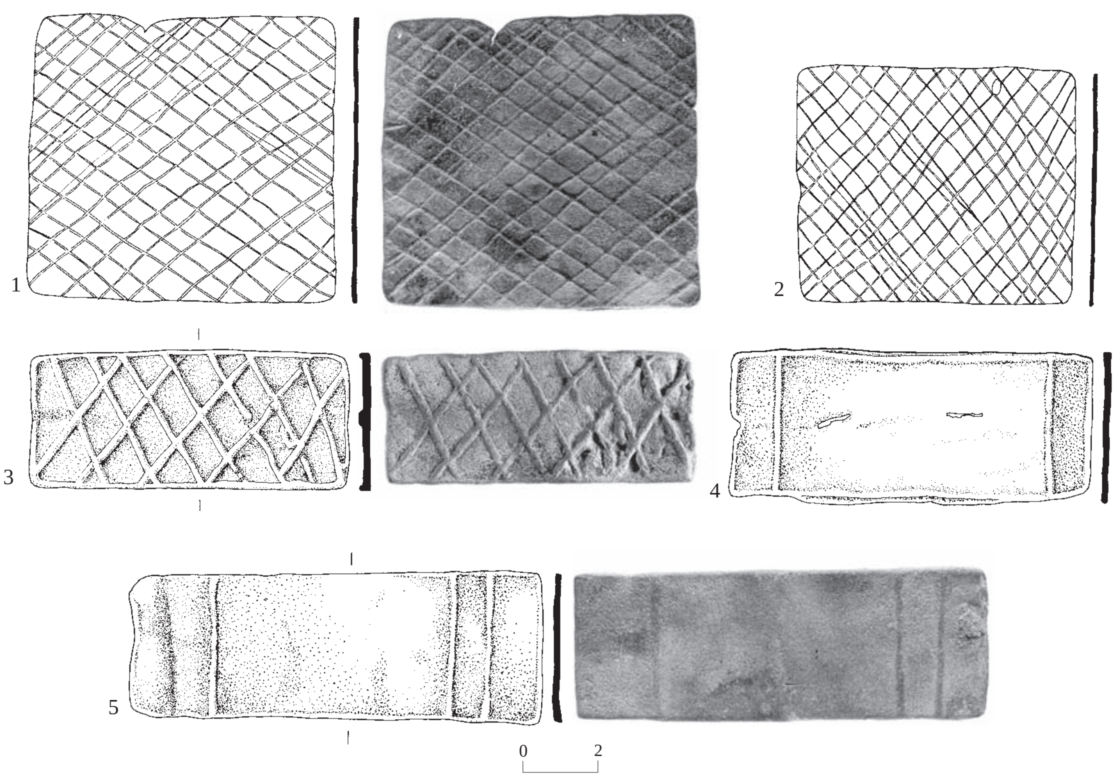

Fig. 43. Lead sheets for producing fishing sinkers.

created by scratching the molds with a sharp object before casting (e.g., Fig. 43:1, 2). Eleven sheets are significantly thicker (1.5–2.5 mm thick), five of which are plain or bear traces of a frame on the rim, and six of which are decorated with a frame and additional hatched lines (e.g., Fig. 43:3), or straight lines parallel to the frame (e.g., Fig. 43:4, 5). The dissimilarity of the decorations demonstrates that they were not cast into the same mold.

Eight tube-like sinkers (Sub-Type L2.2) of several sizes and dimensions were found open, indicating that they could have been torn off a lead line and lost on the seabed, or salvaged and stripped from an old net, to be reused.

Stone Sinkers (Table 6).— Eight stone sinkers were recovered from the site. Stone sinkers have been typologically classified (Fig. 44; Galili, Rosen and Sharvit 2002); however, not all types were found at the site. They are divided into those with a perforation (Type S1) or a groove (Type S2) for the rope. The perforations can be angled (Sub-Type S1.1) or straight (Sub-Type S1.2); the angled perforations are either L-shaped (Sub-Type S1.1.2) or U-shaped (Sub-Type S1.1.3). The grooves can be peripheral (Sub-Type S2.1) or partial (Sub-Type S2.2); they can be crisscross (or grid patterned; Sub-Types S2.1.1, S2.2.1) or single straight grooves (Sub-Types S2.1.2, S2.2.2).

Of the eight recovered sinkers, two, weighing 8.75 and 19.2 kg, are made of undressed coarse sandstone with one biconical perforation (Sub-Type S1.2.1). Another sinker, weighing 5.65 kg, is a short limestone cylinder with intersecting grooves on the bottom and sides for cross winding (Sub-Type S2.2.1). A similar limestone sinker, weighing 4.9 kg, is pear-shaped with grooves for cross winding. Two rectangular sinkers, weighing 9 and 5.5 kg, are made of sandstone with a single cross groove (Sub-Type S2.1.2). Two stone anchors with two and three perforations are made of coarse sandstone and weigh 8.6 and 6.1 kg.

Small stone sinkers were used as end sinkers for nets, although small specimens could also have been strung along the footrope (also called the lead line), as seen on Egyptian drawings of fishing scenes from the early dynasties (Brewer and Friedman 1989:38–46). Sinkers for positioning nets may also have been used to position traps (Stewart 1982:86; Sundstrom 1957:31–34).

Table 6. Properties of Stone Sinkers

No.	Sub-Type	Hole Diam. (mm)	Weight (kg)	Max. Thickness (cm)	Max. Length (cm)	Max. Width (cm)	Notes
1	S1.2.1	55–40	8.75	8	30	27	Biconical perforation; coarse sandstone
2	S1.2.1	60–40	19.20	8	42	31	Biconical perforation; coarse sandstone
3	S1.2.3	40	8.60	6	38	22	Coarse sandstone
4	S1.2.4	40	6.10	6	34	25	Coarse sandstone
5	S2.1.1	-	4.90	10	H14	D17	Limestone cylinder with four partial grooves
6	S2.1.2	-	9.00	12	30	15	Aeolian lime-cemented sandstone
7	S2.1.2	-	5.50	10	25	12	Sandstone
8	S2.2.1	-	5.65	-	H10	D17	Limestone cylinder with four partial grooves

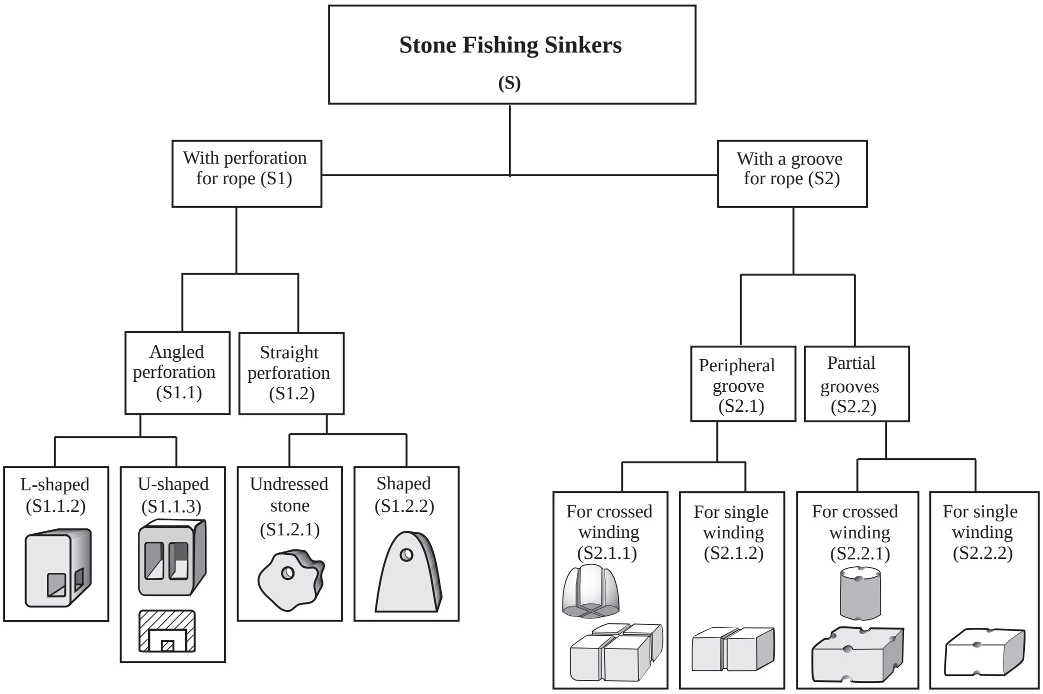

Fig. 44. Classification of stone sinkers.

Figurative Art

Bronze Figurine of Mercury (Fig. 45).— The statuette, which is 12 cm high and weighs 280 g, is relatively well preserved, except for the missing left hand, nipples and base, and the damaged hair, face and neck. It portrays the naked athletic figure of a young man with accentuated muscles. A cloak affixed by a fibula hangs from the left shoulder and is lifted by the left hand, partially covering the left side of the body down to the knee. The figure leans on its right leg, its left leg bent forward, the foot positioned behind that of the right. The head is turned slightly forward and to the right, as if looking upon the purse the figure tightly grasps in his right hand. The purse is leather and covered with tiny depressions. The hairstyle of the figure is short and wavy.

The Roman god Mercury, god of merchants and thieves, was identified with the Greek Hermes, and usually depicted, like him, as a young beardless deity. His attributes were a *caduceus*, a winged wand, symbol of his role as divine messenger; a *petasus*, or broad-brimmed hat; winged sandals; a *chlamys*, or traveler's cloak; and a leather purse, symbol of profit from trade. Two of these attributes—the *chlamys* and the purse—were preserved on our figurine, allowing us to identify the god. The missing left hand could have held a *caduceus*.

The name Mercury is associated with the root merx (merchandise) and mercar (to deal, trade). The Roman Mercury appeared at about the fifth century BCE and was exclusively a merchant's god. Plautus (c. 251–184 BCE), in his prologue to *Amphrytion*, reminded his audience that Mercury presided over messages and commerce and supervised tradesmen's profits. He was one of the most important patron gods of the merchant classes, associated with good fortune, and considered the guardian of property, particularly merchandise. In this capacity and as god of routes, capable of warding off looters and pirates, he was worshipped aboard merchant ships (Barnett 1996:6–106; Graves 1972:207).

The first temple of Mercury in Rome was built in 496 BCE. From this time on, representations of the god spread throughout the Roman world. This figurine, modeled after a statue by Polykleitos, the fifth-century BCE Greek sculptor, is typical of the style common throughout the Greek and Roman worlds. It probably dates from the second century CE. Similar statuettes dating from the Roman period were reported by Lamb (1929: Pl. 87, B.M. No. 825), Furtwangler (1895:232, Fig. 93) and Comstock and Vermeule (1971:104, No. 110). As evident from some of its parallels, the eyes of the figurine were likely originally inlayed with silver and the nipples, with copper.

Bronze Figurine of Serapis (Fig. 46).— The statuette, which is 22 cm high (including the base) and weighs 690 g, was found encased with marine encrustation (Fig. 46:a); it was fully preserved except for the missing left arm and two fingers on the right hand. The figure is dressed in a sleeved *chiton* and a *himation* that covers its left side, left shoulder, back legs and lower front side, from the hips downward to the boots, with overfolds at the front.

The head of the figure is adorned with the god's attribute, the *modius*, a basket-shaped crown decorated with olive leaves. The *modius*, which was used for measuring grain, was a fertility symbol. Four corkscrew locks

Fig. 45. Bronze figurine of Mercury.

fall on the forehead. At the back and sides of the head, the hair is wavy, but smooth, with a wide wreath of corkscrew curls at the neck. The face has a thick beard and moustache. The right arm is outstretched, slightly bent and uplifted. The palm of the right hand is open and perhaps once held a spear or scepter. The figure leans on its left leg, the right slightly bent. The legs are hidden by the *himation*. Sandles cover the ankles and leave the toes exposed (see Dohan-Morrow 1986).

The base is hollow and composed of two parts. The lower part (2.2 cm high) has an asymmetrical hexagon shape, trapezoidal in cross-section (base 8.6 × 8.2 cm; upper section 6.8 cm) and molded (height of each molding: 0.5–0.6 cm). The upper part is round, like the base of a pillar (1.5 cm high, 5.2 cm in diameter at the base and 4.6 cm in diameter at the top).

The statuette undoubtedly represents the god Serapis, one of the principal gods worshipped by seamen in the seas of the Eastern Mediterranean. In a letter written by a young Egyptian sailor, Apion, to his father from the naval base at Misenum, Apion thanks the god Serapis who saved him during a sea journey (Meijer 1986:218). Many types of statuettes of Serapis were produced in a variety of materials and sizes, ranging from several meters down to a few centimeters. They are found all over the ancient world (Comstock and Vermeule 1971:118–119, No. 125). This figurine, probably from the second century CE, may be a Roman variation of a statue of Serapis that was sculpted in 280 BCE for Ptolemy II by Bryaxis the Younger and stood in the Serapion of Alexandria.

Fig. 46. Bronze figurine of Serapis, before (a) and after cleaning (b, c).

Bronze Figurine of Minerva (Fig. 47).— The statuette, which is 19 cm high and weighs 525 g, is generally well preserved except for missing sections of the mantle, remnants of which can be seen on the arms; part of the wing of the *chiton*; and the object carried in the right hand, probably a spear or perhaps a shield. The female figure stands frozen in a forward-stepping movement, as if landing atop an orb, in the pose of a flying victory. The gaze is diverted upward. The feet are bare. She stands on the tip of her toes, as if in a hovering stance, her right leg protruding forward and her left leg pulled slightly backward. The upper part of the body is tilted and swiveled slightly as if she turns to the left, the right shoulder lowered and pulled backward. Her right arm, somewhat bent, points downward. The palm of the right hand holds a missing object; two of the fingers are partly bent, middle finger fully bent, and the thumb straight, pointing to the ground. Her left arm, bent forward, holds the left fringe of the folded *chiton*. Her head and long neck lean slightly to the right. She has a narrow face, large eyes, a straight thin nose, prominent cheeks and a small mouth. Her hair is parted in the middle and covers the ears. It is gathered into a wide tail in an archaistic style by a smooth rectangular hairpin at the nape of the neck. The wavy hair below the hairpin falls onto the upper back.

The figure wears a long, belted *chiton*, falling down to her ankles, the sleeves fastened with buttons. A *kolpos* is visible under the *aegis*. She lifts the hem of the pleated overfold with her left hand. The right edge of the *chiton* is lifted and hangs on the missing object in her right hand. Over the *chiton* is the scaled *aegis* (Fig. 47:g) with folded fringes and four small, elongated grooves, two in the chest area and two on the shoulders. These could have held objects that are now missing. A bronze serpent recovered from the site (see Fig. 48, below) may have been attached to her *aegis*. The aegis has a schematic gorgon in the middle, with hair rendered in the form of two serpents (Fig. 47:e). On each one of the figure's arms are remains of a mantle that was draped over her forearms and around her back, the ends fluttering to the sides. The flowing drapery likely once formed an arching canopy over her head or behind her back. Adorning the head is a pointed Corinthian helmet with large eyeholes and a center shield for the nose (Fig. 47:d, f). The top of the helmet is high, smooth and rounded, ending in the back in a protruding cylindrical nape shield. A cavity in the center of the helmet, above the forehead, probably held feathers. The hairstyle of the figurine is archaistic.

Minerva, the Roman goddess identified with the warrior Greek goddess Athena, was usually depicted with shield and armor, including the goatskin *aegis* and a helmet, attributes of the Greek goddess. In Rome she was introduced into the Capitoline triad with Jupiter and Juno and became an important cult figure. She was described as audacious and brave in battle, but was considered mainly as a guardian of the home, protecting its inhabitants from enemies. She also presided over intellectual and artistic activities and was considered the goddess of craftsmen, artists, poets, musicians and household activities practiced by women.

This figurine, which adopts the classical pose of a victorious goddess, clearly relates to the warrior aspect of Minerva. The archaistic hair style, the adoption of details from different styles for the clothes, such as the use of a *peplos apoptygma* in the *chiton*, and the mixing of traits adopted from different sources, relate the figurine to similar bronze examples from the first century CE. A bronze figurine of Minerva, similar in size and form, was recovered from a shipwreck assemblage in the Apollonia anchorage (Grosman 1993).

Fig. 47. Bronze figurine of Minerva.

Fig. 47. (Cont.)

Bronze Snake Decoration (Fig. 48).— A tiny bronze snake, 2.4 cm long and weighing 0.65 g, was recovered. It was made by folding a piece of bronze into a tube and twisting it into the shape of a snake. The head was given a schematic shape by forging. The snake often symbolizes medicine, although this artifact appears to have adorned some object, or been held by one of the figurines recovered from the site, as suggested above.

Bronze Eagle (Fig. 49).— A well-preserved bronze eagle was retrieved. It is 3.8 cm high, 1.6 cm wide and weighs 26 g. The body is stretched upward, its head raised and gaze looking upward, probably at the figure that once accompanied it. The head, which ends in a short hooked beak, leans slightly to the left. The protruding eyes are accentuated by two deep incisions. The neck is taut and quite thick in relation to the head. Feathers adorn the body, head, neck and legs. The wings, which are rounded at the shoulders, are folded and crossed behind the back, the right wing covering the left. The tail feathers are spread out underneath the wings. The legs are straight and end in large open claws clenching a trapezoidal base. On the bottom side of the base are traces of metal, possibly lead that joined the eagle to another object. The morphology of the bird—the head covered in feathers, the thick neck, the rounded wings—as well as the stature, clearly suggests an eagle. It may have accompanied one of the Minerva or Serapis figurines discussed above, or decorated a fine bronze vessel.

Fig. 48. Bronze snake.

Fig. 49. Bronze eagle.

Anthropomorphic Object (Fig. 50).— This long and narrow bronze object is shaped in the schematic form of a human. It is 16.6 cm high, 3.1 cm wide at the shoulders and 1.7 cm wide at the bottom; it weighs 96 g. The object was cast to form a hollow body later filled with lead. Its very top is shaped like the upper body of a human, with a narrow head topped by a loop for hanging (2.8 cm high). The face has two eyes and a long nose; the mouth is either abraded or lacking altogether. A stylish haircut, which is now quite worn, frames the face. The shoulders are triangular. In the middle of the object is a schematic representation of male genitalia, formed in the shape of a triangle with a tiny protruding penis.

A lid, now missing, may have sealed the lead inside the hollow object or case. Oxidized traces of the lid are visible on the back. Two nails are still inserted into the front surface and there is a smaller nail hole near the bottom of the object. It seems that the three nails were inserted to join the lid to the case. The object is similar to the three lantern parts (see Fig. 30) and may have had the same use.

Fig. 50. Bronze anthropomorphic object.

Jewelry

Ring with Serpent Heads (Fig. 51).— A silver ring (diam. 2.4–2.7 cm, 5.8 g), decorated with two terminal serpent heads, a style widespread during the first century CE, was uncovered. The sides of the heads have incised crisscross lines, imitating scales. On top of the heads are two parallel, gently arched, incised lines ending in an arrow. The eyes are hollowed out and may have been inlaid. The inner surface of the ring is flat, the outer surface convex. The ring seems to have acquired the shape of the bearer’s finger.

Seal Ring (Fig. 52).— This ring is of yellow copper alloy (5 g), its upper piece a round flat disk (1.8 mm thick, diam. 13 mm). On the two sides of the ring, adjacent to the disk, are two decorative depressions creating a flat profile. A winged anthropomorphic figure appears in the center of the disk, which is framed by an incised depression. The ring was cast into a composite mold. The welding marks of the two molds are apparent on the underside of the disk.

Body-Care Implements

Strigil (Fig. 53).— The bronze strigil (scraper), weighing 124 g, is beautifully rounded into an ‘r’-shape, its tip curling slightly upward. The bottom of the arch is adorned on both sides in short diagonal lines. Its concave inner side has a thick middle section that gradually narrows toward the tip and base, near the top of the handle. The handle has an octagonal cross-section and a perforation for tying a rope for hanging. The harsh sea climate, scorching sun and rough nightly winds, as well as the salty air and grime, made it necessary for the sailors to anoint their bodies on a regular basis. The excess oil was removed from the body with a strigil (Von Bothmer 1984).

Fig. 51. Silver ring with serpent heads.

Fig. 53. Bronze strigil.

Fig. 52. Bronze seal ring.

Spoons and Spatulas (Fig. 54).— Several small cosmetic implements were recovered from the wreck. Older publications have often classified similar implements as medical tools (Rimon 1997), although they could have been used for both medical and cosmetic purposes. The items in Fig. 54:1–3 have a spoon on one end and a tiny olive-shaped protrusion on the other. The spoons of Fig. 54:1, 2 are shaped like a concave, elongated leaf; that of Fig. 54:3 is somewhat shovel-like, shaped as an elongated concave triangle with a round base. All three spoons have long, sharp edges that enable scraping, somewhat like a strigil. The two tools in Fig. 54:4, 5 have a flat spatula on one end. Figure 54:4 has a sharp nail-like tip on the other end, and Fig. 54:5 has a very small date- or olive-shaped protrusion. As Fig. 54:4 is shorter than the others, it is possible that its end was sharpened after breakage. Figure 54:6 has both tips formed to perform identical functions, both with a very small date- or olive-shaped working end. Judging by comparable examples (Rimon 1997:62–71), this tool was used for eye lining. Figure 54:7 is a bronze spoon with an almond-shaped head that narrows toward the handle. The handle has a round cross-section and ends in a point. In antiquity, spoons were used in cosmetic and medical contexts, seldom for eating. Our specimen could have also been used for extracting snails from their shells. Such a spoon was called a *cochleare*, after one of the Romans' favorite dishes—snail (*cochleae*).

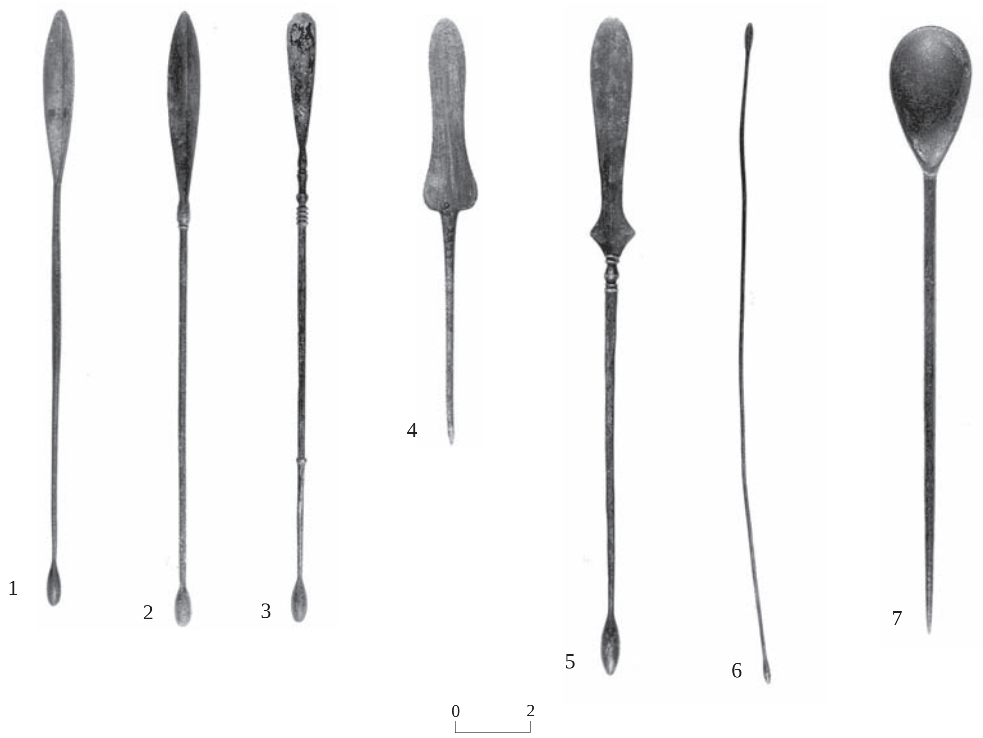

Fig. 54. Spoons and spatulas.

No.	Object	Weight (g)	Total Length (cm)	Decorations on Stem	Width at Middle (mm)	Major Working Edge (cm)		Other Working Edge (cm)	
						Length	Width	Length	Width
1	Spoon	6.8	15.4	-	3.0	4.40	0.95	1.2	0.30
2	Spoon	7.5	17.2	+	2.5	3.88	0.85	1.1	0.50
3	Spoon	7.1	15.7	+	2.0	4.70	0.95	0.8	0.30
4	Spatula	9.2	11.9	-	3.0	5.40	1.50	Broken	Broken
5	Spatula	14.5	18.2	+	3.0	6.80	1.20	1.6	0.50
6	Make-up stick	2.5	17.8	-	1.0	0.70	0.20	0.5	0.15
7	*Cochleare*	11.5	15.9	-	4.0	3.80	2.20	-	-

Small Cosmetics Pestle (Fig. 55).— Among the recovered items was a bronze pestle, 7 cm long and weighing 40.5 g. Its head is dome-shaped with an incised ridge surrounding the bottom circumference. The handle is round in cross-section (diam. 6–8 mm) and gently curves out toward the end. The bottom of the pestle is conical with a convex base (diam. 1.6 cm). The pestle could have been used for crushing cosmetic substances.

Fig. 55. Bronze cosmetic pestle.

Lump of Bismuth.— A lump of raw bismuth weighing 502 g was retrieved among the finds. It was probably used for producing make-up powder.

Various Metal Artifacts

Bronze Hanging Handle (Fig. 56:1).— This bronze item, 143 cm long and weighing 118 g, is made of a leaf-shaped plate, slightly curved, and a flat protrusion folded into a loop. The plate was welded to another object, such as a bowl or pot, and served as a hanging handle. There are traces of the metal (lead and/or tin) used for welding the hook to the vessel on the inner side of the plate.

Bronze Swinging Handle (Fig. 56:2).— Figure 56:2 is an omega-shaped bronze item, 67 cm long and weighing 48 g, with a rectangular cross-section. The object was made from a bar forged into a handle that is thicker in the middle (9 × 9 mm) than at the ends (6 × 6 mm), where it is bent. The artifact could have been used as a vessel handle, similar to the metal handle of a modern bucket.

Bronze Pad Lock (Fig. 57).— The lock is of a type alternatively called a spring lock, barbed-spring lock, barb-bolt lock, cylindrical lock or barrel lock (Pulak, in press). It is composed of two parts: the body and the bolt-locking mechanism. Similar iron locks were recovered from the Serçe Limani shipwreck (Pulak, in press) and bronze specimens at Corinth (Davidson 1952:139, Nos. 107, 108, Pl. 71). They were usually used for locking wooden boxes.

Key.— Among the finds was a small key (not illustrated), 3.7 cm long and weighing 6 g, made of a yellow copper alloy. It has a common shape, consisting of an oval head with a flat cross-section (1.65 × 1.20 cm), a cylindrical shank and a rectangular lock piece, 6 mm from the end of the shank. The lock piece is twisted slightly to the right of the axis of the key head. On the sides of the key are elongated

Fig. 56. Bronze handles: (1) hanging handle; (2) swinging handle.

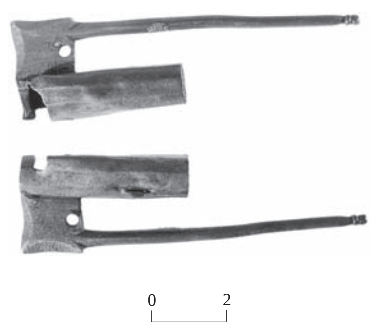

Fig. 57. Bronze pad lock.

ridges indicating where the two sections of the key mold were joined together; the ridges were chafed with a stone file.

Round Metal Plate.— A round disk-shaped plate was found (not illustrated; diam. 14 cm), made of metal containing a large amount of bismuth (Sariel Shalev, pers. comm.). It is slightly concave on one side and flat on the other. On the flat side there is a surrounding ridge (0.4 mm high, 0.8 mm wide) and a malformed incised circle in the middle. In the middle of the concave side are two close incised circles (outer diam. 1.8 mm, inner diam. 1.6 mm); in the middle of the circles is a smaller circle (diam. 0.3 mm). The function of the object is unclear.

DISCUSSION AND CONCLUSIONS

Dating

The archaeological evidence from the wreckage site examined here demonstrates that there were two Roman wrecks at the site, dating to the third and fourth centuries CE, respectively. The 162 coins from the older vessel were minted over a period of 230 years, the latest coins belonging to the reign of Alexander Severus (222–235 CE). Thus, it seems that the earlier wreck occurred around 230–235 CE. Of these coins, 77 were minted in Rome, 38 in Caesarea, 15 in ʻAkko-Ptolemais, 9 in Tyre, 8 in Alexandria and various others in ten other Eastern Mediterranean cities, most coastal (see Meshorer, this volume). The coins may have belonged to passengers or crew members aboard, who intended to use them at their destination on the Eastern Mediterranean coast, probably for trading purposes. Traders would have preferred to carry recognized local coins in order to avoid expenses in exchange. However, the ship port of origin could also have been an Eastern Mediterranean port. The 38 Caesarea coins form the majority of the 74 local coins in the hoard. A look at the distribution of the remaining local coins betrays a pattern: the more distant the local mint from Caesarea, the fewer coins present in the assemblage. This would suggest that Caesarea was the port of origin or the intended destination of the ship.

The coin assemblage from the second wreck consists of 76 coins from a limited period of time at the beginning of the fourth century. Most are dated to 313–318 CE (see Ariel, this volume). Of these coins, 87% (69 out of 79) derive from the western part of the empire, namely Rome and regions to its west.

Site Formation and Post-Depositional Processes

The northern Carmel coast of Israel is sandy, slightly graded and lacking in natural shelters for ships. Storms have trapped ships along the coast over the millennia, crushing the wrecked vessels in the breaker zone. Their remains are scattered on the seabed at depths of 2–4 m (Galili, Shmueli and Arzy 1986:25–37).

The two ships were likely wrecked under similar circumstances, while sailing along the Carmel coast or anchoring off it, one roughly one century after the other. An analysis of the composition of scores of wrecks along the Israeli coast has demonstrated that the products of a shipwreck in the surf zone are generally separated into three main classes by the sea acting on the wreck. People and livestock will drift ashore. Light cargoes, as well as wooden parts and objects firmly attached to them, will also wash ashore. Heavy metallic or stone objects will sink into the sediment during the storm or soon thereafter, accumulating on the clay (or stone) substratum under the sand. Clay amphorae will either drift ashore or roll on the shallow sea bottom and gradually move away from the wreck site. In most cases, they will be well worn by the surf. Therefore, only heavy objects will remain at wreck sites in the surf zone. It thus seems that the cargo of our two wrecks was composed mainly of materials that did not remain on site. In addition, post-depositional processes may have added some intruding artifacts to the site. Some of these may have originated in fishing activity in the coastal region, as demonstrated by the fishing sinker inscribed in Arabic (see Fig. 42:14).

In the last century, sand quarrying and the construction of marine structures, such as breakwaters and quays along the Israeli coast, has interfered with the movement of unconsolidated sediment, creating a shortage of sand and changing the patterns of coastal sedimentation. Wide areas of sea bottom were uncovered, and consequently, hundreds of sites, including that presented here, were exposed and discovered.

The Ships

The size of the ships can be estimated according to the anchors and nails. Anchors about 1 m long, as found at the site (see Figs. 17–20), are attributed to small vessels around 10 m long. However, according to the nails, we estimate that the ships were medium in size, 15–25 m long. The two anchors recovered from the site could have thus been used for fishing boats or lifeboats, or as auxiliary anchors. The two ships were most probably constructed by the 'shell-first' method, using mortises and tenons; ships constructed by the skeleton methods appeared later (Casson 1971:14–16, 201–214). No obvious remnants of ballast were recovered from the site. Possibly, the ships used local stones, *kurkar* or limestone pebbles, ballast which cannot be distinguished from indigenous stones. It is also possible that the cargo was heavy enough that the ship did not need an appreciable amount of ballast.

Fishing Artifacts

Fishing gear found on a given underwater site may have derived from fishing activities or from a shipwreck that deposited on the seabed remnants of the gear it carried. Ancient Mediterranean shipwrecks have sometimes been found to contain fishing sinkers and fishhooks (Parker 1992:330, 356–440; Frost 1991:355–410). Watercraft of all sorts commonly carry fishing gear to augment the diet of crew and passengers and help them pass the time while sailing or anchoring. Ancient or modern fishing activity may have deposited remnants of fishing gear underwater, due to loss or a shipwreck. The organic parts of the fishing gear would have decayed, with only the metal and stone parts surviving (Frost 1991:355–410). These remains may intermix with those of intrusive gear, leaving a puzzle to be solved by archaeologists. In our case, there are remains of other shipwrecks reported in the vicinity of the site (Galili and Sharvit 1999a; Galili, Dahari and Sharvit 1993), and some of the fishing gear recovered, especially sinkers, may be intrusive artifacts.

The lead sheets from the wreckage site (see Fig. 43) show that some fishing-gear sinkers were made onboard from pre-cast sheets. The netting needles (see Fig. 35) are evidence for the manufacture and mending of fishing nets by the ship crew. The nature of the nets will be dictated by the physical characteristics of the fishing ground, such as currents, waves and bottom sediment. The seabed at our wreckage site is flat and sandy, ideal for beach seines and cast nets intended for schools of littoral fish. This seabed is not suitable, however, for hook-and-line fishing, suggesting that the hooks and hook sinkers are associated with the shipwrecks.

The Crew

Among the most important crewmen aboard seagoing vessels were shipwrights, carpenters and sail-makers in charge of canvas tasks and ropes. Carpenter tools such as stocks, pegs and treenails were used for plugging holes and fastening lead sheathing to the hull.

Rites and Symbolism

Bronze figurines, such as those from our site (see Figs. 45–47), have been recovered from many Roman and Hellenistic wreckage assemblages along the Israeli coast (Raban 1971:62–69, Pl. XI; Galili, Dahari and Sharvit 1993; Galili, Sharvit and Dahari 2000; 2001; Galili and Sharvit 1999a; Grossman 1993:224). Ritual objects were customarily carried during sea voyages (Brody 1998; Neilson 2002). Sea travelers would bring their favorite statuettes of gods with them on journeys, as protectors of ships. Ancient mariners faced constant dangers at sea and were thus highly religious and superstitious (Galili, Sharvit and Rosen 2000). A small altar could be used by sailors for ritual offerings to ensure a safe journey (Parker 1992:189, 422). In addition, mariners sometimes attached various symbols to the ship's stern to ensure a safe voyage at sea. It is likely that the three figurines presented here were the personal belongings of the sailors or passengers, or were perhaps allocated a special place of worship aboard the ship, accessible to the crew and passengers. The style of the figurines indicates that they belong to the second century CE, perhaps earlier. They most probably derived from the earlier shipwreck, of the third century CE.

It is worth noting that all three figurines are missing certain body parts, potentially a result of post-depositional processes. Yet, deliberate tampering is also a possibility, given the aversion of observant Jews and certain Christians to idols. Some believed that the presence of idols on a sea voyage could incur the wrath of god and endanger the ship, crew and passengers, as is described in the book of Jonah.

Cultural Aspects

Although there appear to have been no major differences in the marine and coastal environment of the two wreckage events, as well as the construction and maritime material cultures of the two wrecked ships, there are obvious differences in the ritual and numismatic finds of the two assemblages. As surmised from the coins, one ship was wrecked c. 235 CE and the other c. 318 CE. The earlier ship thus sailed during the Roman Imperial period, carrying figurines representing the Roman pantheon and pagan mode of life. The later vessel sailed in a very different cultural and political environment, not long after the formal Roman acceptance of Christianity. Judging by the coin assemblage, it may have carried a person or persons from the western provinces of the empire, perhaps on a pilgrimage to the Holy Land, whose economy had been significantly affected by the Christianization of the empire. Early pilgrimage accounts to the Holy Land are known from the anonymous Pilgrim of Bordeaux in 333 CE; Egeria, possibly from Galicia on the west coast of Spain, a half century later; and a Roman noblewoman named Paula who came in 385 CE (Wilkinson 1977:1–2).

Archaeological evidence for a possible early pilgrimage from the West was discovered in the Chapel of St. Vartan in the Church of the Holy Sepulchre in Jerusalem, consisting of a drawing of a sailing ship, accompanied by a written biblical citation in Latin; it was probably made by Christian pilgrims from the Latin-speaking West, among the earliest able to make their way to Jerusalem openly and express their feeling explicitly (Broshi and Barkay 1985). The new evidence from underwater archaeological research, which has dated the later of the two wrecks presented here to c. 318 CE—some five years after the Edict of Milan in 313 CE and predating the earliest literary description of western pilgrimage mentioned above—might be further testimony to Christian pilgrimage to the Holy Land from the West at the dawn of the Byzantine period.

NOTE

[1] License Nos. G-32/90, G-26/92, G-30/97 and G-29/98. The surveys were headed by Ehud Galili and Jacob Sharvit, with the participation of Dani Moskovitz and C. Sali (diving, retrieving and documenting the archaeological material); Tsila Sagiv (photography); and Sharon Ben-Yehuda (drawings and some editing). The site was examined by divers using S.C.U.B.A. equipment, an underwater metal detector, and surveying and documentation instruments. Limited excavation was carried out by a water jet, generated manually. The authors would like to thank Yosi Ayalon, Susan Katzev, John Peter Oleson, Mendel Nun, Rachel Pollack, Avshalom Zemer, Adam Kotzer and the late Adiv Shehadeh for their information and help on matters related to fishing; and Rivka Gersht and the anonymous reviewer for their considerable help concerning the metal figurines.

Author contribution: E.G. and B.R. studied the material and wrote the article and the discussion. J.S. wrote preliminary drafts on the the lead sheathing and on the bronze figurines of Merury, Serapis and Minerva.

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