THE CONSTRUCTION OF A SEAGOING VESSEL OF THE LATE BRONZE AGE

The excavation of a Late Bronze Age shipwreck at Ulu Burun, near Kas, Turkey (fig. 1), has extended our knowledge of the construction of seagoing vessels by nearly a millennium.[1] Because of the slow and methodical pace of the excavation, however, what we have actually learned of the ship's hull during three summers and over 5,000 dives can be summarized in a single paragraph:

The garboard is attached to the keel and to the second strake by mortise-and-tenon joints secured with wooden pegs, ca. 2.2 cm. in diameter (fig. 2), driven through the top and bottom of each joint. One mortise may be ca. 7 cm. wide and 17 cm. deep, and the center-to-center distance between pegs in adjacent tenons is ca. 21 cm. (fig. 3). The keel is 27.5 wide (or sided), and planking thickness is approximately 6 cm.

In other words, in the 14th century B.C. at least one ship was built much like the Kyrenia ship was built in the 4th century B.C.[2] Beyond that we can say only that the keel and, probably, the strakes are of fir (*Abies* sp.), the tenons are of a species of oak (*Quercus sp.*), and the pegs are of oak or some other hardwood.[3]

This much was revealed in 1984 when one of the stone anchors on the wreck was raised, exposing a small patch of hull partly covered with ballast stones (fig. 4). As soon as this area was drawn and photographed, it was covered again with sand for protection. Since then an effort has been made to avoid exposing more fragile wood before tons of cargo have been removed from above it.

Nevertheless, we may speculate on the nature of the ship, and what we will learn from it. The distribution of cargo between 44 and 51 m. deep (fig. 5) suggests a length of perhaps 15 to 18 m., although how much slippage of cargo has occurred on the steep slope, and how much cargo may still be buried, remain unknown, making our estimate most tentative. At this time we do not even know which end of the wreck represents the bow and which the stern, although a pair of large stone anchors at the deeper (eastern) limit of the site, not visible when fig. 5 was made, suggest that it is the bow.

Twelve anchors have been uncovered. A row of eight, originally stacked in pairs, ran athwartships between stacked rows of copper ingots which comprised the bulk of the cargo (figs. 6 and 7); one of these anchors, not on the plan, seems to have slipped down the slope on the northern edge of the site. Besides the two at the "bow", mentioned above, are two other anchors, not far from them, the lowermost visible in fig. 5. The anchors are of the general type found built into walls and floors at Ras Shamra (Ugarit) and Byblos in the Near East,[4] and Kition on Cyprus.[5] Although some have also been found under water, as off Cyprus[6] and in the harbor at Tel Dor,[7] this is the first time such anchors have been directly associated with a ship.[8] Those on the wreck appear to be of three sizes, and of ten documented so far, six are large, three medium, and one small. The smallest (fig. 4) could hardly have been a ship's anchor, and may have been a hawser weight or

an anchor for a ship's boat; it resembles an anchor from Kommos on Crete.[9] The one anchor raised from the wreck has not yet been cleaned, and thus we cannot comment on the weights of any.

The ship was carrying at least 200 four-handled copper ingots, weighing, so far, between 18 and 29 kg. apiece, totalling 4 to 5 metric tons. Add at least 100 discoid "bun" ingots, weighing from 5 to 8 kg. each, and there may have been almost 6 tons of copper on board. Tin ingots in the same shapes are fewer, but about 250 kg. of pure tin has already been uncovered, with more expected. In addition to metals, there were 100 or more amphoras, each weighing about 5 kg.; if each contained 10 kg. of contents, we should add another 1.5 tons to the weight of cargo. Lastly, there were seven large storage jars, or *pitoi,* which add perhaps another 700 kg. or so, exclusive of their contents. We cannot guess what all the *pithoi* held, although at least one may have been filled with pomegranates and another held stacks of Cypriot export pottery. *If* the contents of each pithos weighed 500 kg., we should add another 4 tons to the weight of cargo. Ignoring smaller ceramic containers, bronze tools and weapons, glass ingots, and other small items, we can still estimate that the Ulu Burun ship carried at least 12 tons of goods, not counting perishables that left no traces (three ebony logs have been found in the cargo, for example, but we cannot guess if quantities of lighter timber floated out and away from an open hold). The anchors weighed perhaps another 1.5 tons, if estimate of 150 kg. per large anchor prove correct. All in all, the ship was large enough to have carried much more.

Different shipbuilding traditions have left their records in the Mediterranean, where mortise-and-tenon-joined and tied hulls co-existed in antiquity. Thus, the nation or culture of origin of the mortise-and-tenon-joined Ulu Burun vessel is important to our understanding of the history of ship construction. Was the ship Canaanite? Cypriot? Myceanean Greek? Egyptian? We cannot, at this stage of the excavation, even speculate.

Because of the nature of its cargo of raw materials, including not only copper and tin ingots, but also such exotica as elephant and hippopotamus tusks, an ostrich egg, logs of African ebony *(Dalbergia melanoxylon),* and the earliest known glass ingots, the ship resembles those described in the 14th century Tell el-Amarna tablets as carrying royal cargoes between the syro-palestinian coast, Egypt, and a land called Alasia (thought by most scholars to be Cyprus).[10] These cuneiform tablets, unearthed in the remains of the Pharaoh Akhenaten's royal city of Akhetaten in Egypt, even mention ships of Alasia, as well as shipments of copper from the same land. Thus, the Ulu Burun ship could have been Cypriot, especially as it carried new Cypriot pottery inside the *Pithos* mentioned above. The same clay tablets, however, tell us that raw glas was exported from Tyre on the Syro-Palestinian coast, and we know from Egyptian tomb paintings that Canaanite ships reached Egypt with cargoes similar to that carried by the Ulu Burun ship.[11] Add to that the fact that much of the Ulu Burun cargo was carried in typically

Canaanite amphoras and pilgrim flasks, and we can as easily assume that our ship was Canaanite. But we must not forget that archaeological finds of Mycenaean pottery throughout Egypt, Cyprus and the Syro-Palestinian coast have been long seen by some scholars as evidence of widespread Bronze Age Greek seafaring in the Levant.[12] As Mycenaean clay tablets written in the linear B script list copper ingots, ebony, and ivory, all items of cargo on the Ulu Burun ship, could our cargo have been destined for a Mycenaean palace?[13] Some of the cargo on the wreck was, indeed, carried in large Mycenaean or Minoan coarse-ware stirrup jars. On the other hand, most of the ship's anchors are of a type not commonly found in the Aegean world.

There is far less evidence that the ship was Egyptian, but we must not ignore scarabs and a stone plaque inscribed with Egyptian hieroglyphs as possible evidence of an Egyptian presence on board.

It is almost certain that the ship was sailing from east to west when she sank, probably blown by an unexpected south wind against the cliff at Ulu Burun during her final voyage. Her cargo, however, came from so many directions, some far from the Mediterranean, that it can tell us little at this time about the ship's nationality. The major source of copper ore was Cyprus, but we should remember that the only mold for casting four-handled ingots of the type found on the wreck was unearthed in Syria,[14] and that Syrian traders are universally associated with ingots of this type in 14th-century Egyptian art.[15] The Baltic amber used for beads came from central Europe or the Black Sea region, and would normally have been thought of as accompanying Myceanean trade goods from west to east. The tin may have been mined in Afghanistan. The ebony logs came from somewhere in Africa south of Egypt. Frankincense originated either in East Africa or South Arabia. Faience *rhyta* could have been made either on the Syro-Palestinian coast or Cyprus, as could terra-cotta "wall brackets". Ivory could have come from either Africa or the Syro-Palestinian coast. And an ostrich egg could have come from the eastern or western desert of Egypt.[16]

One might think that the nationality of weapons on board would suggest the nationality of the ship. Alas, one well-preserved sword seems typically Near Eastern, but another is of Aegean manufacture.

Bronze tools - axes, adzes, chisels, drill bits, tongs - are of different types, pointing to the Aegean, Cyprus, the Syro-Palestinian coast and Egypt for their origins. And we cannot yet speculate about which, if any, belonged to a ship's carprenter and which were cargo.

Bronze finger cymbals, gold pendants, and silver bracelets all seem Near Eastern, bût we do not know if they were cargo or shipboard possessions.

Balance-pan weights, although not yet studied in detail, seem to be based on Near Eastern weight standards, but these same standards were common to Cyprus and Crete, and thus tell us nothing of the Ulu Burun ship's origin.

Can seals, perhaps representing official items on board, be of more help in

determining nationality? I have never wavered from my view that the Syrian cylinder seal found on the Cape Gelidonya shipwreck of ca. 1200 B.C. belonged to a merchant travelling on that vessel's last voyage, although some scholars have held that the seal was a piece of bric-a-brac, a souvenir picked up by a Mycenaean sailor.[17] What of seals on the Ulu Burun wreck? Alas, there are too many! A crude stone seal of Mycenaean type may have belonged to someone actually on the ship, for it seems too humble to have been prized as a memento of a trip to Greece (although logic probably did not dictate the collecting of souvenirs in the past any more than it does today!). Thus, there is some rather convincing evidence that at least one merchant (?) on the Ulu Burun ship was Greek. This is not necessarily contradicted by the presence on board of two Near Eastern cylinder seals, one of quartz and the other hematite. One of these, of probable Kassite origin, had gold caps extending down over its carved scene, making it impractical as a seal but ideal as a piece of jewelry made from a seal. As the cylinder seals were found together, it is likely that both served simply as jewerly - perhaps as souvenirs. Then there is a gold scarab of Queen Nefertiti. One might think this belonged to a royal mesenger of the queen, pointing to the possibility of the Ulu Burun ship being, if not Egyptian, under Egyptian control. Alas, the scarab was found near a hoard of scrap gold, including an Egyptian gold ring which had been purposely cut in two with a chisel. Perhaps Nefertiti's scarab was simply part of this scrap hoard. The Ulu Burun ship cannot yet be dated precisely enough within the 14th century B.C. to tell us if it sank during the queen's lifetime.

Weapons and seals on board being ambiguous, let us turn to pottery. Once more we face problems. The Cypriot pottery seems to be cargo; even the lamps found with the certain Cypriot wares, although not definitely Cypriot, are pristine. These evidently new Cypriot export wares, therefore, do not point to the nationality of the ship or her crew, only to the fact that they were placed on board at a port of call. Syrian lamps, on the other hand, are blackened around their nozzles, suggesting shipboard use by Syrian (?) crew or passengers. Most other Syrian wares, however, such as pilgrim flasks and amphoras, were simply cargo containers, telling us no more about the ship's nationallity than the Cypriot wares. The pottery most likely to have been in actual use on board, besides the lamps, is the Mycenaean pottery, including a *kylix* and a spouted pitcher, neither being a shipping container. We look forward to discovering the ship's cooking wares, for they should be diagnostic of their owners' nationality.

It is clear that the Ulu Burun shipwreck has not yet yielded its most important information. Not only further excavation, but lead-isotope analyses of fishing-net weights, neutron activation studies of clays, and continuing analyses of resins and other excavated materials will furnish additional clues. We hope that they are sufficient to help us solve this fascinating puzzle.

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Notes

1. The excavation is being conducted by the Institute of Nautical Archaeology (INA), based at Texas A&M University, under the direction of the author. The discovery of the site in 1982 is described in C. Pulak and D.A. Frey, *"The Search for a Bronze Age Shipwreck"*, **Archaeology** 38 (1985) 18-24. Artifacts raised for dating and identification purposes during INA's 1983 survey are reported in G.F. Bass, D.A. Frey and C. Pulak, *"A Late Bronze Age Shipwreck at Kas, Turkey"*, **International Journal of Nautical Archaeology** 13 (1984) 271-279. The 1984 excavation campaing is detailed in G.F. Bass, *"A Bronze Age Shipwreck at Ulu Burun (Kas):* 1984 Campaign, **"American Journal of Archaeology** 90 (1986) 269-296 with pl. 17.

Fig. 5 is by Jack W. Kelley. Figs. 1, 3 and 6 are by assistant director Cemal Pulak. Photographs are by INA President Donald A. Frey.

2. J.R. Steffy, *"The Kyrenia Ship: An Interim Report on its Hull Construction."* **American Journal of Archaeology** 89 (1985) 71-101.

3. Our wood identifications are made by Donna J. Christensen of the Center for Wood Anatomy Research, U.S. Forest Products Laboratory, Madison, Wisconsin.

4. C.F.A. Schaeffer, **Ugaritica VIII** (Paris 1978) 389; H. Frost, *"The Stone-Anchors of Byblos"*, **Mélanges de l'Université Saint Joseph, Beyrouth** 45 (1969) 425-442, and *"The Stone Anchors of Ugarit", in C.F.A. Schaeffer,* **Ugaritica** VI (Paris 1969) 235-245, with references to her extensive study of similar anchors.

5. V. Karageorghis, *"Chronique des fouilles à Chypre en 1975"* **Bulletin de correspodnance hellénique** 100 (1975) 875-878, with fig. 71, and **Kition: Myceanean and Phoenician Discoveries in Cyprus** (London 1976) 60, 69, 72, 78 and 169.

6. D. McCaslin, *Stone Anchors in Antiquity: Coastal Settlements and Maritime Trade-Routes in the Eastern Mediterranean ca. 1600-1050 B.C.* (Göteborg 1980).

7. S. Wachsmann and K. Raveh, *"Concerning a Lead Ingot Fragment from ha-Hotrim, Israel"*, **International Journal of Nautical Archaeology** 13 (1984) 169-170 with fig. 2; *A Concise Nautical History of Dor/Tantura"*, **International Journal of Nautical Archaeology** 13 (1984) 225 fig. 2.

8. Anchors found in the sea off Israel have, indeed, been associated with lost cargoes, but the actual ships which carried these cargoes either are not preserved or have not been located beneath the seabed. *From the Depths of the Sea: Cargoes of Ancient Wrecks from the Carmel Coast* **(The Israel Museum, Jerusalem, Cat. No. 263, Summer 1985)** 11 in English.

9. J.W. Shaw and H. Blitzer, *"Stone Weight Anchors from Kommos, Crete"*, **International Journal of Nautical Archaeology** 12 (1983) 93 no. S 853, with figs. 1, 2B and 4.

10. J.A. Knudtzon, *Die El-Amarna-Tafeln* (Aalen 1964, reprint of 1915 edition); S.A.B. Mercer, *The Tell el-Amarna Tablets* (Toronto 1939).

11. N. de G. Davies and R.O. Faulkner *"A Syrian Trading Venture to Egypt"*, **JEA** 33 (1947) 40-46; T. Säve-Söderbergh, *Four Eighteenth Dynasty Tombs* (Private Tombs at Thebes, vol. 1, Oxford 1957) pl. XXIII.

12. H.J. Kantor, *"The Aegean and the Orient in the second Millennium B.C."*, **American Journal of Archaeology** (1947) 1-103; S.A. Immerwahr, *"Mycenaean Trade and Colonization"*, **Archaeology** 13 no. 1 (1960) 4-13.

13. M. Ventris and J. Chadwick, *Documents in Myceanean Greek* (Cambridge 1959) *passim.*

14. J. Lagarce, E. Lagarce, E. Bounni and N. Saliby *"Les fouilles à Ras Ibn Hani en Syrie"*, **Comptes rendus des séances de l'Académie des Inscriptions et Belles-lettres** (1983) 249-290.

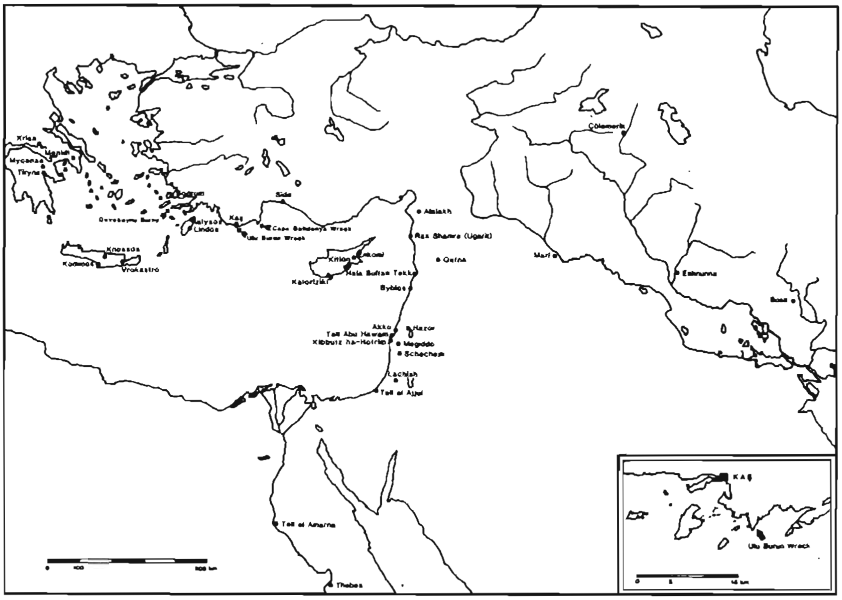
15. G.F. Bass, *Cape Gelidonya: A Bronze Age Shipwreck* **(Transactions of the American Philosophical Society** 58, part 8, Philadelphia 1967) 65-67.

16. Sources of cargo items are discussed in detail in recent (supra note 1) and forthcoming excavation reports.

17. Bass, *Cape Gelidonya* (supra note 15) 163. A response to J.D. Muhly, *"Homer and the Phoenicians"*, **Berytus** 19 (1970) 19-64, which rejected my thesis, is G.F. Bass, *"Cape Gelidonya and Bronze Age Maritime Trade"*, in H.A. Hoffner, Jr., ed., *Orient and Occident, Essays Presented to Cyrus H. Gordon* **(Alter Orient und Altes Testament** 22, Neukirchen 1973) 35-36.

Captions

Figure 1. Map showing the Ulu Burun wreck in relation to the Cape Gelidonya wreck and to the Bronze Age world of the eastern Mediterranean.
Figure 2. Hardwood peg driven through fir strake to hold a mortise in place. Photographed *in situ.*
Figure 3. Diagrams of visible portion of the Ulu Burun hull.
Figure 4. Exposed hull section, showing, from foreground to background, collapsed mortise, ballast stones, keel, and small "anchor." The wood disappears under the large stone anchor to the right.
Figure 5. A sketch plan of the entire shipwreck as it appeared in 1983, before excavation.
Figure 6. Plan showing artifacts exposed after three excavation campaings. The keel runs in an east-west direction in square 15-0.
Figure 7. Stone anchors, *in situ* between rows of copper ingots. One anchor and pithos KW 251 (which rested toward the lower left hand corner of the area shown) had been removed before the photograph was taken. West is at top.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Mycenae
Tiryns
Knossos
Vrokastro
Lindos
Kaş
Side
Cape Gelidonya Wreck
Ulu Burun Wreck
Kition
Enkomi
Hala Sultan Tekke
Alalakh
Ras Shamra (Ugarit)
Qatna
Byblos
Akko
Hazor
Tell Abu Hawam
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Lachish
Tell el Ajjul
Mari
Tell el Amarna
Thebes
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Ulu Burun Wreck

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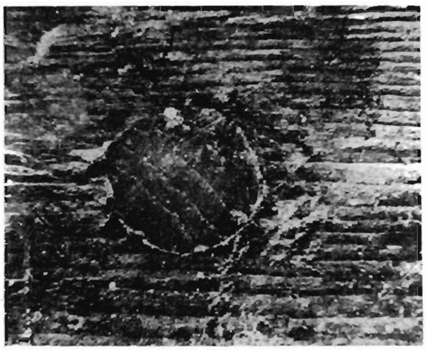

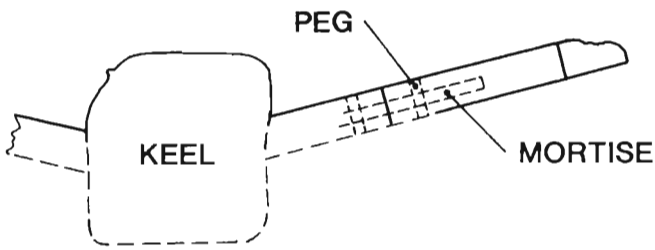
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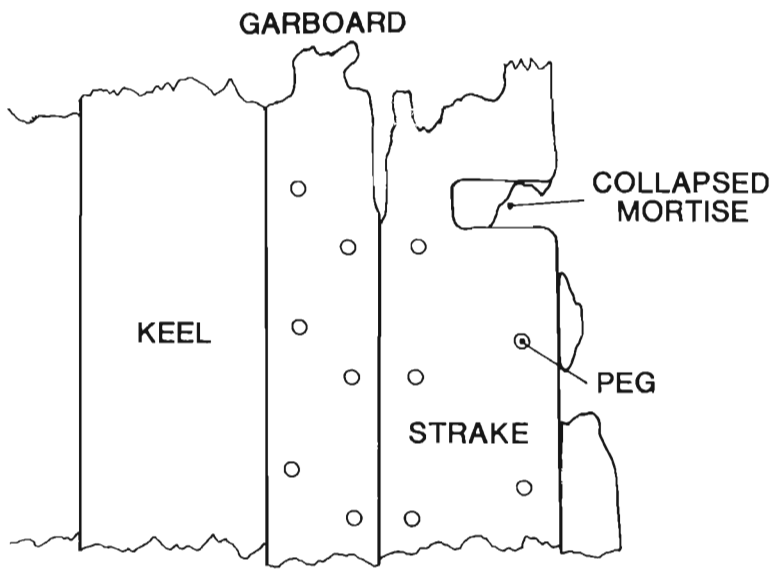
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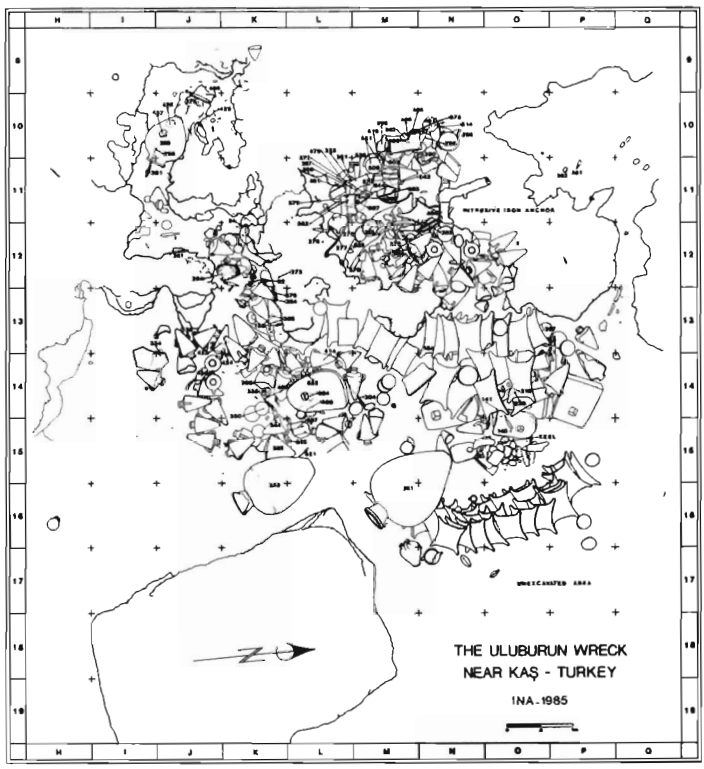
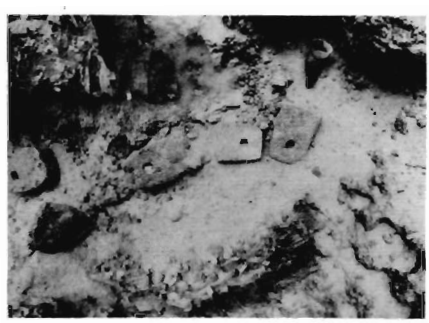


Figure 6



7

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Published by the Organizing Committee of the Symposium, Athens 1989.
Editor: Harry E. Tzalas.
Cover design and layout: Yannis Pantzopoulos.