THE ULUBURUN SHIPWRECK AND LATE BRONZE AGE TRADE

CEMAL PULAK

A shipwreck dating to the Late Bronze Age was excavated off Uluburun—or Grand Cape[1]—approximately 9 kilometers southeast of Kaş, in southern Turkey, between 1984 and 1994.[2] It was discovered by a sponge diver during the summer of 1982 and brought to the attention of archaeologists at the Institute of Nautical Archaeology (INA) conducting annual shipwreck surveys along the coast.[3] The original allure of the site was its cargo of copper ingots. Similar ingots had been discovered during the 1960 excavation of a seafaring merchant ship of around the twelfth-century B.C. off Cape Gelidonya, just 65.5 kilometers east of Uluburun. Analyses of finds from the Cape Gelidonya shipwreck had allowed George Bass to hypothesize about the central role of Near Eastern seafarers in Late Bronze Age trade in the Mediterranean.[4]

Excavations at Uluburun quickly revealed the true wealth of the ship. The vast cargo included ingots of copper and tin, other raw materials, several types of manufactured products, and a collection of premium exotic goods. The assemblage recovered from Uluburun has offered great insight into Late Bronze Age trade, both on land and at sea. The raw materials have yielded information on contemporary metallurgy and technology, and the exotic goods illustrate value-laden commodities. With its coherent artifact assemblage and extant hull remains, the wreck is considered the world's oldest seagoing ship and has pushed back the timeline of shipbuilding technology. Examination of the hull and cargo of the Uluburun ship has challenged many previously held assumptions about Late Bronze Age society, and ramifications of the excavation are still being interpreted. Conservation and analyses of the nearly 17 tons of artifacts recovered from the site continue today, demonstrating the multiplicity and complexity of the find.

The Site

Archaeologists first visited the site, situated 60 meters off Uluburun's east face and about 350 meters from the terminus of the cape, in the autumn of 1982. Immediately visible were several dozen ingots, still arranged in four discernible rows. Their shape was reminiscent of copper ingots recovered from the Cape Gelidonya shipwreck two decades earlier and termed "oxhide" for their rectangular, four-handled appearance. It had been assumed that each ingot represented the shape of an oxhide, possibly as a means of assigning value for trade, although this hypothesis has since been disproved. The form of the oxhide ingots and other artifacts from the wreck allowed us to propose a rough date of about 1300 B.C.[5] With this estimated date in mind, excavations began in the hope of uncovering items that would illuminate aspects of Late Bronze Age trade.

Because of the depth of the site—42 to 61 meters[6]—the cargo had been spared from salvage or pillage. Nevertheless, recovery of the artifacts was not easy. The depth created difficulties for archaeologists, who could dive only twice a day, each dive limited to twenty minutes of bottom time. Over the subsequent eleven seasons of excavation, more than 22,400 dives were conducted, logging a total of 6,613 hours underwater at the wreck site. The majority of the artifacts were scattered over about 250 square meters of the rocky bottom, which is characterized by a jagged, steep slope, averaging 30 degrees, and occasional pockets of sand (figs. 91–93). The ancient ship had come to rest listing 15 degrees to starboard, in an approximately east-west orientation (fig. 92). From the appearance of the cargo, particularly the copper ingots, and the discovery of several stone anchors, it was determined that the stern of the ship lay higher on the slope, on the western end, with the bow at the deeper end of the site. As the ship settled under the weight of the cargo, the wood hull gradually collapsed and eroded in stages. Some artifacts settled into level spots, while others tumbled down the slope. This led to problems, as many artifacts were found out of their original context. Because each sherd was numbered on the seabed and plotted on a site plan, ongoing reassembly of the pottery and other cargo revealed the trail of spillage, permitting, through detailed documentation and computer graphics, the reconstruction of the cargo's original placement within the ship's hold (fig. 94).

Figure 90. Archaeologist excavating copper ingots at site of Uluburun shipwreck.

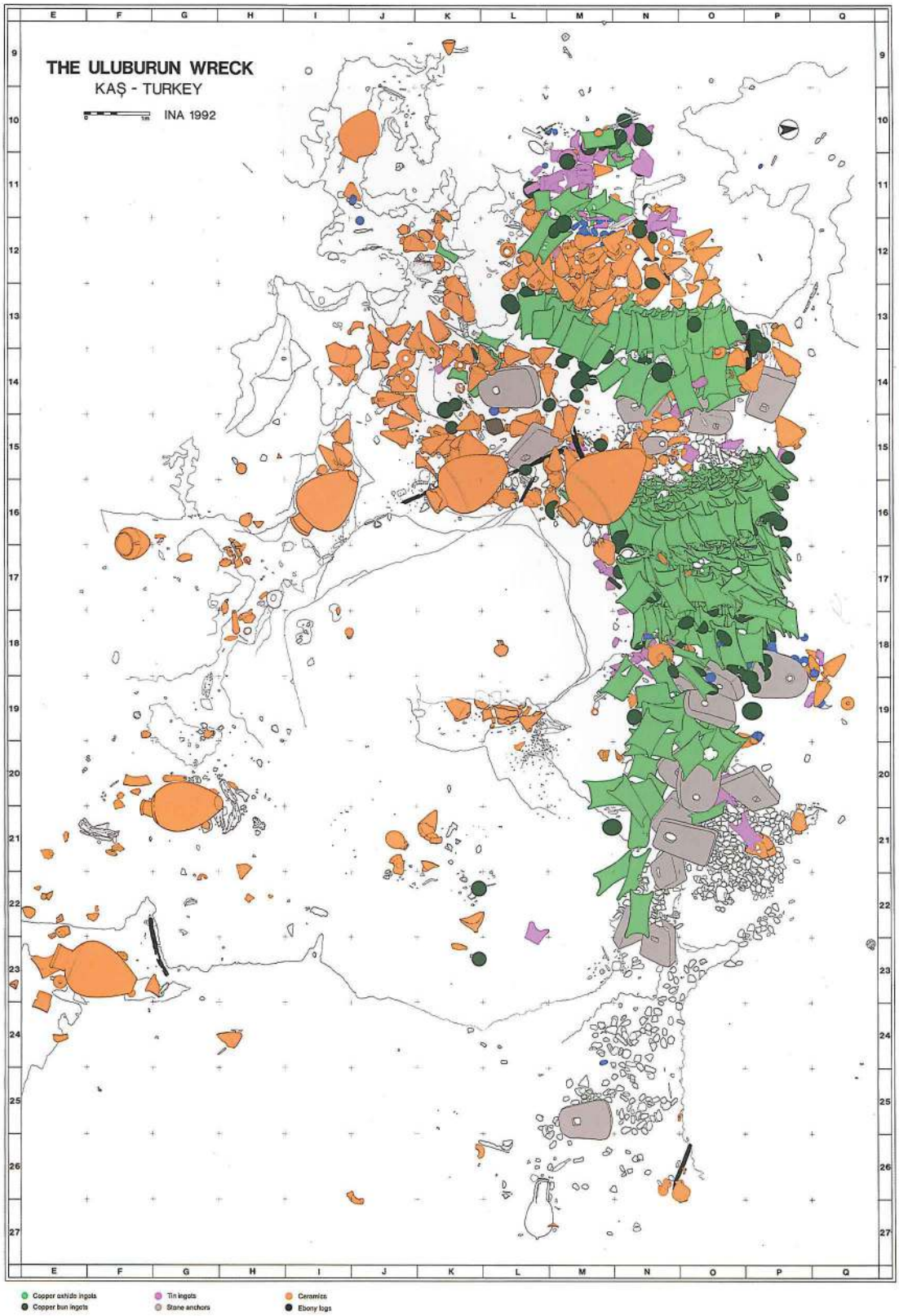


Figure 91. Plan of seabed at the site of the Uluburun shipwreck.

Cargo

The Uluburun ship had a carrying capacity of at least 20 tons' burden.[7] This minimum capacity was calculated by tallying the recovered objects, which included more than 10 tons of copper and one ton of tin ingots, glass ingots, Canaanite jars, large ceramic storage jars (pithoi), stone anchors, and approximately one ton of cobblestone ballast. This estimate assumes that all transport and storage containers were filled with materials approximating the density of water (1 g/cm^3), although some large storage jars were originally packed with Cypriot pottery for export (see cat. no. 193). It is impossible to estimate exactly how much of the ship's original cargo perished, but some fragments of the more delicate items, such as ebony logs, riddled with teredo, or shipworms, hint at the harsh environment.[8]

Of the twenty-four stone anchors carried on the ship, eight remained in the hold in the midship area as reserve anchors

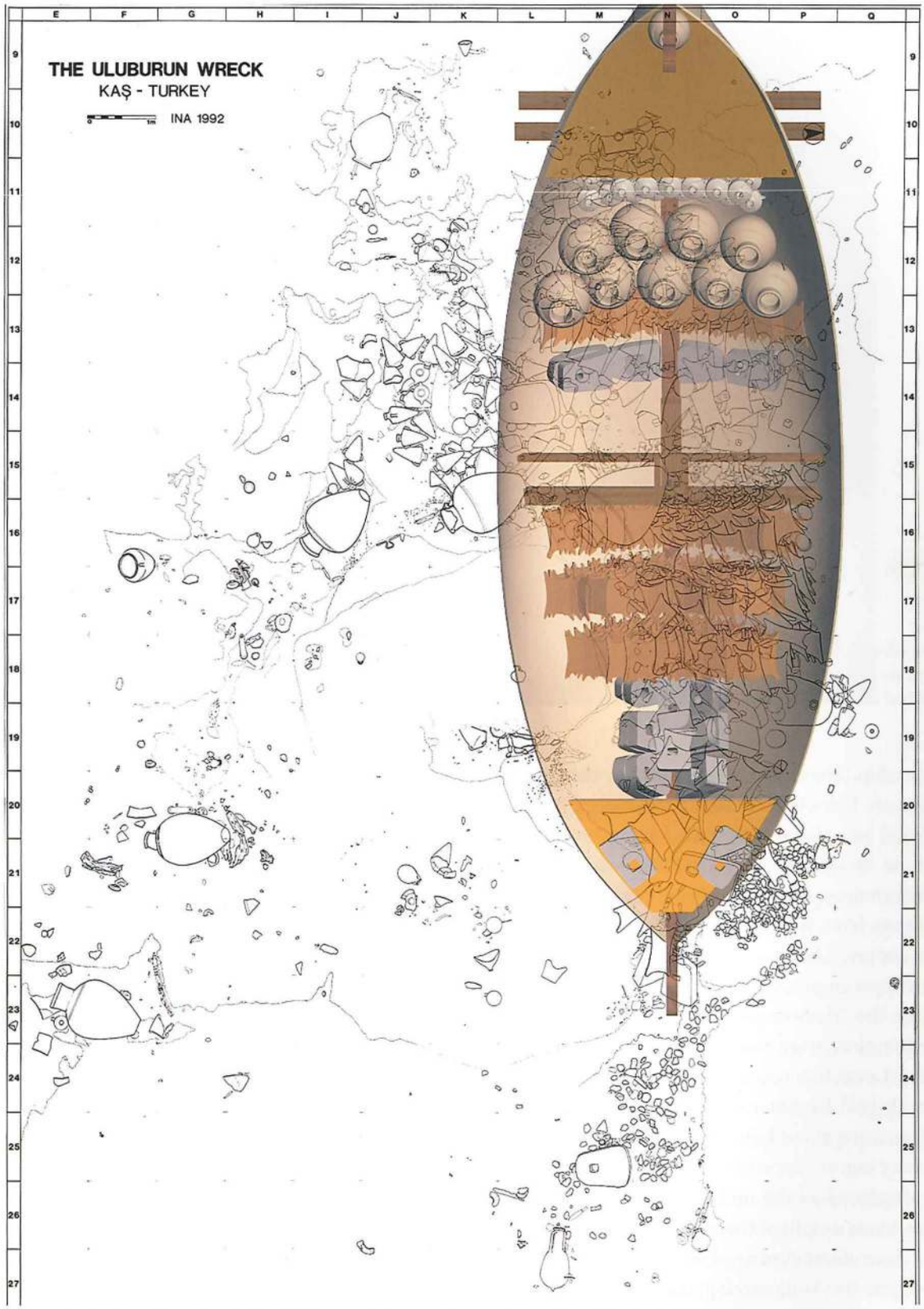


Figure 92. Reconstruction of the Uluburun ship superimposed on plan of seabed.

carried as ballast, while the remainder were stowed at the bow, with several ready for use. An analysis of the cargo provides our clearest glimpse thus far into Late Bronze Age trade in the Mediterranean.[9] The wreck itself is another indicator of a sea route for the east-west transport of materials. Many of the artifacts are Syro-Canaanite and Cypriot in origin, and it seems likely that the vessel was heading for a destination in the Aegean, probably on the Greek mainland (see fig. 97).

Copper and Tin Ingots[10]

The primary freight excavated from the wreck consists of about 10 tons of Cypriot copper in the form of 354 rectangular slab ingots, each with an average weight of about 24 kilograms.[11] Of these, 317 are of the typical oxhide shape, with a protrusion on each of the four corners (see cat. no. 185a); 31 ingots, while of similar form, have only two protrusions, both on the same long side (see cat. no. 185b). The latter are unique

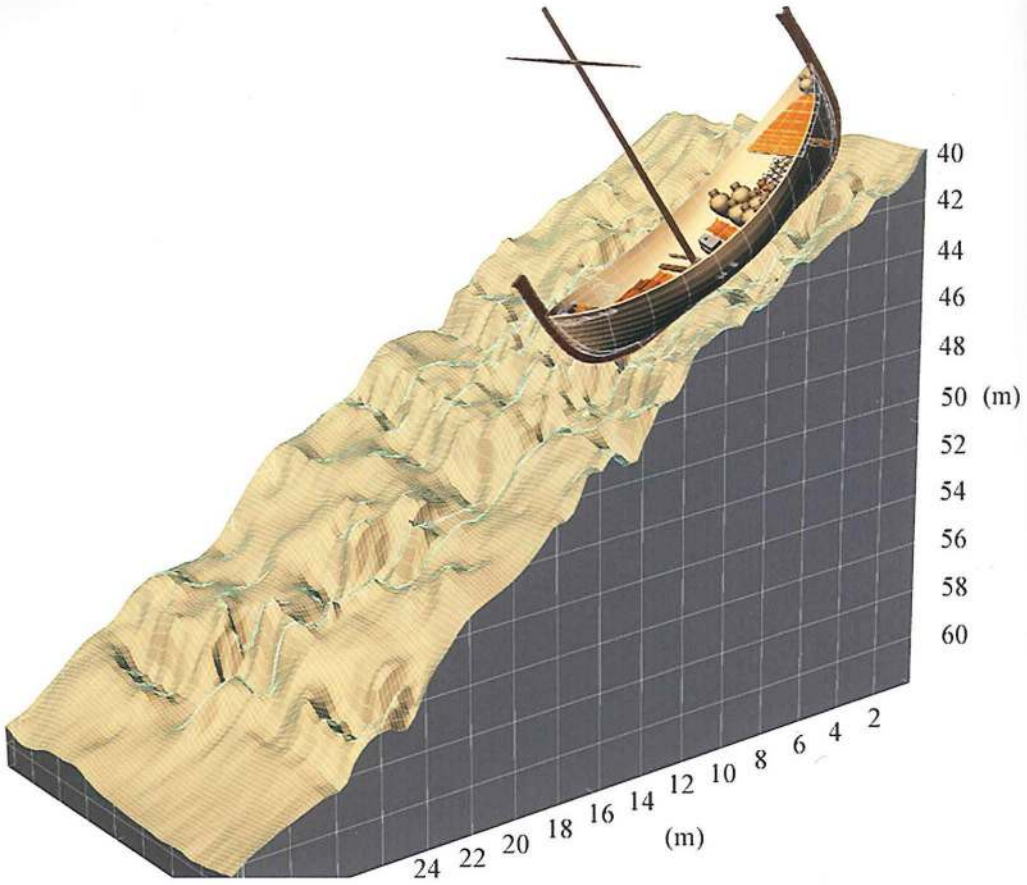


Figure 93. Three-dimensional reconstruction of the Uluburun ship with slope of seabed indicated.

to the Uluburun ship. There are also six smaller oxhide ingots (see cat. no. 185c, e), four of which have shapes of a seemingly earlier type,[12] and 121 plano-convex discoid, or bun-shaped, ingots (see cat. no. 185d), plus fragments of ten more.[13]

Metallurgical analyses of the oxhide and plano-convex discoid copper ingots have shown them to be raw or "blister" ingots of pure copper.[14] Lead-isotope analysis confirms that the Uluburun copper ingots, and most contemporary copper ingots found in the Mediterranean, originally came from Cyprus. Whether they were loaded on the island or at an entrepôt on the Levantine coast cannot be proved, but the latter is more likely.[15] In either case, the evidence provides significant information about how the ship was laden.

Although many ingots slipped down the slope after the ship sank or were displaced as the hull settled and broke apart under the tremendous weight of the cargo, their basic arrangement survived. Four distinct rows of copper ingots stretched transversely across the hull, overlapping like roof shingles. The direction of overlap alternated from layer to layer, apparently to prevent slippage during transit. In each row were as many as 12 ingots, stacked eight to eleven layers deep at the middle of the ship, with the number of ingots decreasing toward either side of the hull. The bottom layers were placed on beds of brushwood and branches, also known as "dunnage," to protect the hull timbers.[16] All ingots appear to have been stowed with their mold sides down, both to facilitate handling when loading and unloading and to increase friction between ingots, thereby minimizing shifting during the voyage.[17] The weight of the ingots, in addition to that of the stone anchors, helped preserve some portions of the hull remains. Several more perishable artifacts were recovered here because they had become trapped between or beneath the copper ingots and thus saved from the ravages of marine organisms by the copper corrosion products.

In addition to the carefully stowed copper ingots, tin was also carried on board. The tin was cast in several ingot shapes: oxhide, discoid, slab, and a unique ingot shaped like a stone weight anchor, with a circular hole at one end. Many of these had been cut into quarters or halves before they were taken on board (see cat. no. 185f, g).[18] Some of the tin on the wreck had, through a complex change in its crystalline structure, converted to another, nonmetallic phase of tin with the consistency of toothpaste, which disintegrated during excavation.[19] For this reason, it is impossible to determine the exact amount of tin on the ship. Although nearly one ton was recovered during excavations, the original quantity carried must have been much greater. Alloying all the metal ingots on board would have produced 11 tons of bronze in the optimal 10 to 1 ratio of copper to tin.[20]

Lacking in the Mediterranean, tin was likely obtained through trade. Sources of Bronze Age tin remain unknown, although ancient texts indicate that it may have been obtained from regions east of Mesopotamia,[21] probably Central Asia,[22] and shipped via the Levantine coast.

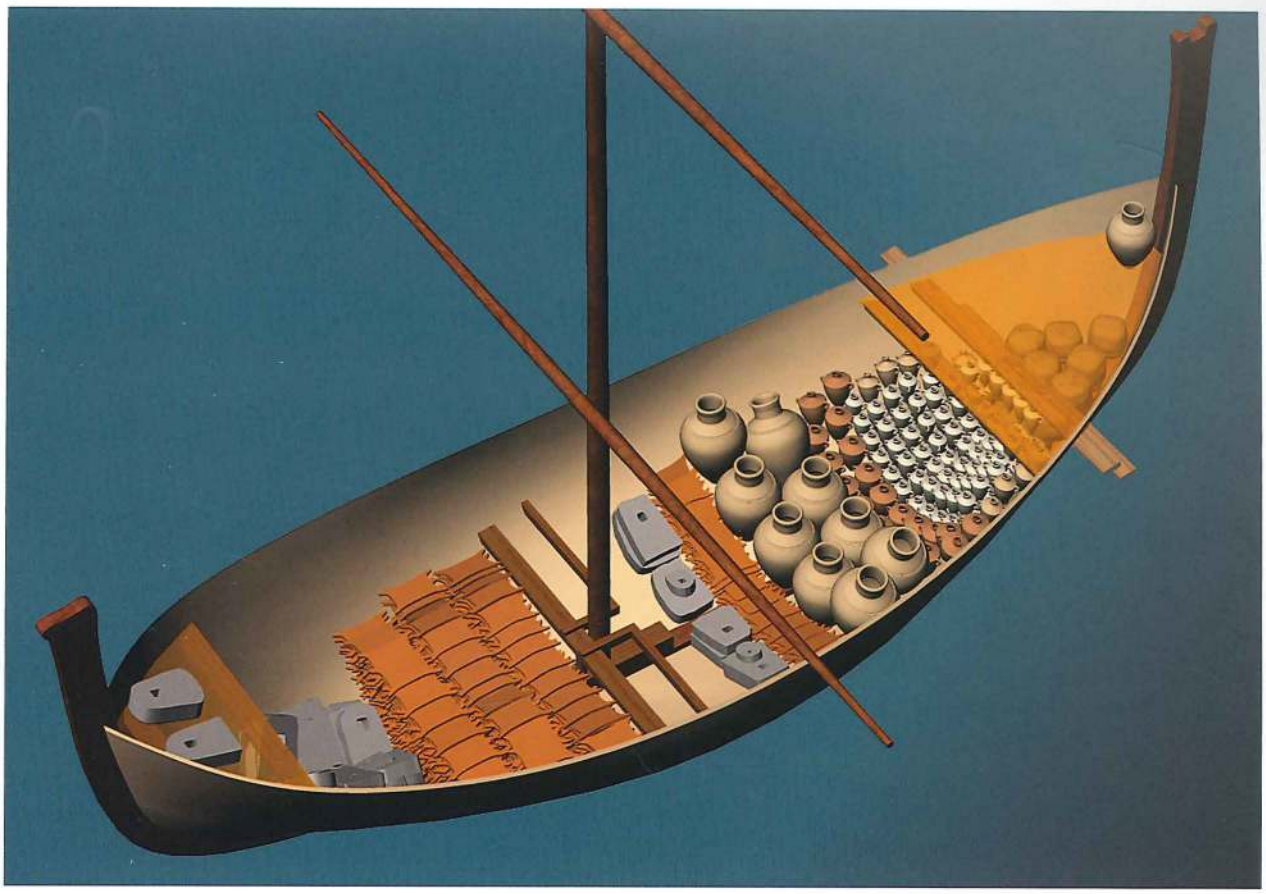


Figure 94. Reconstruction of original arrangement of cargo on the Uluburun ship.

Glass Ingots

Glass ingots, each in the shape of a roughly truncated cone, were also part of the cargo.[23] Some were in an excellent state of preservation, and others suffered partial or complete deterioration, but it is estimated that 175 pieces, totaling some 350 kilograms, were on board. The majority of the glass ingots were cobalt blue or turquoise in color, but at least two ingots of purple and one of amber are also represented (cat. no. 187).[24] These are among the earliest well-preserved examples of their type, as complete glass ingots in any quantity are rarely found in land excavations.

Chemical analyses of the alkalis and the coloring agents suggest that the glass was obtained from both Egypt and the Near East.[25] The transparent cobalt blue ingots, however, are chemically similar to core-formed vessels of cobalt blue glass from Amarna in Egypt and to typical cobalt blue Mycenaean relief beads (cat. nos. 239, 246).[26] This similarity is sufficient to suggest that the glass for all the cobalt blue ingots was probably made in the same general region at about the same time from similar raw materials and following the same batching and glassmaking processes.[27]

Wood

African blackwood (*Dalbergia melanoxylon*) was an important component of Bronze Age trade. This is the ancient *hbny* of the Egyptians, from which the English word "ebony" derives.[28] Ebony has become a generic name for many different dense, black woods from around the world, whereas the *hbny* of the ancient Egyptians originated in tropical Africa.[29] It was the favorite material for furniture among the Egyptian elite, as attested by the bed frames, thrones, chairs, footstools, boxes, and walking sticks made from ebony and found in the Tomb of Tutankhamun.[30] Evidence of the ebony trade exists in both ancient texts and the archaeological record. About 18 intact and fragmentary small ebony logs were found on the Uluburun ship.[31] All are composed only of dark heartwood, the commercially valuable part; the bark and thin layer of yellowish sapwood were useless and therefore stripped from the log. The logs were cut to standard lengths of about one meter,[32] perhaps approximating two Egyptian royal cubits of 52.4 centimeters.

Several centuries before the Uluburun shipwreck, Hatshepsut's expedition to Punt (see fig. 5), probably somewhere in modern-day Somalia, brought back ebony wood, among many other exotic items.[33] Ebony continued to be exported from East Africa through Nubia, down the Nile, and into Egypt during the reigns of Thutmose III and Amenhotep II.[34] Several New Kingdom reliefs depict Nubians bearing ebony as tribute, including those in the mid-fifteenth-century B.C. Tomb of Rekhmire in Thebes (fig. 95),[35] the late fifteenth-century B.C. tomb chapel of Sebekhotep near Thebes,[36] and the thirteenth-century B.C. rock temple built by Ramesses II at Beit el-Wali in Nubia.[37]

The Egyptians exported ebony in the form of both logs and furniture, and the ebony furniture referred to in the Linear B

Figure 95. Wall painting with Nubians carrying ebony logs and ivory tusks. Thebes, Tomb of Rekhmire (TT 100). Dynasty 18, reigns of Thutmose III–Amenhotep II.

tablets from Pylos, on the Greek mainland, may have come from Egypt.[38] While ebony fits well with the valuable and rare goods that make up some of the cargo, it is remarkable that it was exported in unfinished state, for this suggests that it was destined for a palace or other centralized entity capable of mobilizing the resources necessary to operate a workshop for the final production of such luxuries.[39]

Ivory

The Uluburun ship carried a short section of a large elephant tusk (cat. no. 197) and 14 hippopotamus teeth (see cat. no. 198).[40] Combs, plaques, and furniture inlays made of ivory were common products of the Aegean during the Bronze Age, but ivory was also carved into figurines, containers, and pins.[41] Elephant tusk was the material of choice because it offered large quantities of solid ivory, although hippopotamus teeth were also commonly used.[42] It is not always easy to distinguish between the two types of ivory, and the full extent of the trade in hippopotamus ivory cannot yet be fully assessed. Based on existing finds, including the discoveries on the Uluburun ship, it would seem that hippopotamus teeth were a more common source of ivory than hitherto believed (see pp. 406–7).

Ostrich Eggshells

The Uluburun ship carried three ostrich eggshells, one of which was found intact (cat. no. 194a).[43] These were undoubtedly exotica destined to be transformed into ornate jugs or vases by the addition of spouts, handles, and bases of faience or precious metals.[44] Ostrich eggshell vases and eggshell fragments have been found at several sites on the Greek mainland and the major Aegean islands.[45] A blue glass disc found separately, and in a poor state of preservation, may have been a base for one of the Uluburun eggshells (cat. no. 194b). If this is the case, it is evidence that the eggshells had already been made into luxury vases for use as prestige gifts or items of elite consumption before they were placed in the ship. The Uluburun ostrich eggshells could have been obtained in either Africa or the Near East, as ostriches inhabited both regions at the time.[46]

Orpiment

Orpiment, or yellow trisulphide of arsenic, was also carried on the Uluburun ship,[47] in a quantity that suggests that it was probably cargo, although some of it may have been intended for shipboard use as well. Orpiment was primarily used in Egypt, as a pigment,[48] and perhaps also as an ingredient for lapis lazuli–colored glass later on, in the seventh century B.C.[49] It was also mixed with beeswax, presumably to impart a more pleasing color, and used to create surfaces for wood writing boards,[50] two sets of which were found on the Uluburun ship, although their waxed surfaces did not survive (cat. no. 234). In classical times, orpiment served as a pigment in the encaustic paint used for the hulls of ships,[51] and, when mixed with lime, as a depilatory.[52] Pliny notes that it was mined in Syria,[53] which may have been the source of the Uluburun supply; it is also found elsewhere in the Near East.[54]

Murex opercula

Thousands of opercula from murex (*Murex* sp.) shells were lodged between the copper ingots and elsewhere on the Uluburun ship.[55] An operculum is the chitinous (hornlike material) or calcareous (shell-like material) plate attached to

the foot of a gastropod that closes to form a protective barrier when the snail retracts into its shell. In *Murex* species, the operculum is of the chitinous type and, unlike the calcareous types of some species, normally would not have survived the ravages of the sea for extended periods. Most of the opercula have disappeared, but those that became trapped in the crevices between the copper ingots were preserved as a result of their impregnation with copper and probably also because the toxic environment created by the corroding ingots would have kept away predatory marine organisms. The number recovered suggests that a significant amount of opercula was originally carried on the Uluburun ship.

This is the first discovery of *Murex opercula* in any quantity from a Bronze Age archaeological context. Certain gastropod opercula may have been used in antiquity as an ingredient for incense. Under the Greek name *onycha*, opercula seems to have constituted one ingredient of the Holy Incense mentioned in Exodus (30:34).[56] The *shlt* listed in an Ugaritic inventory of foodstuffs, spices, and medicinal substances may also refer to opercula,[57] whose medicinal uses were noted by Pliny.[58] Opercula may have been procured as a by-product of the more lucrative dye-extraction process.[59] Whatever their purpose, their presence on the Uluburun ship has shown for the first time that they were an item of interregional trade along with spices and resins.

Terebinth Resin

Well over half of the approximately 150 Canaanite jars (see cat. no. 190) aboard the Uluburun ship contained an estimated half a ton of a yellowish substance chemically identified as terebinth resin,[60] making it the second-largest consignment on the ship, after the copper and tin ingots.[61] Terebinth resin has been identified with the Egyptian *sntr* and also possibly as the Linear B *ki-ta-no*.[62] Probably from the *Pistacia atlantica*, a tree common throughout the eastern Mediterranean region, the resin was noted in antiquity for its use in incense and scented oils, and it may have been added to wine to inhibit the growth of bacteria.[63] It is likely that the resin aboard the Uluburun ship was intended for use in the scented-oil industry in the Aegean.[64] If the interpretation of Egyptian *sntr* as terebinth resin[65] is correct, which seems likely, then Thutmose III imported it annually from the Near East, probably in quantities averaging 9,250 liters, to be burned as incense in religious rites.[66] Moreover, it was likely imported in Canaanite jars similar to those found on the Uluburun ship. A Canaanite jar depicted in a storeroom scene in the Tomb of Rekhmire in Thebes is labeled *sntr* (fig. 96).[67]

Figure 96. Wall painting showing storeroom with goods of foreign manufacture. Thebes, Tomb of Rekhmire (TT 100). Dynasty 18, reigns of Thutmose III–Amenhotep II.

The terebinth resin on the Uluburun ship, the largest ancient deposit of the material ever found, provided the first opportunity for its identification by modern analytical methods. Analysis of pollen extracted from the terebinth resin cautiously suggests an origin in the general area of the northern Jordan River valley and the Sea of Galilee.[68] The malacological study of endemic terrestrial snails found in some jars similarly points to a nearby region west and northwest of the Dead Sea.[69] The discovery of such a large quantity of terebinth resin in a commercial context leaves no doubt that it was traded in the eastern Mediterranean during the Late Bronze Age.

Spices, Condiments, and Foodstuffs

Coriander, black cumin or nigella, and safflower were all carried on the Uluburun ship,[70] together with sumac, which was still being exported westward from the Levantine coast in medieval times.[71] Coriander and cyperus may have been imported from Cyprus, as they were described in texts from Minoan Crete as Cypriot.[72] Black cumin was traded at Ugarit.[73] Specialty oils mentioned in Linear B tablets from Pylos, Mycenae, and Knossos were pretreated with astringents such as coriander and cyperus and then scented with rose and sage.[74] The oil base for these specialty products was usually made from olives, almonds, and sesame,[75] some of which were recovered from the Uluburun ship; it is not known whether they were for export or shipboard use.

Organic remains of almonds, pine nuts, fig seed (from dried figs), grape pips (from either raisins or wine), and pomegranate seeds and fruit fragments; several Canaanite jars containing olives; and charred barley and wheat probably represent the ship's stores, although some of it could have been cargo.[76] The contents of one Canaanite jar, for example, consisted of at least 2,500 pits from olives that may have been a specialty product, since olive stones from this jar are generally larger than typical olive stones from most Near Eastern Bronze Age sites.[77] Pomegranate seeds and remains of anther, stamen, and skin were recovered from more than 25 percent of all sampled

contexts on the Uluburun ship. Large, open ceramic storage vessels, such as a pithos and a pithoid krater, produced more than a thousand seeds and epidermal fragments, suggesting that the fruits stored inside it were likely among the products being exported to the Aegean.[78]

Manufactured Goods

Alongside raw materials, the Uluburun cargo included manufactured goods such as Cypriot pottery, copper-alloy vessels, glass and faience beads, and perhaps textiles. Ten large pithoi of varying sizes found on the ship served as containers during transit and likely as export pottery as well. These storage jars are typically Cypriot, known from a number of sites on the island.[79] Careful excavation and sieving of sediments from the more complete vessels have shown that they were used for carrying liquids (perhaps oil), fruit (pomegranates), Cypriot pottery, and probably other commodities.[80] In addition to high-end raw materials like ebony and ivory, some of the manufactured goods aboard the ship, including cosmetics containers of ivory, vessels of tin, and perhaps even dyed textiles or garments, appear to constitute value-laden gifts exchanged between royals or other high-ranking elites. Other manufactured articles offer insight into the number and ethnic identity of the crew and the passengers aboard the vessel, including evidence of their garments, adornments, and personal possessions.

Cypriot Pottery

The Cypriot pottery contained in the pithoi includes oil lamps, wall brackets, Bucchero jugs, White Shaved juglets, Base Ring II and White Slip II bowls and other vessels, making a total corpus of about 155 vessels, including possibly as many as 137 fine wares (see cat. no. 193).[81] The most common vessels are White Shaved juglets and White Slip II milk bowls.[82] If the intended destination of the Cypriot pottery cargo was the Aegean, the sheer quantities of these wares aboard the Uluburun ship contrasts with what has been found to date in the region. If one excludes the shipwreck evidence from Cape Gelidonya and Uluburun from an inventory of Cypriot pottery in the Late Bronze Aegean, one is left with only 68 ceramic vessels. Had the Uluburun ship reached its destination, the number would have been altered significantly. This great disparity clearly demonstrates that the archaeological record, even with respect to nonperishable goods, does not necessarily reflect the true nature and magnitude of the trade in question.[83]

Metal Vessels

In addition to pottery, copper-alloy vessels were carried aboard the Uluburun ship. They were primarily thin-walled and had for the most part disintegrated through corrosion, although their sturdier components, such as rims and handles, survived to reveal their approximate shapes and sizes. Among these are sets of bowls once composed of at least three graduated sizes nested together, suggesting that other scattered bowl fragments may have been grouped in this manner. At least one of these bowl sets appears to have been stored in a large cauldron, identified by its handle and reinforcement straps. Elements of other vessels, such as a riveted spout, hint at the variety of metal forms that existed but which may never be fully reconstructed because of the lack of sufficiently preserved parts.[84]

In addition, several tin vessels, including a pilgrim flask, a plate, and a double-handled cup, have been found. Each is unique, suggesting that such vessels were among the prestige goods carried aboard to be presented as gifts to high-ranking individuals or elites.[85]

Wood Vessels

An oblong lid and a circular base for two containers of boxwood were among the perishable objects recovered from a squat, large-mouthed Cypriot pithoid krater. It is likely that these wood containers fell into the jar after the ship sank and were preserved by being quickly covered with sediments. These and several other poorly preserved fragments indicate that wood vessels of high-quality craftsmanship were carried on the Uluburun ship. Since nearly all of this cargo has perished, it cannot be determined whether these exquisite containers were primary cargo or additional prestige gifts.[86]

Beads

Several types of glass and faience beads were among the manufactured goods. Spherical glass beads were found among the copper oxhide ingots, suggesting that they were carried in perishable containers, such as cloth or leather bags, which have since disintegrated. An irregular, concreted cluster of seemingly white tiny faience beads, which undoubtedly have lost their original colors, was probably also carried in such a bag. Thousands of smaller glass beads were found inside a Canaanite jar (cat. no. 188) indicating that they were intended for export. Faience beads of red, yellow, green, black, and blue, found mostly in a shallow depression in the central part of the wreck site that served as a catchment basin for many objects rolling down the steep slope (see fig. 93), probably constituted a part of a cargo of bulk jewelry, and perhaps also were appliqués on garments or decorative attachments on the surfaces of boxes or other specialty items.[87] Many other types of faience and glass beads, as well as beads of agate, other stones, amber, and ostrich eggshell, may have been for the personal adornment of those aboard the ship.

Textiles

Bolts of dyed cloth may have been carried on the ship, although there is no conclusive evidence to suggest that textiles made up a significant portion of the original cargo.[88] The sediment contents of Canaanite jars contained a number of individual fibers dyed blue, purple, and red, but whether they were from lengths

of cloth, luxury garments sent as gifts, or clothing of the merchants aboard cannot be determined. That some highly valued textiles were carried on the ship, however, is certain.[89]

The blue and purple color of some of the fibers almost certainly came from murex shellfish dye.[90] Who first developed purple dyeing is still unclear, although some of the earlier murex shell middens come from Middle Minoan Crete.[91] Near the dyers' workshops at Minet el-Beidha, the port of Ugarit, slightly later Late Bronze Age heaps of crushed murex shells were identified.[92] Other mounds and pits filled with murex shells abound along the Syro-Levantine coast.[93] Contemporary texts from Ugarit give evidence of a considerable trade in purple cloth.[94] Although murex can yield colors ranging across various shades of red, purple, and blue, it is not known whether the red fibers from the Uluburun ship were colored with shellfish dye or with red dye from another source.

Also in question is whether some of the faience beads from the ship were originally sewn on to cloth or garments. Some of these beads were found concreted, indicating that they were stored together, probably as cargo. The rest, however, may once have been decorative elements of fine cloth, either woven into the weft or embroidered on after the weaving was completed. Examples of cloth with sewn-on beads have been found in both the Aegean and the Near East in Late Bronze Age contexts.[95]

Gold and Silver

Gold and silver were also found on the Uluburun ship, mostly in the form of intact and scrap jewelry but also as a gold ring ingot, silver bar ingots, and amorphous lumps. Along with a large gold chalice (cat. no. 219) weighing about 236 grams, which may have been for personal or ritualistic use, or perhaps represented a prestige gift, approximately 530 grams of gold in total were found on the ship. Much of the gold and silver, whether intact or scrap, was excavated in the same small area of the site, indicating that it was kept together and probably used as bullion when required. Interestingly, two of the scrap silver pieces are debased, containing copper; one of them has a copper core. Two other pieces that appear to be silver bars also yielded high copper content. If these scrap silver pieces were intended as bullion in trade, one must wonder how ancient traders ensured the purity of the metal they received in payment. Even the most pristine jewelry may have been used as bullion when required, for a number of silver bangles and various gold pieces had sections removed with a chisel, apparently for use in previous transactions.[96]

Most of the gold and silver jewelry pieces are Canaanite, but Egyptian items and a few others of unknown origin were also present. One remarkable piece is a small gold scarab (cat. no. 223), inscribed with the name of Nefertiti, wife of the Egyptian pharaoh Akhenaten.[97] It would seem that gold from the Near East reached the Aegean largely as intact and scrap jewelry, not only supplying Aegean craftsmen with raw materials but introducing Near Eastern styles and examples of goldworking techniques.[98]

Based on lead-isotope analysis, the majority of the silver appears to have originated in southern Anatolia, as expected, since this region was well known for its silver. It was therefore traveling westward from eastern sources.[99] The gold and silver, both jewelry and scrap, were probably kept in a pouch or chest along with pieces of ingots, an Egyptian stone plaque, scarabs, and cylinder seals. The pouch was likely the possession of the chief merchant aboard the ship and kept at the stern in a secure compartment. Its precious-metal contents may have been used to provision the ship and crew during the voyage.

Trade Routes

The westward flow of eastern materials indicates the proposed counterclockwise trade routes of the Late Bronze Age Mediterranean (fig. 97). The Uluburun ship epitomizes the various means by which Near Eastern and African raw materials and finished goods reached the Aegean and ports beyond. In addition, its cargo represents the commodities being shipped—utilitarian raw materials, products for elite consumption, and prestige goods for gift exchange.[100]

Using various chronological methods, both relative and absolute, it has been possible to date the Uluburun ship to the end of the fourteenth century B.C.,[101] one of the most active and colorful periods of the ancient world. During this century, seafaring Syrians and Canaanites, a general term used to denote the Semitic peoples along the Levantine coast during the second millennium B.C., traded extensively with Egypt, Cyprus, and the Aegean world. Syro-Canaanite cities served as hubs for overland trade connecting Egypt, Mesopotamia, and the Hittite Empire.[102] The exact nature of interregional trade is not fully understood. Textual evidence suggests, however, that much of the trade that took place at the palace level was conducted in the guise of gift exchange. Transactions, primarily commercial, also occurred at a lower level.

Gift exchange in the Late Bronze Age was, in a sense, a type of prenegotiated directed trade, inasmuch as a vessel was loaded in one port and had a specific destination. In other patterns of so-called tramping or cabotage,[103] the ship was loaded with goods, which it then traded when it made landfall, often without a distinct destination. Tramping was usually a low-commerce trade, whereas gift exchange was a high-commerce, prestigious trade, occurring over long distances and involving items of great economic value. The term is commonly invoked to describe interregional trade between entities of equal (or lesser) power who may also have been competitors. This is the type of trade illustrated by the Amarna Letters (see pp. 168–69), the correspondence between the Egyptian pharaoh and other royalty.[104]

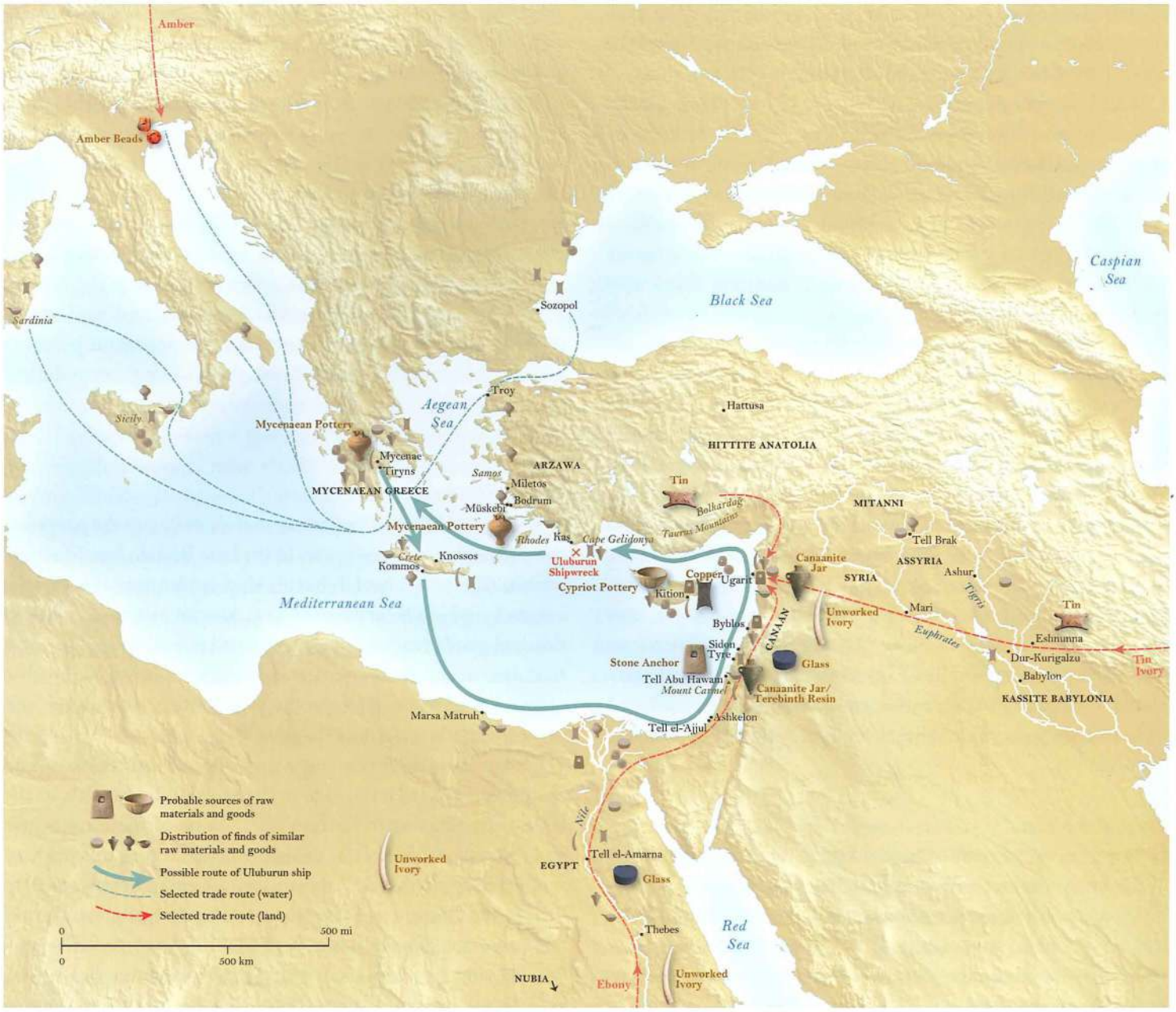


Figure 97. Possible route of the Uluburun ship.

The traditional view of gift exchange sees such transactions as reciprocal; trade relations were conducted between seemingly equal entities and were based on the creation of obligatory, continuing reciprocity. This vision of trade in the Late Bronze Age may seem somewhat altruistic. A closer reading of the Amarna Letters reveals that while luxury gifts were exchanged, they often served specific purposes such as dowries or tribute. Most tribute, on the other hand, may have been only perceived, and was the concept under which most trade was transacted (see pp. 161–68). The exchange of raw and finished goods may have operated through the use of "letters of credit."[105]

As a high-risk endeavor, long-distance trade necessitated extensive preparations, provisions for security during the voyage, and substantial capital investment for the procurement of goods. All these services were best provided by the state, which came to dominate nearly all aspects of social, economic, political, and military life.[106] While private merchants engaged in retail trade in domestic markets, most interregional exchange in the Near East during this time was probably controlled or influenced by the palaces or elite centers. Undoubtedly, some interregional trade must have occurred, but even seemingly private mercantile trade enterprises appear to have been mostly conducted through merchants who were in some manner connected to or operating around the palace. Thus the Uluburun ship probably represents a royal or elite shipment of the type exchanged between Egypt, the Levantine coast, Alashiya (Cyprus), and Anatolia, as is vividly revealed by the Amarna Letters, albeit one whose ultimate destination was in the Aegean. Unlike the Cape Gelidonya ship, which was engaged in opportunistic trade or tramping along the southern coast of Anatolia and Cyprus, probably between minor ports,

and whose cargo included only a modest quantity and variety of raw materials and large amounts of scrap metal, the Uluburun cargo may be seen as evidence for directional trade where intra-Mediterranean voyages involved specific destinations.[107] The study of the ship, its immensely rich and diverse cargo, and the personal effects of those on board corresponds with the commercial activities conducted under the guise of royal or elite gift exchange and partly described in contemporary documents. This notion of distribution appears to be a working example of the concept of gateway communities, in which imported goods are directed to a few major centers characterized by long-distance trade connections.[108]

The Uluburun ship demonstrates the simultaneous flow of raw materials and manufactured goods from the Levantine coast and Cyprus into the Aegean. Some of the cargo was in transshipment, as it came over great distances; the ebony logs originated in equatorial Africa and some of the tin probably came from Central Asia, while other materials were obtained from closer sources—copper and pottery from Cyprus, for example, and glass ingots principally from Egypt. The assemblage reveals the way in which various goods reached the Aegean and, almost certainly, points farther north and west. While evidence for Bronze Age shipwrecks ceases west of the Aegean, goods similar to those found on shipwreck sites are known from mainland Greece, Crete and other islands, southern Italy, Sicily, Sardinia, and elsewhere, indicating that these goods certainly reached the Aegean and central Mediterranean in some quantity by sea.

The Route of the Uluburun Ship

Assigning a specific home port for the Uluburun ship and its crew is difficult, but based on certain artifacts of a personal nature and those intended for shipboard use, it would appear that it was somewhere along the Levantine coast rather than on Cyprus.[109] The stone anchors of the type carried on the vessel are good indicators as these items were not cargo and most were probably not transported very far from their production centers before being loaded onto the ship.[110] Preliminary petrographic examination of the anchors indicates that most of them were hewn from beachrock, or coastal sandstone, found specifically in the vicinity of the Carmel coast in the Levant.[111]

Stylistic features of the ship's galley wares, such as bowls, jugs, and oil lamps, also support this hypothesis.[112] The source of the clay for nearly all the galley wares, including the oil lamps in use aboard the ship (see cat. no. 192), has also shown to have been in the same general area, but just north of the Carmel coast.[113] A site in this region, such as Tell Abu Hawam, may have been the home port of the ship, or at least the origin of its final voyage. Indeed, this site's well-placed location, its prominence in the region, and the period during which it flourished, along with the presence of many objects similar to those found on the ship, make it a likely candidate. Although Tell Abu Hawam is a comparatively small site, excavations have uncovered an international assemblage of artifacts, leading to its identification as the port city associated with the major inland site of Megiddo.[114] Significant quantities of Cypriot pottery found at Tell Abu Hawam suggest that the pottery was imported from Cyprus and then stockpiled to await export aboard such ships as the one that sank at Uluburun.[115]

That the Uluburun ship took its cargo of Cypriot pottery—and probably also the copper ingots—from an entrepôt or way station like Tell Abu Hawam rather than directly from a Cypriot port is also suggested by the nature of the pottery assemblage and the manner in which the pots were stacked. While the pottery comprises nearly all major export types made on the island, there is considerable variation in the style, size, and quality of craftsmanship among individual pieces within a given type. This suggests that the assemblage consisted of leftover pieces obtained at different times from different shipments and, perhaps, from different workshops. Had they been procured directly from Cypriot purveyors as a single group, they would have been significantly more homogeneous within the type groups. On board the ship, Cypriot fine wares were stored along with mainland wares from just north of the Carmel coast, another indication that they were not taken directly from Cyprus.

From its presumed point of origin just north of the Carmel coast, the Uluburun vessel headed north along the Levantine coast and then sailed west along the coast of southern Anatolia, keeping the northern coast of Cyprus on its port side until it eventually foundered at Uluburun. The discoveries of contemporary shipwrecks along the southern coast of Anatolia at Antalya and Cape Gelidonya suggest that ships navigating this route hugged the coast during their journeys from east to west.[116] After negotiating Cape Gelidonya and the treacherous cape at Uluburun, westbound ships apparently continued toward the southwestern tip of Anatolia, as revealed by a copper ingot caught in a sponge trawler's net at Knidos, in water more than 100 meters deep.[117] From there, the ships appear to have sailed either west, in the direction of Greece, or north into the Aegean, as suggested by a shipwreck laden with oxhide ingots reported, but not yet verified, between Samos and the western Anatolian mainland.[118] A single oxhide ingot found on land near Sozopol, on the western coast of the Black Sea, and a corner fragment of an oxhide ingot found just inland of the northern coast of the Sea of Marmara may have originated from such northbound ships or, more likely, arrived there by overland routes after having been unloaded at a port on mainland Greece.[119] On the other hand, copper oxhide ingots, as well as tin and lead ingots of other forms, found south of Haifa represent lost cargoes from the maritime trade in metals along the Levantine coast.[120]

Why the wreck occurred at Uluburun will probably never be known with certainty; it is possible that the ship, sailing in

a northwesterly direction, drew dangerously close to the point before tacking and then failed to clear it. It is also conceivable that the ship was dashed against the rocky promontory by an unexpected southerly gale, or that it experienced some difficulty in steering while trying to round the cape.[121]

The importation to the Aegean of foreign goods from the Levantine coast, Cyprus, and Egypt shows a shift away from Crete and toward mainland Greece at the end of the Late Helladic/Late Minoan IIIA period. This may be an indication that by the end of the fourteenth century B.C., the Mycenaeans had taken away from the Cretans control of the trade routes to the eastern Mediterranean.[122] This is noteworthy, since it coincides with the date of the Uluburun wreck. The importation of foreign goods to the mainland then peaks in the subsequent Late Helladic IIIB period. Based on the nature of the ship's cargo and the likelihood that the Mycenaeans aboard the ship were mainlanders, it would seem that the vessel's final destination was most likely on the Greek mainland. And while its ultimate port of call cannot be determined with certainty, there were in fact few palatial centers on the mainland that could have absorbed the quantity of goods carried on board. Such a center would have disseminated portions of the cargo to lesser centers through a system of redistribution. The most likely palatial center that could have adequately fulfilled these criteria is Mycenae itself, to which imported goods were funneled from the port city Tiryns to its south.

During this period of Levantine imports into Tiryns and Mycenae, Tiryns appears to have retained most of the Cypriot goods (except for copper ingots), which are exceedingly rare at Mycenae. Of the Syro-Canaanite goods, however, some were retained at Tiryns while most were forwarded on to Mycenae.[123] To that end, it may be of some interest to note that both Cypriot goods—mostly in the form of pottery, which seems to have been favored at Tiryns—and Syro-Canaanite goods and raw materials are represented in abundance on the Uluburun ship, perhaps to satisfy the needs of both centers.

The People Aboard the Ship

It is impossible to know the fate of the crew and passengers on the Uluburun ship; surviving artifacts, however, offer insight into their identities. Some of the manufactured goods have been identified as personal possessions of those on board, and give an indication of how many people were on the ship and where they might have come from. Careful study of these artifacts indicates that the ship was crewed by Syro-Canaanite merchants and sailors accompanied by two Mycenaeans of elite status and probably also a third individual who may have been from the area north of Greece.[124] The identifying personal effects are weapons, items of personal adornment, seals, pottery for shipboard use, and ship's tools. Sets of weights and balances, a merchant's most important tools, were also present, as these were essential for conducting trade.[125]

Analysis of the balance weights shows that three or four merchants were aboard, each of whom must have carried a pair of personal sets of weights. In all, 149 objects were catalogued as balance weights, the largest and most complete contemporary weight assemblage from the Bronze Age Mediterranean. As the weights were from a closed context and in use at the time of sinking, the assemblage must exhibit all standards and sets necessary for an effective maritime merchant venture, with the possible exception of smaller denominations in metal that may have been missed in excavation or corroded over the millennia. These weights are divided into three main groups based on shape: domed, sphendonoid, and zoomorphic (cat. no. 235). Many of the sphendonoid weights (oblong, with pointed or rounded ends) correspond to fractions and multiples of a unit mass, or shekel, in the vicinity of 9.3–9.4 grams.[126] It seems that there were at least seven weight sets (four sphendonoid, three domed) that were structured to that standard.

A small portion of the sphendonoid weights, however, do not conform to this mass standard. Most of these correspond to a few precision sets based on a unit mass, or shekel, of about 8.3 grams, a Mesopotamian standard, and a standard close to the Syro-Canaanite *peyem* that ranged from 7.4 to 8.0 grams.[127] Metal corrosion made it impossible to determine the standard(s) represented by the zoomorphic weights.

Each merchant was probably equipped with at least one sphendonoid-weight set (the precision set) for the accurate weighing of valuable commodities, such as gold and silver bullion, and one domed-weight set for weighing heavier or everyday goods.[128] Both sets, regardless of the shapes of their weights, conform to the same mass standard of 9.3–9.4 grams, but with different weighing ranges. This suggests the presence of four merchants, one of whom also carried the zoomorphic weights. This unique set probably belonged to the chief merchant. That these balance weights were for everyday use and not simply a part of the ship's cargo is indicated by their used state and the presence of odd and perhaps homemade pieces to replace those that were lost over time. The four Canaanite or Cypriot merchants proposed for the Uluburun ship compare favorably with the maritime scene depicted in the Tomb of Kenamun at Thebes, which shows a Syrian merchant fleet arriving in Egypt (fig. 98).[129] The four merchants shown on one of the ships are dressed in typical Syro-Canaanite robes with tasseled belts, and are engaged in various activities, including conducting rituals associated with a safe arrival. Three crewmen are also shown climbing around the ship's sail and rigging, while a fourth sits in the crow's nest atop the mast. To sail a ship of that size would have required no less than four crewmen. Even so, it has to be remembered that Egyptian tomb paintings do not necessarily depict reality but rather perception, and care must be used in their literal interpretation.[130]

The numbers of excavated weapons also appear to support the view that there were four merchants aboard. The chief

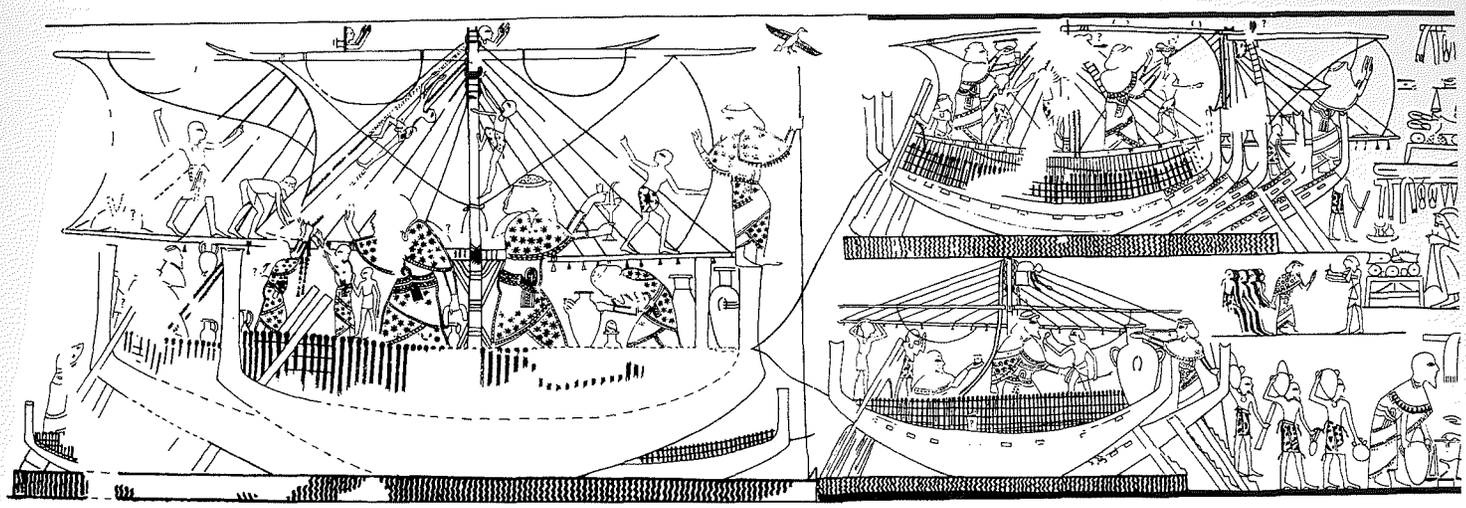


Figure 98. Drawing of wall painting with Syrian ships. Thebes, Tomb of Kenamun (TT 162). Dynasty 18, reign of Amenhotep III.

merchant was in charge of the ship and its cargo. He was also probably the ship's captain, and must have carried the only Canaanite sword found on the ship.[131] Almost fully preserved, it is a single-piece cast-bronze weapon with inlaid hilt plates of ebony and ivory, indicative of the owner's elite status. Among the daggers excavated—visible symbols of status roughly equivalent to the sword—two were nearly identical in make and design to the Canaanite sword; one of the daggers still retains its hilt plates and inlays of ebony and ivory (cat. no. 233).[132] A tanged dagger may have belonged to the fourth merchant.

To these merchants also probably belonged some, if not all, of a group of nine cylinder seals found mostly near the stern of the vessel in association with much of the silver and gold (cat. nos. 230–232).[133] It is uncertain if these items were in use as cylinder seals at the time the ship sank or if they served merely as elaborate beads. They are of different sizes and crafted from various materials: hematite, quartz, other stone, and faience, of which two were gold capped (see cat. no. 231a).

Little can be determined about the Uluburun crew, since their personal effects would not have included distinctive and valuable items. Among the objects recovered are several relatively plain daggers, knives, and simple pendants. Food was prepared by grinding in one of three stone mortars and eaten in simple bowls, and at night Canaanite oil lamps (cat. no. 192) were used for illumination.[134] Assorted fishhooks, lead line sinkers, troll line sinkers, a barbed trident, and a harpoon, along with more than a thousand lead net sinkers of two types, probably denoting seine and casting nets, indicate that the crew fished during the voyage to supplement their otherwise dull diets. What little free time was available may have been passed by playing the game of knucklebones, as suggested by their presence on the ship.

Mycenaean objects, such as fine tablewares, swords, spears, razors, chisels, axes, glass relief beads, faience and amber beads, quartz beads, and lentoid seals, were also discovered.[135] That these artifacts speak to a Mycenaean as opposed to a Minoan presence is evident from three different artifact types: lentoid seals, deep-bar chisels, and double-axes.[136] The closest parallels to the lentoid steatite sealstones from Uluburun (cat. no. 241) belong to Younger's "Mainland Popular Group" from the Greek mainland.[137] Six deep-bar chisels are of the shorter, more robust types associated with the Greek mainland, rather than with the delicate-looking elongated versions found on Crete.[138] Two double-axes have ovoid shaft holes generally found on examples from the Greek mainland, rather than the circular ones seen on those from Crete.[139] The categorically Minoan artifacts aboard the ship were coarse-ware transport stirrup jars, a vessel type made primarily as a container for exporting oil. More telling of the Mycenaeans' identity are the utilitarian fine-ware pouring-and-drinking sets comprising a beaked jug, a narrow-necked jug, a cup, a dipper, and a kylix (see cat. no. 242a).[140] With the exception of the kylix, none in the assemblage is among the Mycenaean types commonly exported to the Levant.[141]

Two knives and a tang portion of a third are also among the Mycenaean artifacts.[142] A knife for everyday needs would have been an essential tool for a Mycenaean Greek, especially one enduring a long journey to and from the Levantine coast. Also on the ship were five typically Mycenaean razors.[143] These offer a glimpse into the grooming practices of these well-equipped individuals, and of the care they afforded to their appearance. Two of the razors are nearly identical in size and shape, and display a fine decorative ridge, just below the back edge, which extends the full length of the blade and tang.

The presence of at least two pouring-and-drinking sets, two swords, two relief-bead necklaces, two quartz beads, and two lentoid seals, along with the occurrence of other Mycenaean objects in multiples, strongly suggests that there were two Mycenaeans aboard the Uluburun ship.[144] These individuals do not appear to have been simple merchants, as they apparently lacked the single most important tool used to conduct

commercial transactions in a precoinage society: balances and weight sets. Without weights, it would have been impossible to measure metals for payment of goods received.[145]

The wealth of their personal adornments and other items considered with the quality of their weaponry suggest that the Mycenaeans aboard the ship were elites. Two bronze swords, typical of Aegean products of the fourteenth century B.C., were also among the Mycenaean finds (see cat. no. 238a). In the Late Bronze Age Aegean, a sword probably served as an object of prestige signifying military rank, or was a weapon used in warfare by a select few.[146] That being the case, it is likely that the two Mycenaeans were of the warrior class or palace staff, perhaps acting as emissaries or ambassadors—the "messengers" mentioned in ancient texts—accompanying to the Aegean a cargo of reciprocated "gift exchange."[147] As representatives of palatial or elite interests, their purpose may have been to oversee the safe delivery of the ship and its precious cargo to its final destination at or near their homeland. Likely empowered to handle letters of credit or other methods of reciprocity by which interregional trade was conducted, they may also have served as pilots and negotiators for the ship in Aegean territorial waters, with which they would have been familiar.

A troubling aspect of the Mycenaean assemblage is the absence of sealstones appropriate to such elites or emissaries. The two steatite lentoid sealstones (cat. no. 241) are of a type predominantly found in simple burials, settlements, and even sanctuaries. Perhaps these items did not function as seals, but instead were strung as beads and served as amulets, talismans, or jewelry.[148] Conversely, they may have been intended as votive offerings to be placed in a sanctuary upon the safe conclusion of the voyage or certain portions of it.[149]

The identity of a third foreign individual on the Uluburun ship is more speculative than that of the Mycenaean emissaries. His presence is attested by an assemblage of loosely linked foreign (northern) artifacts, including a central Mediterranean–type sword, spearheads, a bronze pin, and a scepter-mace with its closest parallels in the northern Balkans (cat. no. 237).[150]

This shadowy figure, possibly hailing from a region north of the Greek mainland, may have served as an elite mercenary in the service of the Mycenaeans, or as another messenger.[151] Piracy on the high seas would undoubtedly have posed a threat for a high-profile mission like the one represented by the Uluburun ship. The shipment of valuable goods was a risky undertaking, and certain Amarna Letters refer to a messenger merchant killed by bandits.[152] These well-armed individuals, along with the armed Canaanite merchants and crew, would have served as a deterrent for looters and rogue seafarers.

The Hull

Because most of the ship's hull as well as some of the cargo perished when the ship sank, and the position of the artifacts that had spilled down the slope no longer reflected their original locations, estimates of the ship's size and shape are, for the most part, necessarily speculative. Nevertheless, the distribution of the recovered remains and the surviving portions of the hull suggest that the ship had a length of about 15 meters and a beam of about 5 meters, with a cargo carrying capacity of at least 20 tons.

In some areas of the site, preservation was aided by conditions unfavorable to shipworms and other detrimental organisms. A portion of the hull remains was located underneath some of the copper ingots. The copper created a toxic environment that discouraged marine life, preserving the hull timbers and layers of dunnage placed over them. These surviving timbers allowed for the identification of the wood as Cedar of Lebanon (*Cedrus libani*), which Bronze Age sources often mention as the preferred timber for building ships.[153]

The ship was constructed in a "shell-based" method, in which the planking is joined edge-to-edge on either side of the ship's keel. In this type of construction, mortises or recesses are cut into the edges of adjacent planks, and a tenon is placed within the mortise. The mortises are then secured with a peg on either side of the plank seam, thereby locking all the planks together to form the hull. The planking of the Uluburun ship was made of cedar, with tenons and pegs cut and shaped from evergreen, or kermes, oak (*Quercus coccifera*).[154] In addition to the hull itself, remains of a bulwark fencing of branches have also been identified (fig. 99).[155]

Reconstructing any hull on paper is analogous to assembling a puzzle or solving a riddle. In the case of the Uluburun ship, this process was complicated by varying levels of preservation and disarticulation of some of the remains. Results of reconstruction studies, in spite of difficulties, have provided an invaluable glimpse into the construction of Bronze Age seagoing ships.

Perhaps the most unusual feature of the Uluburun hull is its keel, the primary longitudinal member forming the ship's spine. Unlike modern keels, it is wider than it is high and extends upward into the hull. Although the keel did not protrude more than a few centimeters beyond the outboard surfaces of the hull planking, it served as an effective spine for the ship. Designated as a proto-keel, it also protected the planking from damage if the ship ran aground, and supported the vessel when beached for repairs or for wintering. Unlike true keels in later sailing ships, however, it did not offer much lateral resistance, which is needed for the ship to hold course when sailing. This rudimentary feature therefore limited the headway a ship could make against counterwinds, which probably resulted in favoring certain maritime routes during certain sailing periods.[156]

The Uluburun ship is significant to any study of shipbuilding techniques, as it is the earliest seagoing ship to be found and excavated. Analysis of the hull, and the manner in which it was constructed, has provided new information regarding seagoing ships and the use of mortise-and-tenon joinery. Early

Figure 99. Archaeologist excavating remains of bulwark fencing. Uluburun shipwreck.

Egyptian examples of mortise-and-tenon joints, as seen in Khufu's funerary boat at Giza and Senwosret III's boat at Dahshur,[157] were freestanding and not pegged to lock adjacent planks to one another. Egyptian woodwork shows that, at least as early as Dynasty 3, the Egyptians, while fully aware of this type of fastening,[158] did not use it in shipbuilding, unless pegged tenons were restricted to ships for which we have no surviving examples.[159]

Exactly when and where pegged mortise-and-tenon joints were first used to build seagoing ships is not known. The earliest documented use of this type of joint in the Near East is much later than in Egypt and is seen in woodwork dating to the Middle Bronze IIB period.[160] Based on present evidence, it appears that the use of pegged mortise-and-tenon joints in shipbuilding developed on the Levantine littoral and spread westward. Their earliest archaeologically documented use in shipbuilding occurs on the Uluburun ship, which almost certainly was built somewhere along the Levantine coast.[161]

Because there is no evidence of frames or other internal lateral strengthening timbers, the strength of the Uluburun vessel must have come almost solely from the hull planking itself, with additional reinforcement provided by bulkheads and through-beams. The mortise-and-tenon joints must have been remarkably strong. The tenons were strikingly large, and frequently spaced.[162] Rather than evenly staggering the mortise-and-tenon joints in one edge of a plank from those in the opposite edge, each mortise cut was positioned immediately adjacent to the nearest joint in the opposite edge of the same plank, such that one mortise often intruded into the space of another. Placing tenons adjacent to one another would appear to have compromised the structural integrity of the planking and thus of the hull. Studies of replicated sections of the hull have shown, however, that the arrangement probably made for a stronger plank than would have been the case had they been placed farther apart.[163] The tenons were obviously more than simple fasteners, serving as small internal frames and providing considerable stiffness and integrity to the shell of planking. The Uluburun ship relied heavily on these long oak tenons, which were clearly intended to supplement the hull's lateral rigidity and to compensate for the paucity or absence of proper frames. This method of construction partially explains how heavy cargoes could be carried directly on the hull planking without resorting to visible lateral support in the form of frames or bulkheads.[164]

Conclusions

Excavation of the Uluburun shipwreck recovered more than 15,000 catalogued artifacts, one of the largest and richest assemblages of Bronze Age goods ever found. The ship's cargo, perhaps of a royal nature, consisted mostly of raw materials, although finished goods were also present. Galley wares, tools, fishing implements, and some foodstuffs were for shipboard use, while cylinder seals, jewelry, weapons, and balance weights represent some of the personal effects of those on board. These items indicate that the likely site for the home port of the ship was just north of the Carmel coast. The finds further suggest the presence on board of three, possibly four, Canaanite merchants, two Mycenaeans of rank, acting as official messengers or envoys escorting a shipment of important cargo bound for their homeland, and another individual, who also may have been an escort in his own right or an elite

mercenary for the two Mycenaean officials. The assemblage has provided evidence for a counterclockwise Late Bronze Age maritime trade network that circled the eastern Mediterranean; it appears the ship was a merchantman from the Levantine coast headed in a northwesterly direction for the Aegean (see fig. 97).

The Uluburun ship epitomizes the various means by which Near Eastern and other foreign goods entered the Aegean during the Late Bronze Age. New implications for the dynamic and far-reaching trade activities in this period are just beginning to emerge. The stunning diversity and wealth of artifacts found on the Uluburun wreck are products of numerous cultures: Canaanite, Mycenaean, Cypriot, Egyptian, Nubian, Baltic, northern Balkan, Old Babylonian, Kassite, Assyrian, Central Asian, and possibly south Italian or Sicilian. The ship and its cargo appear to represent an elite dispatch of an enormously wealthy and diverse cargo of raw materials and manufactured goods intended for a specific destination. In addition to utilitarian objects and raw materials, the presence of value-laden or prestige goods would appear to indicate that the Late Bronze Age Aegean was not far removed from the long-distance interregional trade that was based on royal or elite exchange in the Near East and reflected vividly in the nearly contemporary Amarna Letters. As was the practice in such ventures, the ship's cargo was probably placed in the care of an official who represented elite or royal interests, but who may have engaged in some private trade of his own on the side. This merchant emissary or messenger also was entrusted with a contingent of prestige goods that he would present personally to the royalty or elite receiving the cargo. The Uluburun ship captures, in transit, tangible evidence for the flow of goods and raw materials from the Levantine coast to the Aegean, while at the same time providing a rare glimpse of the individuals involved in long-distance trade and the ships with which it was conducted.

1. As is customary in nautical archaeology, when a shipwreck cannot be identified with a specific name, it and the artifacts found with it are often given the name of the site at which it was found, in this case, Uluburun. Each object was given a find number beginning with KW; originally the ship was referred to as the Kaş wreck.
2. The site was excavated with the permission of the Turkish Department of Antiquities and Monuments. The work was carried out under the auspices of the Institute of Nautical Archaeology (INA) at Texas A&M University, with funding from the INA Board of Directors and grants from the National Endowment for the Humanities, the National Science Foundation, the National Geographic Society, Texas A&M University, the Institute for Aegean Prehistory, and others. The post-excavation, conservation phase continues in the Bodrum Museum of Underwater Archaeology with support from the museum administration, and at the conservation laboratory of the INA Research Center in Bodrum, with grants from the Institute for Aegean Prehistory, funding by the INA Board of Directors and Texas A&M University, and contributions by many individuals and companies. For further reference, see Bass 1986; Pulak 1988; Bass et al. 1989; Pulak 1997; Pulak 1998; Pulak 2001; Pulak 2005c.
3. Bass, Frey, and Pulak 1984; Pulak and Frey 1985.
4. Bass 1967, pp. 163–67; Bass 1973.
5. Pulak 1998, pp. 213–14.
6. Ibid., p. 188.
7. Ibid., pp. 210–13.
8. Pulak 2002, p. 615.
9. Pulak 2001, p. 13.
10. Pulak 1998, pp. 193–201; Pulak 2000b.
11. Originally, the ingots would have been heavier, since the corrosive seawater environment dissolved some of the copper and reduced parts of the ingots to a spongy consistency. The original weight of an ingot is therefore impossible to determine with accuracy.
12. Pulak 2000b, p. 141; Pulak 2001, p. 18.
13. Pulak 2000b, p. 143; Pulak 1998, pp. 196–97.
14. Hauptmann, Maddin, and Prange 2002.
15. Pulak 2001, p. 21.
16. Pulak 2000b, pp. 140–41.
17. Ibid., p. 141; Pulak 1997, pp. 235–36.
18. Pulak 2000b, pp. 150–52, figs. 16–22; Pulak 1998, pp. 202–3, fig. 16; Bass 1986, pp. 281–82, ills. 15, 16.
19. For metallurgical aspects of the Uluburun tin ingots, see Hauptmann, Maddin, and Prange 2002, pp. 15–17.
20. Pulak 2001, p. 22.
21. L. Weeks 1999, p. 61.
22. Dossin 1970, pp. 101–6; Muhly 1985, pp. 282–83; Pulak 2000b, p. 153.
23. Pulak 2001, pp. 25–30; Bass 1986, pp. 281–82.
24. Pulak 2001, p. 25.
25. Lilyquist and Brill 1993, p. 41; Brill and Shirahata 1997, pp. 89–91; Henderson 1997, pp. 94, 97–98; Rehren, Pusch, and Herold 1998, p. 243; Brill 1999, vol. 1, pp. 47–48, 280, vol. 2, pp. 53–54; Shortland and Tite 2000, pp. 16–17, 50, 98, 147–49, 183, fig. 3.1, table 3.2; Pulak 2001, pp. 27–30.
26. Bass 1986, p. 282; Brill 1999, pp. 53–54; Pulak 2000b, p. 28.
27. Brill, personal communication, 1997.
28. Gardiner 1950, pp. 517, 579, 611.
29. Lucas and Harris 1962, pp. 224–28; Hepper 1977, p. 129.
30. Pulak 2001, p. 31.
31. Bass et al. 1989, pp. 9–10.
32. None of the ebony logs is complete, with worm damage on surfaces and ends rendering them somewhat shorter than their original lengths.
33. Naville 1896, pp. 1–3.
34. Davies 1973, p. 14, pl. 17.
35. Ibid., pp. 19, 26, 46, pls. 17–20, 40.
36. Taylor 1991, title page.
37. Ibid., p. 33, fig. 37.
38. Meiggs 1982, p. 284; Ventris and Chadwick 1973, pp. 342–43; EA 1, 31, 34 (Moran 1992, pp. 1–3, 101–2, 105–6).
39. Pulak 2001, pp. 31–32. One ebony piece from Uluburun was worked.
40. Bass 1986, pp. 282–85, figs. 18, 19; Bass et al. 1989, p. 11, fig. 20; Pulak 1995, p. 16, fig. 14.
41. Poursat 1977a.
42. Reese 1985b, pp. 393–94.
43. Pulak 2001, pp. 39–40; Pulak 1997, p. 242.
44. This appears to be their only use in the Bronze Age Aegean (Renfrew and Cherry 1985, p. 324, pl. 64a–b).
45. Cline 1994, pp. 237–38, nos. 945, 946.
46. Conwell 1987, p. 29; Reese 1985a, p. 378.
47. Bass 1997, p. 159; Bass 1986, p. 278.
48. Bass 2004, p. 280, and n. 61; Bass 1986, p. 278, n. 37.
49. Bass 1997, p. 159, citing Oppenheim et al. 1970, pp. 40–43, and nn. 52, 91.
50. Mallowan 1954, p. 99; Wiseman 1955, p. 5.
51. Pliny *Natural History* 35.31.
52. Ibid., 34.56; Bass 1997, p. 159; Bass 2004, pp. 280–81.
53. Pliny *Natural History* 32.22.
54. Schafer 1955, pp. 73–74.
55. Pulak 1988, p. 5; Pulak 2001, pp. 32–33.
56. Hart 1888, p. 200.
57. UT 12, Robert Stieglitz, personal communication, 1994.
58. Pliny *Natural History* 32.41.

59. Pulak 2001, p. 33.
60. Mills and White 1989; Hairfield and Hairfield 1990.
61. Pulak 2001, p. 36; Pulak 1998, pp. 201–2.
62. Bass 1997, p. 164; Melena 1976, pp. 177–90.
63. McGovern 1997, pp. 84–85.
64. Pulak 2001, pp. 35–36.
65. Serpico and White 2000, p. 894.
66. Loret 1949, pp. 20–23.
67. Davies 1973, pl. 48.
68. Jacobsen, Bryant, and Jones 1998, p. 80.
69. Welter-Schultes 2008, pp. 84–85.
70. Haldane 1993, p. 352; Pulak 2001, p. 37.
71. Haldane 1993, p. 352; Bass 1997, p. 167, n. 209.
72. Bass 1997, p. 167; Ventris and Chadwick 1973, pp. 221–22.
73. Heltzer 1978, p. 20.
74. E. Foster 1977, pp. 32–35.
75. Shelmerdine 1985, pp. 17–18.
76. Pulak 2001, p. 37; Haldane 1990, pp. 57–59; Haldane 1993, pp. 352–56.
77. Haldane 1993, pp. 353–55.
78. Ward 2003, pp. 530, 537.
79. P. Åström 1999; Schaeffer 1949, pp. 208–9, fig. 86, pl. 31.2; Watrous 1992, pp. 157–58, fig. 70, pl. 52; Karageorghis 1993, p. 584, fig. 3; Vagnetti and Lo Schiavo 1989, pp. 220–21, fig. 28.1a–b; Vagnetti 1999, pp. 189–90, 206, fig. 4.
80. Pulak 2001, p. 40.
81. Ibid., pp. 41–42. Although the numbers of Cypriot vessels in the cited article are lower, based on ongoing conservation and mending of these vessels, Nicolle Hirschfeld, who is studying the Cypriot fine wares for publication, reports the higher numbers indicated here.
82. Pulak 2001, pp. 41–42; Bass 1986, pp. 279–82, ills. 10–14.
83. Pulak 1997, pp. 242–43.
84. Pulak 2001, pp. 42–43; Pulak 1997, p. 243, fig. 11.
85. Pulak 1997, p. 243.
86. Pulak 2001, p. 43.
87. Ibid., pp. 43–44.
88. Ibid., pp. 44–45.
89. For similar, purple-dyed wool fibers on an eighth-century B.C. Phoenician ship discovered off the coast of Ashkelon, see Stager 2003, pp. 242–43. These fibers suggest the presence on board the ship of prized purple textiles or garments for export, as may have been the case on the Uluburun ship.
90. Pulak 2001, p. 44.
91. Reese 1980, pp. 81–82; Reese 1987, pp. 203–6.
92. Schaeffer 1951, pp. 188–89.
93. Pulak 1988, p. 5, n. 5, with references; Reese 1987, pp. 205–6.
94. Schaeffer 1951, pp. 190–92.
95. Barber 1991, pp. 171–74; Persson 1931, pp. 29–30, 39–41, 60, 106, no. 51, pls. VIII, XV, XXXIV, XXXV; Carter and Mace 1923–33, pp. 167–71, pls. 34, 37, 38; N. Özgüç 1966, p. 47, pl. 22.
96. Pulak 2001, pp. 24–25.
97. Weinstein 1989.
98. Pulak 2001, p. 25.
99. Ibid., pp. 24–25; Zofia Stos-Gale, personal communication, 2000.
100. Pulak 2001, pp. 13–14.
101. Ongoing dendrochronological wiggle-matching and 14-C dating of short-lived specimens from the wreck such as leaves, young branches, olive pits, nuts, and resin suggest a date at the end of the fourteenth century B.C. for the sinking of the ship.
102. Knapp 1993, pp. 334–36.
103. Horden and Purcell 2000, pp. 365–66.
104. Zaccagnini 1987, pp. 47–56; Moran 1992.
105. Manning and Hulin 2005, pp. 286–88.
106. Liverani 1987; B. Foster 1987; Peltenburg 1991, pp. 161–70.
107. Pulak 1998, pp. 215–16.
108. Cline 1994, pp. 87–88; Cline 2007, p. 199.
109. Pulak 1997; Pulak 1998.
110. Pulak 1997, p. 252; J. Shaw 1995, pp. 281–82.
111. Based on petrographic analysis with Yuval Goren.
112. Pulak 1997, pp. 252–53.
113. See note 111 above.
114. Loud 1948.
115. Schaeffer 1939a, p. 19. For similar stockpiling of Cypriot export wares at Minet el-Beidha and in a house at Ugarit, see Schaeffer 1937, p. 128, pl. 20:3; Schaeffer 1962, p. 100, figs. 83, 84, p. 119.
116. Pulak 1997, p. 2.
117. Ibid., pp. 234–35; Bass 1986, p. 272; Buchholz 1959, pp. 27, 29, pl. 3:5–6; Buchholz 1966, pp. 63, 65, fig. 2b.
118. A hoard of 19 copper ingots from a shipwreck near Kyme on Euboia is probably not of Bronze Age date, as the size and shapes of these ingots are very different from the typical Bronze Age oxhide ingot.
119. Pulak 1997, pp. 255–56.
120. Pulak 2001, pp. 16–17.
121. Pulak 1998, pp. 188–89, 218–20.
122. Cline 2007, pp. 194–95.
123. Ibid., p. 195.
124. Pulak 1998, pp. 216–18.
125. Pulak 2001, pp. 13–14.
126. Pulak 2000a, p. 261.
127. Ibid., pp. 256, 261.
128. Ibid., pp. 262–64.
129. Davies 1963, p. 14, pl. 15; Davies and Faulker 1947, pp. 40–46.
130. Wachsmann 1987, p. 4.
131. Pulak 1988, p. 20, fig. 20, p. 21.
132. Pulak 1997, p. 246.
133. See Collon, this volume; Bass et al. 1989, pp. 12–16.
134. Pulak 2005a, p. 296. Ongoing petrographic analysis has shown that the used lamps, revealed by charring around their wick nozzles, were all made with clay from the vicinity of Tell Abu Hawam and slightly farther north.
135. See Pulak 2005a for the Mycenaean objects on the Uluburun ship.
136. Ibid., p. 296; Cline 2007, p. 129; Bachhuber 2006, pp. 351–55.
137. Pulak 2005a, p. 305; Younger 1987, p. 65.
138. Pulak 2005a, p. 302.
139. Ibid., p. 302, n. 58.
140. Ibid., pp. 296–98.
141. Ibid., pp. 297–98.
142. Ibid., pp. 300–301.
143. ibid., pp. 301–2.
144. Ibid., pp. 296ff.
145. Ibid., p. 306.
146. Driessen and MacDonald 1984, p. 56; Pulak 2005a, p. 298.
147. Pulak 2005a, pp. 306–9.
148. Ibid., p. 305; Betts 1997, pp. 63, 65.
149. Pulak 2005a, pp. 307–8.
150. Vagnetti and Lo Schiavo 1989, pp. 223–24; Buchholz 1999; Bodinaku 1995, p. 268; Pulak 1997, pp. 253–54, fig. 22; pp. 254–55; Pulak 2005a, p. 209.
151. Pulak 2001, pp. 48–49.
152. EA 8 (Moran 1992, pp. 16–17); Pulak 2005a, p. 308.
153. Pulak 1999, p. 212. This wood was used for Egyptian funerary ships and for the Cape Gelidonya ship; see Pulak 2001, pp. 27–29, 33.
154. Pulak 2001, p. 13.
155. Pulak 1999, p. 212.
156. Pulak 2002, pp. 618–21, figs. 1–4.
157. Lipke 1984, p. 64; Steffy 1994, pp. 25–27, 32–36; Patch and Haldane 1990, pp. 34–35, fig. 19.
158. Lucas and Harris 1962, p. 451.
159. Pulak 1999, p. 213.
160. Ricketts 1960, p. 530, fig. 229.1.
161. Pulak 1999, p. 215.
162. Pulak 2002, p. 629, fig. 2.
163. Ibid., pp. 626–27, fig. 1.
164. Ibid., p. 626.

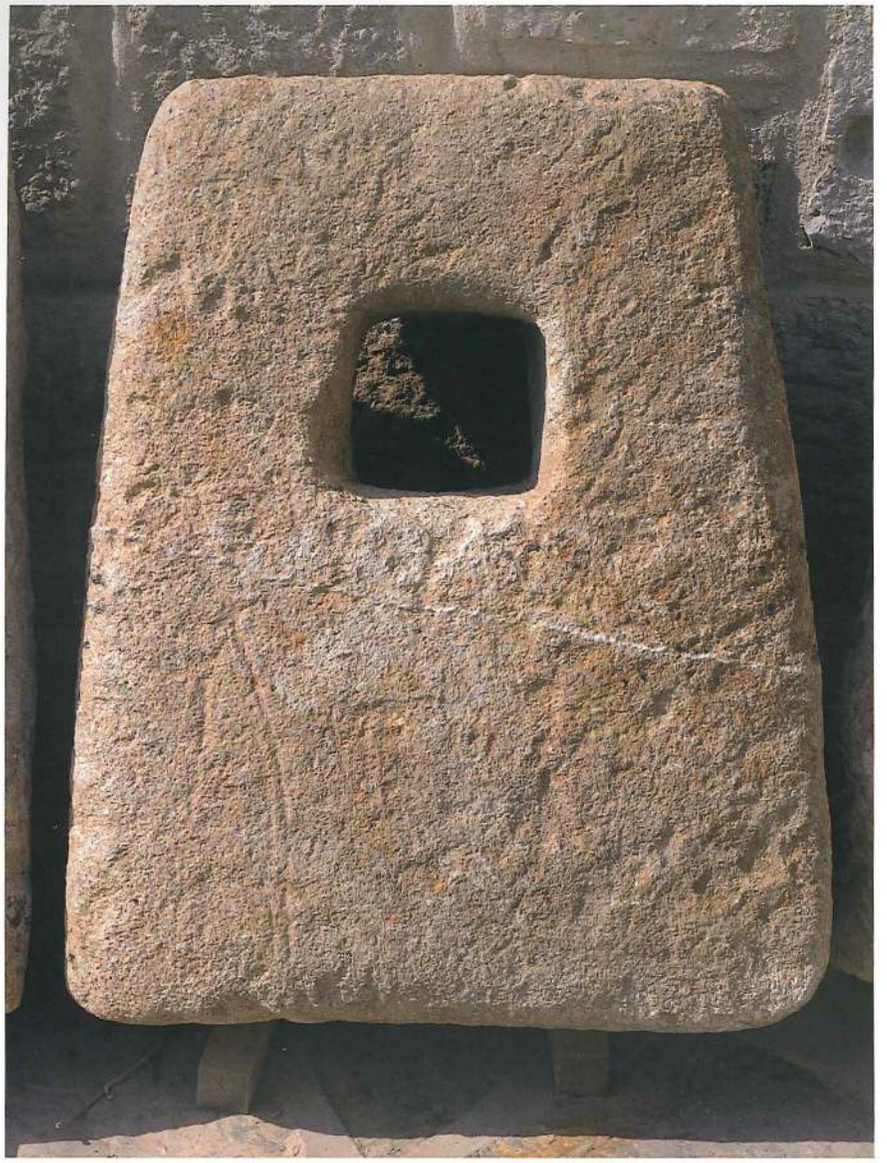


Figure 100. Archaeologist preparing to raise anchors from seabed. Uluburun shipwreck.

184

Weight Anchor

Beachrock
Height 75.4 cm (29¾ in.); max. width 61 cm (24 in.); max. thickness 22 cm (8¾ in.); weight 148.3 kg
Uluburun shipwreck
Late Bronze Age, ca. 1300 B.C.
Bodrum Museum of Underwater Archaeology, Turkey 37.1.94
(KW 3330)

The Uluburun assemblage of 22 large coastal sandstone, or beachrock, anchors[1] and two smaller ones of limestone, the latter possibly for the ship's boat, collectively weighs 3.3 tons and is the largest group of anchors found associated with any shipwreck (fig. 100).[2] This example is of beachrock, trapezoidal in shape, with rounded corners and a square apical hole for an anchor cable or hawser at its narrower end. It is one of four with incised marks on the surface, in this case an inverted V.

Because the Uluburun anchors were preserved in their original context, they offer insight into specific onboard uses of stone anchors during this period. The anchors were found in two groups: 16 were strewn in a line at the eastern end of the site, corresponding to the ship's bow, and another line of eight lay two deep across the keel, extending from one side of the hull to the other, near the center of the ship, just aft of the mast step. The anchors found near the center of the wreck were spares stored in the hold and were also used as temporary ballast, while those at the bow were for immediate use.

At least two of the bow anchors were originally stored on the ship's foredeck, ready for deployment, with others stowed in the area under the foredeck and immediately aft of it. These spare bow anchors were meant to be used in addition to those on the foredeck, or as equivalent substitutes in their absence. Although the anchors were intended to be retrieved after use, the large number aboard the ship suggests that they were frequently lost or had to be cut loose in an emergency.[3]

Weight anchors moored ships by sheer mass, in contrast to stone composite anchors, which gripped the seabed with wood stakes.[4] Anchors excavated on land usually represent votive and funerary offerings deposited in wells, temples, and tombs at sites such as Ugarit and its port at Minet el-Beidha,[5] Byblos,[6] and Kition on Cyprus.[7] In marine contexts, however, they often mark offshore moorings, inshore anchorages, and proto-harbors.[8] Other

Bronze Age shipwreck anchors include 15 found off Newe-Yam on the Carmel coast,[9] and a single anchor associated with the Cape Gelidonya ship,[10] although the Uluburun assemblage is the only complete set found to date.

The weight anchor is virtually unknown in the Aegean,[11] although some examples have been found at Mallia and Kommos on Crete as well as off Cape Iria in the Gulf of Argos.[12] Ongoing petrographic analysis of the Uluburun anchors suggests an origin in coastal regions in the vicinity of Tell Abu Hawam or slightly farther north, the same area where the ship's galley ware (see cat. no. 192), much of its pottery cargo, and probably the very ship itself appear to have originated.[13] CP

1. Beachrock is formed by sedimentation of beach sand and sediments in intertidal zones: Beachrock formations occur only a few meters from shore and generally run parallel to the coastline.
2. Pulak 1997, p. 252, fig. 20; Pulak 1998, p. 216. The twenty-two large anchors are loosely grouped into three basic weight categories: the heaviest at about 201 kg, the midrange at 164–82 kg, and the lightest at about 97 kg, averaging 147.7 kg. The two small anchors have an average weight of 23.9. Pulak 1999, pp. 210–11, fig. 1.
3. Pulak 1999, pp. 210–11.
4. Kapitän 1984, pp. 33–36; for Bronze Age anchors in general, see also Wachsmann 1998, pp. 255–93.
5. Schaeffer 1978, pp. 371–81; Frost 1969b; Frost 1991.
6. Wachsmann 1998, pp. 271–73; Frost 1969a.
7. Karageorghis 1976b, pp. 60, 69, 72, 78, 169; Frost 1985; Wachsmann 1998, pp. 273–74.
8. Galili, Sharvit, and Artzy 1994, pp. 93–95, 106–7.
9. Galili 1985, pp. 144–49.
10. Pulak and Rogers 1994, pp. 20–21, fig. 7; Wachsmann 1998, pp. 283, 285.
11. The few stone anchors found in the Aegean and in the western Mediterranean are usually much smaller than those from Uluburun or are of the composite type with three holes, rather than the single-holed weight type recovered from the Uluburun ship. They are catalogued in Wachsmann 1998, pp. 279–83; for Italy and Sardinia, see Lo Schiavo 1995, pp. 406–21.
12. J. Shaw 1995, pp. 280–82, 290, n. 8.
13. Based on preliminary results from Yuval Goren.

Cargo

185a–g
Selection of Ingots

a. Large oxhide ingot incised with image of ship
Copper
Height 43.7 cm (17¼ in.); length 77.1 cm (30⅜ in.); thickness 4.2 cm (1⅝ in.); weight 20.4 kg
35.4.88 (KW 1526)

b. Large oxhide ingot with two protrusions
Copper
Height 37.8 cm (14⅞ in.); length 62.2 (24½ in.); thickness 4.5 cm (1¾ in.); weight 22.7 kg
38.4.88 (KW 1549)

c. Small oxhide ingot
Copper
Height 25.6 cm (10⅛ in.); length 32.7 cm (12⅞ in.); thickness 3.7 cm (1½ in.); weight 10.7 kg
104.24.86 (KW 389)

d. Plano-convex discoid (bun-shaped) ingot
Copper
Diameter 22 cm (8⅝ in.); thickness 4.6 cm (1¾ in.); weight 6.6 kg
2006/4/10A (KW 3108)

e. Small oxhide ingot
Copper
Height 24.7 cm (9¾ in.); length 26.7 cm (10½ in.); thickness 6.6 cm (2⅝ in.); weight 10.1 kg
39.5.90 (KW 1983)

f. Quarter-oxhide ingot
Tin
Width 17.4 cm (6⅞ in.); length 29 cm (11⅜ in.); thickness 4 cm (1⅝ in.); weight 6.3 kg
5.1.2000 (KW 3061)

g. Half-oxhide ingot
Tin
Width 29.1 cm (11½ in.); length 29.1 cm (11½ in.); thickness 7.5 cm (3 in.); weight 11.7 kg
60.4.88 (KW 1371)

Uluburun shipwreck
Late Bronze Age, ca. 1300 B.C.
Bodrum Museum of Underwater Archaeology, Turkey

Of the 354 copper oxhide ingots found in the Uluburun wreck,[1] 317 feature protrusions, or "handles," at the four corners,[2] and an average weight of just under 24 kilograms.[3] While of similar form, 31 have only two protrusions or handles on the same long side.[4] There are also 6 smaller ingots, 4 of which are nearly identical,[5] consisting of two pairs of mold siblings, cast in the same mold;[6] a small ingot that has the same general shape as the others but lacks corner protrusions; and an ingot that is much thicker than the other small ingots, with exaggerated corner protrusions.[7] These 6, as well as the two-handled and the small ingots, are unique to the Uluburun shipwreck. There are also 121 intact ingots of a plano-convex discoid, or "bun," shape.[8] As with the oxhide shape, these ingots vary in weight but average about 6.2 kilograms apiece. The recurrence of differing weights for the Uluburun oxhide ingots indicates that they constituted a quantity of "blister," or raw, copper probably subject to weighing and evaluation during each commercial transaction. Although they were not of a standardized quantity of metal, their broadly common weight groupings would have simplified accounting procedures.[9]

The Uluburun shipwreck yielded some of the earliest known tin ingots,[10] most apparently in the same oxhide shape as the majority of the copper ingots. Except for three intact specimens, however, nearly all of the tin oxhide ingots had been cut into quarters or halves before they were taken on board. Other tin ingot shapes from Uluburun include bun ingots, two complete rectangular slab ingots, sections of slab ingots, thick wedge-shaped sections cut from large ingots of indeterminate shapes, halves of elongated ovoid loaves, and a unique ingot shaped like a stone weight anchor with a large hole near one end.[11] The intact tin ingots are of approximately the same weight range as the copper oxhide ingots.[12]

Tin and raw copper were probably transported as whole oxhide ingots, overland from mines, primary smelting works, or central ore-processing installations to distribution or manufacturing centers, where they were cut into fractions of their

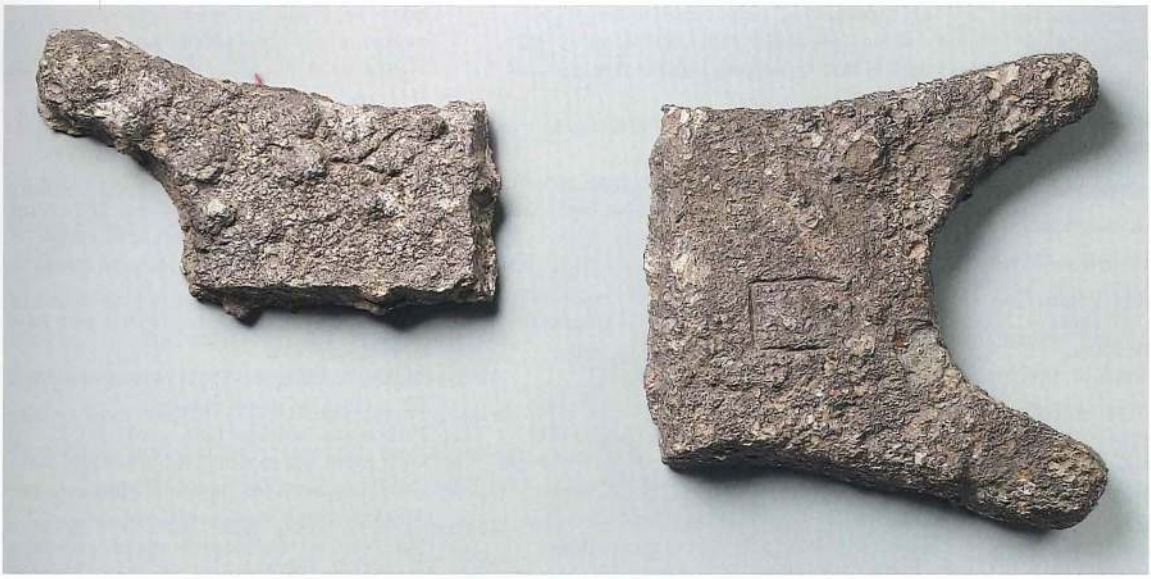
185a

185b

185c

185d

185e



185f, g

original form. The Uluburun assemblage contains many partial tin ingots, which were probably gathered by barter, levies, taxes, gifts, or some other mechanism for constituting the appropriate counterpart to the amount of copper loaded on board the ship. This suggests that the ship owners had direct access to sources of copper, whereas most of the tin was procured through indirect sources.[13]

Preliminary examination of the Uluburun copper oxhide ingots has shown that no fewer than 162 ingots are incised with at least one, and possibly as many as three, marks on their upper surfaces (a).[14] Of the bun ingots, 62 are marked on their lower or mold surfaces.[15] That similar marks were found on both the copper and tin ingots,[16] and that the marks were all incised after casting or cooling, rather than stamped during the casting process, suggest that they were probably made at a point of export or receipt rather than at primary production centers.[17]

The earliest evidence for full-size oxhide ingots comes from sixteenth-century B.C. sites on Crete[18] and depictions in Egyptian tomb paintings, where they are frequently associated with Syrian merchants and tribute-bearers (fig. 101).[19] Later copper-oxhide ingots of the fourteenth, thirteenth, and early twelfth centuries B.C. have been found as far west as Sardinia and Sicily, and as far east as central and eastern Anatolia, Syria, and Mesopotamia.[20] They also occur in southern Germany,[21] Bulgaria, mainland Greece, western and southern Anatolia, Cyprus, the southern Levant, and the Nile Delta.[22]

Thirty-four oxhide ingots were also recovered from the Cape Gelidonya shipwreck.[23] Lead-isotope analysis has shown that oxhide ingots postdating the mid-fourteenth century B.C. differed in the source of their metal from those of earlier Cretan finds. The analysis further indicates that ingots dating from the mid-thirteenth century B.C. to the early twelfth century B.C. were produced from Cypriot copper ores mostly originating in the Apliki mines in the northwestern foothills of the Troodos Mountains.[24] Lead-isotope analysis of the Uluburun oxhide ingots[25] shows that they form a relatively homogeneous Cypriot group and were probably derived from a hitherto undiscovered deposit, almost certainly among the Solea axis ores of northwestern Cyprus, which includes the Apliki deposits.[26]

Sources of Bronze Age tin remain unknown, although ancient texts indicate that

Figure 101. Wall painting with Syrian carrying copper oxhide ingot. Thebes, Tomb of Rekhmire (TT 100). Dynasty 18, reigns of Thutmose III–Amenhotep II.

it may have been obtained from regions to the east of Mesopotamia.[27] Although lead-isotope analysis of tin is in its infancy,[28] preliminary results suggest two sources, one in the Bolkardağ Valley in the central Taurus Mountains in south-central Anatolia,[29] the other probably located in Central Asia, possibly Afghanistan.[30] CP

1. Pulak 2000b, pp. 140–41, fig. 3, pp. 141–53; Pulak 2001, pp. 18–22; Pulak 2005c, pp. 59–65, figs. 5–13.
2. Such rectangular ingots with a projection at each corner were originally termed "oxhide" when it was believed, erroneously, that they were cast to resemble dried oxhides (Bass 1967, p. 69). The shape itself probably evolved to facilitate loading of the ingots onto specially designed saddles or harnesses for transport over long distances by pack animals (Pulak 1998, p. 193; Pulak 2000b, pp. 137–38).
3. The original weights would have been heavier prior to the corrosion and metal leaching that occurred during three millennia in the undersea environment.
4. Pulak 2000b, p. 141, fig. 4.
5. The four small ingots are roughly pillow shaped, seemingly a type more common in the sixteenth and fifteenth centuries B.C. Rather than representing the earlier ingot type, the Uluburun examples are seen as fractional copper ingots, which would have been handled differently and not have required the large corner projections (Pulak 2000b, p. 138).
6. Mold siblings are revealed by identical impressions on the surfaces in contact with the mold. At least six ovoid bun ingots, which also bear identical incised marks, are also mold siblings. It is likely, therefore, that these ingots may have been cast in reusable stone or clay molds, rather than in temporary sand molds. Although not yet studied, a single pair of "two-handled" oxhide mold siblings has also been identified (Pulak 2005c, pp. 59–60, fig. 8, p. 567, figs. 30, 31; Pulak 2000b, pp. 141–42, fig. 5).
7. Pulak 2005c, p. 568, fig. 32; Pulak 1998, pp. 193–94, fig. 9.
8. Pulak 2005c, pp. 59–60, figs. 9, 10, pp. 569–71, figs. 33–46; Pulak 2000b, pp. 143–46, figs. 8–12.
9. Pulak 2001, p. 18; Parise 1968, p. 128; Zaccagnini 1986, pp. 414–15. For a discussion of the chemical composition of the copper and tin ingots, see Hauptmann and Maddin 2005, pp. 133–40; Hauptmann, Maddin, and Prange 2002.
10. Pulak 2005c, pp. 63–65, figs. 12, 13; Pulak 2001, pp. 22–23; Pulak 2000b, pp. 150–55; Pulak 1998, pp. 199–201, figs. 13, 14. Although poorly preserved, a single tin ingot resembling one from the Uluburun shipwreck was found in a foundation deposit in the House of the Metal Merchant on Mochlos, Crete, in a Late Minoan IB context. It is more than a century older than the Uluburun tin ingots (Soles 2008). Tin ingots were also found on wrecks off Cape Gelidonya (Bass 1967, pp. 52–83) and Haifa (Stos-Gale et al. 1998, pp. 119, 123, fig. 6; Galili, Shmueli, and Artzy 1986).
11. Pulak 1998, p. 199, fig. 14. For other tin ingot shapes from Uluburun, see Pulak 2005c, pp. 572–75, figs. 47–61; Pulak 2000b, pp. 150–53, figs. 16–22.
12. Pulak 2000b, p. 152.
13. Pulak 2001, p. 22; Pulak 2000b, pp. 152–53.
14. The marks vary in shape from a simple cross to more complicated forms, some associated with the sea and ships (cat. no. 185a), such as fishhooks, a trident, a fish, and possible quarter rudders. Pulak 1998, pp. 194–96; Pulak 2000b, p. 146, fig. 13.
15. There are thirty-two different types of marks on the ingots. Of these, only thirteen appear more than once, and one is repeated as many as seventeen times. Only seven different marks are found on the bun ingots, five of which are also occur on the copper oxhide ingots (Pulak 2000b, p. 146, fig. 13).
16. Ibid., pp. 146, 153, figs. 13, 21.
17. Pulak 1998, pp. 194–96.
18. Buchholz 1959, p. 33, pl. 4; Platon 1971, pp. 116–18; Hazzidakis 1921, pp. 56–57, fig. 31; Gale 1991b, pp. 202–3, pls. 1–2d. The Cretan ingot finds are listed in Evely 1993–2000, vol. 2, pp. 343–46; and in Hakulin 2004, pp. 19–20, 54–55.
19. Pulak 2000b, p. 138; Pulak 1998, p. 193; Bass 1967, pp. 62–67.
20. Muhly, Maddin, and Stech 1988, pp. 281–85, fig. 1; Gale 1991b, pp. 200–201.
21. Primas and Pernicka 1998, pp. 27–50.
22. Gale 1991b, pp. 200–203, fig. 2; See also Stos-Gale et al. 1997, pp. 109–15, for lead-isotope data for most of these oxhide ingots.
23. Bass 1967, pp. 52–60; for lead-isotope results of the Cape Gelidonya ingots, see Gale 1991b, pp. 227–28.
24. Gale and Stos-Gale 2005, pp. 117–31; Gale, Stos-Gale, and Maliotis 2000, p. 339; Stos-Gale et al. 1997, pp. 109–12; Stos-Gale et al. 1998, pp. 115–26.
25. Gale and Stos-Gale 2005, pp. 117–31.
26. This is supported by recent analysis of copper ores from the nearby Phoenix mine and fourteenth century B.C. copper-smelting slag from Enkomi and Kalavassos. See Pulak 2001, pp. 20–21; Stos-Gale, personal communication, 2000.
27. Descriptions of the tin trade in ancient texts from western Asia hint at a tin source located somewhere to the east, perhaps Iran or Central Asia. Pulak 1998, p. 199; Dossin 1970, pp. 101–6 (see fig. 1, this volume); Muhly 1985, pp. 283–85; L. Weeks 1999, p. 51.
28. Gale and Stos-Gale 2002, pp. 279–302.
29. Pulak 2000b, pp. 153–55, fig. 23; Stos-Gale et al. 1998, pp. 119, 123, fig. 5.
30. L. Weeks 1999, pp. 60–61.