A LATE BRONZE AGE SHIPWRECK AT ULU BURUN:
PRELIMINARY ANALYSIS
(1984-1985 EXCAVATION CAMPAIGNS)

A Thesis
by
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ABSTRACT

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A Late Bronze Age shipwreck, tentatively dated to the late 14th century B.C.E., was excavated in 1984 and 1985 by the Institute of Nautical Archaeology at Ulu Burun, a cape near Kaş, Turkey. The ship's cargo comprised primarily raw goods including copper and tin ingots cast in the ox-hide and bun shapes, disc-shaped blue glass ingots, elephant and hippopotamus ivory, and Canaanite jars filled with resin and orpiment. Cargo of manufactured goods included glass beads, Cypriot pottery and possibly foodstuffs; it is probable that the Mycenaean pottery on the wreck was for shipboard use. Other finds included bronze tools, weapons, and balance-pan weights of common and zoomorphic forms; stone artifacts; beads of glass, faience, stone and amber; a scarab, a stone plaque and a fragmentary gold ring, all inscribed with Egyptian hieroglyphs; fragments of faience rhyta; gold and silver jewelry, some as scrap; sea-shell rings; and a Mycenaean sealstone and a globed pin of the type usually worn by Mycenaeans and dated to the end of the Mycenaean period and later. At least eight stone weight
anchors were carried on the ship which was constructed in a similar manner to Greek ships a millennium later. The cargo clearly shows that the ship was sailing from east to west, but the nationality of her crew remains uncertain.
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INTRODUCTION

The Late Bronze Age shipwreck discovered by Peter Throckmorton in 1959 at Cape Gelidonya on Turkey's southern coast, was the first ancient wreck studied on the floor of the Mediterranean by diving archaeologists. George Bass' excavation of the site in 1960,¹ and exemplary publication of his results in 1967,² heralded the beginning of underwater archaeology as a scholarly discipline.

Based on artifacts from the site, Bass concluded that the Cape Gelidonya merchantman was a Canaanite or Cypriot vessel which sank around 1200 B.C.E., perhaps slightly earlier.³ Also, his restudy of previous finds in Greece, Cyprus and the Near East, and examination of Egyptian tomb-paintings, combined with new evidence from the Cape Gelidonya wreck, suggested that Semitic seafarers played a more significant role in the maritime commerce of the Levant during the last centuries of the Late Bronze Age than previously recognized. Because Bass' conclusions challenged, among others, the prevailing view of a Mycenaean economic thalassocracy in the Late Bronze Age Eastern Mediterranean, they were mostly controversial and subsequently questioned by some scholars.⁴

In the 25 years since the Cape Gelidonya excavation,

This thesis follows the format of The American Journal of Archaeology (AJA).
tin and lead ingots and a few other objects recently discovered along a three mile stretch of coast in Israel, may be all that remained of the only other Bronze Age shipwreck discovered since Cape Gelidonya. The composition and assemblages of these finds, however, are such that it is impossible to speculate if the finds represent a single wreck, three separate wrecks, or only jettisoned cargo from a ship(s) in distress.

A more systematic approach was needed for locating wrecks. The founding of the Institute of Nautical Archaeology (INA) by George Bass in 1973 was an important step in establishing a permanent group that could concentrate their efforts on various aspects of nautical archaeology. Included in the Institute's program is the investigation of Turkish coastal waters to locate and inventory shipwrecks not only for excavation purposes, but also to protect them from possible looters. At first, these surveys were somewhat haphazard affairs, but after the purchase of the Institute's 65-foot, steel-hulled research vessel Virazon in 1979, they became annual projects. As a result, nearly one hundred ancient wrecks have been recorded during one-to two-month survey campaigns conducted every autumn under the directorship of Donald Frey. Although remote-sensing equipment sometimes was used, most shipwreck discoveries made during these surveys resulted from leads provided by sponge divers, just as information
from a sponge diver led Throckmorton to the wreck at Cape Gelidonya.

Every year about 50 of the approximately 200 registered sponge boats in Turkey sail out for sponges. In recent years, sponge populations in relatively accessible areas have been so depleted, and prices of natural sponges have dropped so low due to competition from cheaper synthetic varieties, that nearly half of these boats supplement or even earn a major portion of their income by illegal spear fishing. Nevertheless, even a conservative estimate of 25 boats, each with five divers making two 45-minute dives daily during the season of approximately 100 days, amass 18,750 hours under water. This does not include the time spent in shallows for decompression. The total underwater time of these divers would be equal to the time spent by a single surveyor diving around the clock for two years. Thus, the Turkish sponge divers are an invaluable source of information for locating shipwrecks; every wreck we located during our surveys had been seen in the past by at least several sponge divers. In most cases, therefore, the only additional effort required by INA archaeologists for finding new wrecks, is to talk to these men about their previous sightings and advise them as to what to look for during their dives. This has been done mainly by visiting the sponge divers in their villages and towns during the dormant winter months, not only to give
slide shows and talks about ancient wrecks, but also to
develop good relations. The Virazon now makes it possible
to contact sponge boats while they are still at sea when
all information is still fresh.
THE DISCOVERY

How this survey program led to the discovery of the Ulu Burun wreck near Kaş is worth noting. During the summer of 1982, sponge divers from the town of Yalıkavak near Bodrum were dining on their usual meal of fried fish aboard their small boat Adnan II, anchored for the night in a calm cove. Their talk centered around hard times and submerged ancient treasures awaiting to be found by fortunate divers. Such instant wealth not only meant a better life, but, more importantly for these men, a safer one, for the risky occupation of deep-water diving would no longer have to be continued to insure one's daily bread. Mehmet Çakır, the novice diver of the group, remembered the strange flat objects resembling "metal biscuits with ears" which he had seen two weeks earlier near Ulu Burun in water more than 40 meters deep. Mehmet's comments did not stoke the curiosity of his fellow divers, but the boat's captain Ahmet Güntaş, pulled out a pencil and piece of paper and asked Mehmet to draw one of the "biscuits." The captain immediately recognized Mehmet's rendition of the curious object, for the metal slab was identical to pictures of "ox-hide" ingots he had seen earlier during an INA slide presentation in his village. He realized the significance of Mehmet's discovery, but decided to verify the presence of the ingots himself before reporting this important discovery to the INA.
archaeologists in Bodrum.

News of the discovery first came to us in Alanya where Yaşar Yıldız and Bahadır Berkaya, both of the Bodrum Museum of Underwater Archaeology, and I had stopped for lunch in July. We were returning to Bodrum after having spent nearly a week recovering a larger than life Roman bronze statue from the sea near Adana. Yaşar suggested visiting the Alanya harbor to seek out sponge boats that might have called in for provisioning or machinery repairs. There we saw Ahmet. He immediately told us about Mehmet’s discovery. We were immensely excited but tried to listen calmly; we knew only too well of wreck reports which could not be verified no matter how hard we tried, and still others which led us to something other than ancient shipwrecks.

In the fall of the same year, a joint team from INA and the Bodrum Museum of Underwater Archaeology visited the site (ill. 1). Mehmet Çakır skillfully directed the boat to the wreck, from which an ingot of typical Late Bronze Age "ox-hide" shape was raised by Feyyaz Subay and Aşkin Canbazoğlu for identification.12

The following year, I received permission from the Turkish Ministry of Culture and Tourism to conduct another INA survey in the Mediterranean. As part of this survey, we investigated the Bronze Age wreck at Ulu Burun between August 18 and 27 in preparation for its full-scale excavation in 1984. The wreck was re-located immediately and the Virazon
FIG. 1. Bronze Age sites mentioned in text.
moored directly above it.

The site lies about 50 meters from shore, between 41 and 51 meters deep on a steep rocky bottom, spread over an area of approximately 10 by 18 meters (ill. 2). Large limestone boulders which had toppled from the cliffs of the rocky promontory dominated the upslope portion of the site. The ship had come to rest just next to a large boulder-like rock outcrop which marked the center of the visible wreckage. Some artifacts lay scattered on the inclined rocky bottom surrounding the boulder, while others were caught in sand pockets farther upslope.

The wreck appeared to be far larger than that at Cape Gelidonya. Most striking among the visible cargo were the so-called "ox-hide" copper ingots, some still stacked as they had once been stowed on the ship. A preliminary count produced 84 visible "ox-hide" ingots in two sizes, with round plano-convex or "bun" ingots, also in two sizes, dispersed among them; surveying with a metal detector, however, revealed other ingots buried beneath the sand. After completing two full excavation campaigns, we are still uncertain about the total number of "ox-hide" ingots on the site, but a figure of 200 would not be an unreasonable estimate. The position of stacked ingot rows placed athwartships suggested in 1983 that the ship's longitudinal axis lay approximately in a west-east direction with the western extremity of the site being
Ill.2. Sketch plan of site made during 1983 survey.
higher on the slope.

The largest of the six visible pithoi, or storage jars, shared the central sandy area of the wreckage just upslope of the boulder with two other pithoi of intermediate size. Two similar jars had rolled down the steep sea bed, while the sixth and smallest jar, caught in a rock crevice, remained farther upslope. Other visible terra-cotta artifacts included eight amphoras, a wall bracket, and three pilgrim flasks. An example of each artifact was raised for identification purposes after being noted on a sketch plan of the site, made with photo-mosaics and control measurements taken on the sea bed. Other raised samples included a round plano-convex or "bun" ingot of copper; a lump of gray material later identified by Lucius Pitkin, Inc., for Robert H. Brill of the Corning Museum of Glass as 99.5% tin; and a large twig, possibly dunnage, reported by Regis B. Miller of the Center for Wood Anatomy Research, U.S. Forest Products Laboratory, to be pistachio (*Pistacia*, perhaps *P. lentiscus*) wood.

Exposed among the amphoras and copper ingots were two stone weight anchors with a similar third anchor lying at the deeper end of the site. Each of these oblong and slightly tapering anchors is hewn from a single large stone slab and is provide with a hole at its narrower end for the attachment of a hawser.
THE EXCAVATION

The Institute of Nautical Archaeology began full-scale excavation of the Ulu Burun shipwreck in 1984 under the direction of George Bass, with Cemal Pulak as assistant director.15

First, a camp was built into the inhospitable face of the rocky promontory against which the Bronze Age ship probably was dashed by an unexpected wind while trying to round the tip of the cape about half a kilometer distant. Comprising facilities for study and storage of artifacts, drafting stations, workshop areas, dormitories and a dining area, the excavation camp housed half of the staff, while the other half lived aboard the Institute's vessel Virazon moored directly over the site. Outfitted with all the necessary equipment for underwater surveys and excavations, the Virazon was fully equipped with generators, high and low pressure air compressors, fresh-water maker, photographic darkroom, and a double-lock recompression chamber.

In the first days of diving, an underwater telephone booth was placed next to the wreck for diver safety, and air-lifts were installed for the removal of sand overburden.16 A horizontal bar positioned over the wreck served as the flight-line for photogrammetric mapping.17 Owing to the extreme irregularity of the sea bed at Ulu
Burun, however, our field equipment was incapable of producing immediate and satisfactory results directly from stereo-photographic pairs. Each small section of the wreck mapped by this method had to be joined to adjacent sections with the aid of many control measurements taken on the sea floor. Once the visible wreckage had been mapped by photogrammetry and control measurements, newly uncovered objects were plotted on the plan by measuring them with meter tapes to previously established datum points. New datum points were fixed around the site as needed, all accurately tied to the master points. Ironically, therefore, the wreck was essentially mapped by triangulation, a method used nearly 25 years earlier on the Cape Gelidonya wreck, and considered then too inefficient for underwater use. The method, however, does produce accurate measurements that can be quickly confirmed and readily used to produce a plan.

Diving twice daily, with nearly six hours between dives, six days a week, we compiled 2,381 dives (91 dives to 50-140 ft., 1,966 dives to between 140 and 150 ft., 226 dives to between 150 and 160 ft., and 58 dives to between 160 and 170 ft.), totalling ca. 848.1 hrs. during the 1984 and 1985 campaigns.

At the end of each campaign, the site was completely covered with tons of sand for protection against adverse winter conditions and possible looting by divers.
THE LADING OF THE SHIP

The sketch plan of the site made during the 1983 survey shows wreckage scattered over an area approximately 10 m. by 18 m. (ill. 2 on p. 10). Only about a third of this area, mainly its shallower reaches, has been thus far excavated. We hoped, by the end of the 1985 campaign, to complete excavation of these uppermost regions, but the wealth of finds and heavy encrustation encasing the delicate material there prevented it. Meticulous dissection of the rock-hard matrix with chisels and hammers was extremely slow; attempts to use small, hand-held pneumatic chisels here were abandoned because they lacked the control required for extracting fragile items. The problem was exacerbated when areas previously designated as bedrock proved to be tin ingots interspersed with other artifacts. The situation was especially complicated by the corrosion of the tin into amorphous masses indistinguishable from calcium carbonate deposits and bedrock. When tin was encountered by excavators, its immediate area was cleared and the borders of the ingot defined for excavation and removal. Work in this upper area by three divers for more than two months in 1985 resulted in expanding the known boundaries of the wreck by an additional three square meters.

An area about half a meter square (L-M intersection at
11) was especially rich in finds (ills. 3 and 4). Once its crust of corroded tin and encrustation had been lifted, a small pocket of loose sand yielded artifacts including a mace-head (KW 278); bronze arrowheads; bronze tools, including three sickle blades and three chisels; lead fishing-net weights; a large lead weight, perhaps the ship's sounding lead (KW 267); bronze balance-pan weights, including a lead-cored example decorated with shepherd and sheep figurines (KW 582); a gold flower (KW 361) and disc pendant (KW 551), both with granulated decoration; faience beads; a gold-framed bone scarab (KW 338) and a plaque of greenish stone (KW 481), each carved with Egyptian hieroglyphs; and a unique copper ingot (KW 388).

A somewhat larger deposit nearby in grid squares M-10, M-11 and N-10 also yielded an abundance of objects: numerous lead fishing-net weights; terra-cotta lamps (KW 485, 502); a stone mace-head (KW 486); a bronze dirk (KW 296); arrowheads; a pair of tongs (KW 378); chisels (KW 536, 566); an adze blade (KW 576); part of a gold alloy signet ring with Egyptian hieroglyphs on its bezel (KW 603); balance-pan weights of unidentified stone, hematite, and bronze or copper; and ingots in both "bun" and "ox-hide" forms. A large number of tin ingots comprising quarter "ox-hide" pieces, half an "ox-hide" section (KW 644), and four others apparently cast in the "bun" shape (KW 401, 409, 519, 614), were also found in this general
ILL. 3. 1984 excavation plan.
Ill. 3. 1985 excavation plan.
area.

Directly below the deposit was a relatively flat shelf initially thought to be bedrock. Investigation, however, revealed this to be an encrusted layer of Canaanite amphoras. The positions of the amphoras indicate that they were arranged in neat rows before the ship broke up. Their downward slippage was inhibited by what appeared to be a terrace-like rock ledge, but later proved to be a neatly stacked mass of at least twenty copper "ox-hide" ingots.

This ledge area contained Canaanite amphoras, more than a dozen glass ingots (originally stacked two- and, possibly, three-high), a stone mace-head (KW 2), lead fishing-net weights, a stone balance-pan weight, a stone tray or mortar (KW 164); and bronze items including a sickle, an arrowhead, more metal ingots, and bronze pin KW 570. The stone tray was concreted to an intrusive Byzantine anchor in area N-11. When the anchor was removed, the cause of its ironic loss became apparent; its fluke had caught on several copper and tin ingots.

On either side of the heavily concreted ledge area are sand-filled gullies where work progressed more easily. The northern gully, virtually devoid of artifacts in its upper reaches save for a few lead fishing-net weights, a bronze drill bit (KW 381), and a large disc-shaped stone balance-pan weight, stretches downward along the sloping sea bed. The large, boulder-like rock outcrop in the middle of the site
forms the gully's southern flank. Stone anchors and "ox-hide" ingots are visible at the gulley's middle and lower reaches, while scattered ingots and a single stone anchor mark its deepest extension.

The excavation of the southern gully (J/K-12), at whose upper end rested small pithos KW 250, proved extraordinarily rich in artifacts. Among the finds were elephant (KW 162) and hippopotamus (KW 167) ivory; gold, silver, faience, stone, and amber jewelry; Mycenaean, Cypriot, and Syrian pottery, including a "Canaanite" lamp; glass ingots KW 3 and KW 4; a fragmentary copper "ox-hide" ingot; Canaanite amphoras, including one filled with glass beads; bronze weapons; lead fishing-net weights; Mycenaean seal KW 134; gold chalice KW 99; and bronze finger-cymbal KW 126.18 Pithos KW 250, wedged between and concreted to bedrock, had to be chiseled free before it could be raised; the silt inside was saved for identification of possible organic contents, but already we know that it contained 21 lead fishing-net weights, a small pilgrim flask (KW 438), and an oil lamp (KW 437) identical to the lamps found in pithos KW 251, discussed below. Directly under pithos KW 250, buried in deep sand, emerged a well preserved short sword (KW 301), apparently of Aegean origin. A second, equally well preserved short sword (KW 275), seemingly Near Eastern in origin, surfaced next to a silver plate deliberately crumpled for scrap, and ten bronze arrowheads
about a meter farther upslope. The same area produced, among other objects, two centrally pierced lead discs (KW 298, 459), and a long bronze spearhead (KW 261). Downslope of the pithos, a large deposit of fish bones was uncovered. Whether they represent the spilled contents of a container or the accumulated excrement of a large predator once living in the pithos is under investigation; the bones reveal that the fish were complete and of small size. A similar deposit of hundreds of murex shell opercula, identified as belonging to the species *Phyllonotus trunculus* L. by John Taylor of the British Museum of Natural History's Gastropod Section, was also noted.19 Preserved under several copper "ox-hide" ingots, these murex shell "doors" seldom survive prolonged submersion. At first they appeared to be from dead shells, but the scarcity of actual shells and the apparent stacking of three and even four opercula wedged between ingots, some in areas too narrow to admit live murex shells, may indicate that they were carried as cargo in a bag. The purpose of these opercula escapes us, but they probably represent a by-product of the purple-dye industry. Pliny noted that murex opercula could be boiled in oil to prepare an ointment to prevent hair from falling out, and that "when beaten up, they could unite cut sinews even when severed."20

In the lower region of the gully lay an incomplete
bronze sword (KW 155); more spearheads; a poorly preserved one-handled tin cup; faience, amber, and stone beads; and a small fragmentary painted stirrup jar (KW 305).

The narrow gully widens to a sloping field of sand containing many scattered amphorae. The southern end of this sand field (I-13 and J-13 to J-15), marking the visible boundary of the site in this direction, produced a gold roundel (KW 138) which lay next to a painted stirrup jar (KW 137), nested inside Syrian lamp (KW 139); a painted Mycenaean one-handled cup (KW 334); several large spearheads and two broad chisels (KW 423, 424); fragments of faience rhyta (KW 42), at least one in the form of a ram's head and another shaped after a female's head; several amber beads and fragments of a seventh pithos.

To the south, in area K-14, is another fragmentary painted stirrup jar (KW 308), and many balance-pan weights of standard sphendonoid and domed shapes, as well as three zoomorphic forms comprising a duck (KW 350), a bull (KW 335), and a sphinx (KW 468). Just downslope, in areas K-15 and L-15, were a poorly preserved bronze dagger (KW 621), fragments of yet another ram's-head rhyton (KW 565), and a one-handled Syrian jug (KW 231). A unique amphora of exceptionally large capacity (KW 588) was found next to the rhyton and may have crushed it. Two large pithoi (KW 252, 253) lie almost against the western side of the "boulder."

The sandy area extends to the north and east around the
large boulder-like outcrop. The northern extension, containing several stone anchors and pithos KW 251, merges with the northern gully. South of the "boulder", however, the sandy slope drops steeply into deeper water where a partly buried pithos is visible at a depth of 51 meters. The northernmost pithos (KW 251) contained stacks of Cypriot pottery of the types commonly exported to the Syro-Palestinian coast, comprising Bucchero jugs, White Shaved juglets, White Slip II milk-bowls, and Base-ring II bowls; saucer-shaped oil lamps common in the Near East were also found inside. Nearby was another painted stirrup jar, again fragmentary, a terra-cotta wall bracket (KW 304), and a concreted lump of tiny discoid beads identified as faience by Robert H. Brill of the Corning Museum of Glass.

Seven stone weight anchors, so called because their hold on the sea bed depended entirely on their weight, appear to be arranged athwartships in pairs stacked one on top of the other. Four are large, two are intermediate in size, and one is rather small. The last, too small to be an effective ship's anchor, may have served as a hawser weight, or as the lead weight on a fish-net, or it may have belonged to the ship's boat.

Between the anchors and a second stacked row of "ox-hide" copper ingots to the east, in areas N to P-16, were found ballast stones and small finds, including additional balance-pan weights, two of which were shaped
like a frog (KW 220, 237), a bronze double axe, bronze blades, a whetstone, fishing-net weights, a lamp, a terra-cotta wall bracket glass ingots, and possibly an intact tin "ox-hide" ingot, not yet raised from the site.

Raising one of the medium sized weight anchors revealed many cobble-sized ballast stones lying directly over a section of the ship's hull, confirming the east-west orientation surmised from the distribution of artifacts on the 1983 sketch plan of the site (ill. 2 on p. 10).

Between the exposed hull remains and the second row of stacked copper ingots mapped but still unexcavated, were several Cypriot bowls; among the ingots are two pilgrim flasks, and a coarse-ware stirrup jar in area M-17, not yet removed.

Because both campaigns were devoted primarily to the excavation of the shallower section of the wreck, the true extent and nature of scatter in deeper parts remain unknown. It would be premature, therefore, to assign stern and bow areas to the site. When the completed excavation allows these determinations, and the final site plan reveals artifact distributions, we should be able to speculate with greater confidence about which items were cargo and which were the personal effects of those on board. Until then, however, it must suffice to note that the west-east orientation of the wreck is along the gradient of the sea bed, and that three rows of copper
"ox-hide" ingots appear to be stowed athwartships with a row of anchors, possibly spares, arranged in groups between them. At each end of the ship and beyond the last two row of ingots, there may be shorter rows of copper and tin "ox-hide" ingots.
THE INGOTS

The bulk of the cargo on the Ulu Burun ship consists of copper ingots in two basic forms: those in the so-called "ox-hide" shape, and plano-convex, discoid or "bun" ingots; the former is by far the most numerous on the wreck. A unique, small rectangular slab was also recovered.

Flat, oblong with protrusions or handles at each end of its four corners, always rough on one surface and much smoother on the other, the "ox-hide" ingot was so termed because of the mistaken belief that each ingot was cast to imitate a dried and stretched ox skin.\textsuperscript{21} It was also believed that each ingot equaled the price of an ox in a pre-monetary system of currency,\textsuperscript{22} a confusion based on the assumption that Latin pecunia originally meant "cattle". It is now known that the derivation of pecunia has nothing to do with "cattle" or "currency".\textsuperscript{23}

The ox-hide theory has been questioned. Buchholz demonstrated that the shape evolved over the centuries; the ingot's legs, non-existent on the earliest forms, gradually became prominent and grew longer during its evolution. He believed, therefore, that the legs were developed merely for ease of portage, and the resemblance to a dried ox skin resulted naturally as a consequence of casting.\textsuperscript{24} While this appears to be the general case, Bass has demonstrated that ox-hide ingots could not always be
separated chronologically to the extent Buchholz believed. Much has been speculated about the ox-hide ingot's shape and standardization of its weight, not so much from the viewpoint of portage and convenience of handling, but primarily from the simplification of accounting procedures involving these ingots. Even after taking into account the change in weight due to corrosion, the ox-hide ingots recovered from the Late Bronze Age shipwreck at Cape Gelidonya varied considerably in weight, leading Bass to conclude that they were not intended to conform to any weight standard, but merely represented blister copper cast in shapes convenient for carrying. Muhly, on the other hand, believed that the earliest ox-hide ingots were cast to equal one talent of 29 kg., and that the variation in weight of Cape Gelidonya ingots resulted possibly from the collapse of international order at the end of the Late Bronze Age. That these ingots conformed to a somewhat uniform quantity of raw metal, but one subject to weighing during each commercial transaction in order to determine their precise weights, is the intermediate view taken by some scholars, including Parise. A similar interpretation is advocated by Zaccagnini, who notes that a search for precise weight standards of ox-hide ingots would be meaningless, since Near Eastern accounting practices concerning metals were always ultimately based on weighing the metal regardless of its shape and size. He suggests,
however, that the ingots may have been cast within a
general weight range that would allow for a rough, but
quick reckoning of a given quantity of raw metal.29

Once all the Ulu Burun ingots are excavated, cleaned
and studied, they will probably provide the single most
important source of information for our understanding of
the mechanism behind ox-hide ingot trade.

Buchholz, calling the ox-hide ingots "Keftiubarren" in
the belief that ancient Egyptian artists commonly
associated them with people from the land of Keftiu, also
proposed an ingot typology based primarily on
archaeological material.30 A detailed survey of Egyptian
representational evidence by Bass, however, has shown these
ingots to be more frequently depicted with Syrian merchants
and tribute-bearers,31 and that various ingot types,
although following Buchholz's typology in a most general
way, were used contemporaneously and could not always be
separated chronologically to the extent Buchholz
believed.32

Complete ox-hide ingots raised to date from the Ulu
Burun wreck total 27, but it is impossible to estimate
accurately the number remaining on the site. The 84 visible
ingots on the wreck once suggested no less than 150 in
ox-hide form, but we later realized that what in one case
we had assumed to be a single row of seven ingots was in
reality an enormous pile stacked at least eight deep in
places.

So far, of the three ox-hide ingots that have been cleaned of marine encrustation, none shows evidence of primary or secondary marks. That such marks exist, however, is indicated by ingot fragment KW 632, found near a stone anchor in area L-14. The unobscured mark II, not represented in the compendium of ingot marks in the Cape Gelidonya publication, appears on the ingot's rough, upper surface.

Most ingots' weights have not been determined because of heavy encrustation not yet removed, but their dimensions reflect considerable variability. The largest (KW 71) is 0.91 m. long, 0.47 m. wide, and 0.033 m. thick; one of the smallest (KW 628) is 0.725 to 0.73 m. long, 0.37 to 0.402 m. wide, has a maximum thickness of 0.045 m., and weighs 26.37 kg. The only other ingots that have been cleaned of concretion, weigh 28.8 kg. (KW 404; 0.815 to 0.825 m. long, 0.422 m. to 0.466 m. wide, with a maximum thickness of 0.06 m.) and 17.87 kg. (KW 184: 0.769 m. long, 0.463 m. wide, and 0.025 m. thick).

Some ingots suffered more from corrosion than others. In many instances they have been reduced, at their edges and especially on their handle-like protrusions, to a dark brown porous substance, devoid of metal, that yields at the slightest force. It is impossible to determine the original dimensions of ingots in this condition, and in many cases
even to distinguish upper faces from lower surfaces.33

The Ulu Burun wreck provides the first direct evidence for the synchronous use of ingots of Buchholz's types 1, 2, and 3 (ill. 5; ill. 6).34 Until the discovery of the Ulu Burun ship, known full-sized ingots of Type 3 (ill. 5, figs. 3 and 6) were limited to two intact and several fragmentary examples from Cyprus. Although none had been dated by stratigraphic excavation, some were attributed to about the 12th century B.C.E. on the basis of associated artifacts and the re-examination of their find spots.35 Consequently, the type is generally seen as the ox-hide ingot's fully developed form before its disappearance at the end of the Late Bronze Age.36 Bass has shown, however, that the type has been depicted twice in the 14th century, in the tombs of Huya and Huy.37

Ingots of Type 2 (ill. 5, figs. 2 and 5; ill. 6, figs. 1 and 2), dated by Buchholz to around 1400 B.C.E., are seen as early as the mid-15th century in the tomb of Penhet, and as late as the 12th century on the relief of Ramesses III; but scenes of ingots in the latter relief may have been copied directly from the 13th-century Ramesseum.38 This type is also the only shape represented on the Cape Gelidonya wreck.39

Four copper ingots of Buchholz's Type 1b (ill. 5, figs. 1 and 4) three of which were stacked (KW 389, 390, 517), were recovered from the upslope area of the wreck in
Ill. 5. Copper ox-hide ingot types. 1:10
Fig. 1. Type 2a (?).  
(Ulu Burun KW 869)

Fig. 2. Type 2a.  
(Cape Gelidonya In. 13)

Fig. 3.  
(Ulu Burun KW 200)

Fig. 4.  
(Ulu Burun KW 644)

Ill. 6. Copper and tin ox-hide ingot types. 1:10
areas L-11 and N-10. These Type 1b ingots are asymmetrical in that no two of their sides are equal (KW 117: ill. 5, fig. 1 on p. 30; l. 0.295, w. 0.24, max. th. 0.042; KW 389: l. 0.322 to 0.327, w. 0.244 to 0.249, max. th. 0.046; and KW 390: l. 0.299 to 0.301, w. 0.237 to 0.250, max. th. 0.054).

Ingots of Type 1b appear to be more common during the 16th and 15th centuries B.C.E. and continue into the 14th century, but the problems of dating ingots by shape have already been mentioned. It is possible, however, that we have at Ulu Burun a separate category of smaller, perhaps fractional ingots that did not require handles for carrying, for the Type 1b ingots on the wreck appear to be smaller than most Type 1b ingots found elsewhere and depicted in Egyptian tomb paintings.

A trapeziform (i.e., no two sides are parallel) copper slab (KW 388: l. 0.293 to 0.316, w. 0.20, th. 0.04), with distinctly bevelled edges, surfaced in area M-11 only about a meter from the Type 1b ingots.

Thirty-nine bun ingots have been raised from the wreck to date. As with the ox-hide form, these exhibit much diversity in size; the largest (KW 514) measures 30 cm. in diameter and 3.2 cm. in thickness, and the smallest (KW 106) is 20 by 3.9 cm. If bun ingots should be divided into two basic categories by size, a reasonable dividing point would be about 27 cm. in diameter. In accordance with such a
division, 70 percent of these ingots would be classified as "small", with an average diameter of about 23 cm.

One well-preserved bun ingot (KW 397) is inscribed with a sign resembling an open-sided rectangle on its relatively smooth convex bottom. Most of the bun ingots have yet to be fully cleaned and conserved, but conservator Robert Payton reports from Bodrum that of the 19 freed of encrustation, four are of the "large" size and are unmarked, whereas ten of the 14 "small" ingots are incised on their convex surfaces with the sign $\overline{\text{T}}$ (type 39B of Gelidonya ingots).41

Although metallurgical studies of the Ulu Burun ingots have not been completed, analyses have shown that the ox-hide ingots and at least some of the bun ingots on the Cape Gelidonya ship were cast from the same, nearly pure copper. In fact, there does not appear to be any compositional difference between these two major types except for size and, therefore, the amount of copper in each ingot; the different shapes have been attributed to the possibility of different production techniques or areas, or to the need for smaller units of copper.42 Whether the ox-hide ingots themselves resulted directly from primary smelting of copper-bearing ores or from remelting of raw copper metal is uncertain. The discovery on the Ulu Burun wreck of smaller Type 1b ox-hide ingots makes it less likely that bun ingots were intentionally
cast as fractional units of the ox-hide form, although their manufacture as such cannot be precluded. It has also been suggested that primary bun ingots, that is those which were not formed from re-melted scrap metal, may in fact be the copper left at the bottoms of smelting furnaces after slag tapping, while ox-hide ingots were cast outside the furnace, possibly even with re-melted bun ingots. Bun ingots from the Cape Gelidonya wreck, however, preserved on their edges possible evidence for a sprue, either as slight protrusions or straight cuts by which they were probably removed from the ingots. Assuming that these sprue-like excrescences did not result from metal solidifying in the mouth of the channel for tapping slag, it would appear then, that at least some bun ingots were cast in molds outside the furnace, much in the manner of their ox-hide counterparts. Whatever the case may be, both Cape Gelidonya and Ulu Burun wrecks provide ample evidence for the concurrent shipment of bun and ox-hide ingots during the Late Bronze Age, indicating that the bun shape did not serve as an intermediary product before being recast in the ox-hide shape; the shape of one was not preferred over the other.

The wide-spread occurrence of the basic ox-hide ingot shape, from Sardinia to Mesopotamia and from Egypt (as representations) to the Black Sea, has suggested a central authority excercising control over the production
of and the trade in this important commodity. The recurrence of differing weights for the ox-hide ingots, although a broadly common weight standard may be found for some series, probably indicates that these ingots were not intended for use as currency but rather represented a standard of metal subject to weighing and evaluation at each transaction according to prevailing market conditions. The shape, itself, probably evolved merely for its ease of transportation over long distances on pack animals. That this shape was also influenced by its being stowed more efficiently on ships than discoid ingots, however, has been negated by the discovery of the latter ingots on the Cape Gelidonya and Ulu burun ships.

More than 40 tin ingots and many ingot fragments reduced to unrecognizable lumps have been found on the wreck. Of these, 17 appear to be fragments of ox-hide ingots, four of bun or plano-convex ingots, and the remainder too corroded for attribution to any specific type. The reversion of tin, especially in ingots trapped beneath copper ox-hide ingots, to a grayish powdery pulp that dissipates easily when disturbed under water may partly be due to the tin's galvanic reaction with copper. In other cases, however, the tin has fared better, and it is possible to discern an ingot's general shape in spite of its rough and blistered surfaces. When these bubble-like blisters are broken off, a gray-white, hard crystalline
structure can usually be observed beneath. In these cases, the transformation of tin from its white state to a gray, granular substance with few metallic properties is due to a totally different mechanism. This allotropic modification of tin into gray tin ("tin pest") is observed when tin of high purity is subjected to low temperatures (13.20°C) for substantial periods.\(^\text{49}\) That this reaction may be responsible for the condition of the Ulu Burun material is substantiated by the purity of the tin. Robert Maddin, who sampled most of the copper and several of the tin ingots raised in 1984, reports that gray tin is present. This transformation occurs with a volume change of about 20 to nearly 25%, resulting in crumbling granules. Given favorable conditions and time, the transformation continues until all white tin is consumed. Apparently, this is the first time gray tin has been uncovered in an archaeological context.\(^\text{50}\)

Of the 17 tin ingots in ox-hide form, 16 represent quarter ingots, each preserving one handle (ill. 6, fig. 3 on p. 31). The seemingly intact quarter-ingots range in size from ca. 36 cm. long, ca. 14.5 cm. wide, and ca. 4 cm. thick (KW 204) to ca. 29 cm. long, ca. 12 cm. wide, and ca. 5 cm. thick (KW 403). Due to extensive surface corrosion on all ingots, measurements are only approximate. Whether the partial ingots represent exact quadrants of the ingots from which they were cut cannot be ascertained, but it seems
reasonable to assume that at least some attempt was made to maintain the uniformity of the pieces. Conservator Payton reports that of the few ingots of tin which have been cleaned, one (KW 200: ill. 6, fig. 3 on p. 31) although poorly preserved, appears to be marked with the sign \[\text{T} \], the same sign observed on most of the copper bun ingots. A second tin ingot (KW 201) is pierced and is marked on one of its surfaces with a straight line; this may be yet a third tin-ingot type, but its full shape has not been determined.

Ingot KW 644 (ill. 6, fig. 4 on p. 31; l. 0.36, w. at handles 0.30, w. at waist 0.20), raised from area M-11 as part of an encrusted mass of tin ingots, is the only half ox-hide ingot of tin recovered to date. It is not known if it was cut deliberately or broken during the wrecking of the ship.

Several tin plano-convex, discoid or bun ingots were also recovered. Of these, KW 401 has a maximum diameter of 23.2 cm. and a thickness of 4 cm. Three incomplete ingots appear to have the same general shape; two can be reconstructed to approximately the same dimensions, while the third, if indeed it is a bun ingot, has a preserved diameter of 30.5 cm. and a thickness of 7.3 cm. \[51\] Whether the occurrence of tin ingots in exactly the same forms as that of copper, i.e., ox-hide and bun shapes, suggests a similar production technique or reflects the influence of a
possible control over the shape of metals remains to be investigated.

Ulu Burun provides the first examples of four-handled tin ingots in the ox-hide shape. Ingots of Type I, painted in white by Egyptian artists, have been interpreted as lead, electrum and silver, but Bass' contention that some of these might represent tin ingots appears to be reinforced by the Ulu Burun finds.52
THE POTTERY

The 67 amphoras raised so far represent only about half of the total number estimated on the wreck. The Ulu Burun amphoras are still being cleaned and conserved and have not yet been studied in detail. Only one has been drawn (ill. 7), and comparisons with other amphoras are tentative. Similarities between the Ulu Burun amphoras and Canaanite amphoras from Mycenae, Menidi, Tell Abu Hawam, and the tombs near the Persian Garden at Akko have been noted, but mention may also be made of somewhat similar amphoras from Megiddo and Byblos, and two examples from the sea off the coast of Israel; Raban, on the basis of chemical analyses of the amphoras from the sea, proposes that amphoras of this type originated along the Syro-Palestinian coast from Akko to Ugarit. The undated amphoras excavated by Tsountas in Tombs 58 and 59 at Mycenae remain the best parallels.

A unique amphora of large proportions (KW 588), but incomplete from the neck up, resembles a large amphora from the Akko tombs. No dimensions are given for the Akko jar, but from the scale provided it appears to be somewhat taller than the Ulu Burun example, although with about the same shoulder diameter.

It is now possible to divide the Ulu Burun amphoras tentatively into three basic sizes. Amphora KW 588 has a
Ill. 7. Canaanite amphora. 1:4
maximum preserved height of 49.5 cm. (ca. 4 cm. missing from the neck and rim), and maximum diameter of 39.5 cm. Only a few leaf fragments and several fig seeds were recovered by sieving the contents of this capacious jar. The second size comprises amphorae averaging 58 to 59 cm. in height and about 29 cm. in diameter, while the third and by far the most common size appears to average 50 to 51 cm. in height and 24 cm. in diameter; the last two sizes are not clearly distinct, and intermediate forms do exist.

Sieving of contents yielded a yellow resin from at least 45 amphorae or 67 percent of the total number excavated. Some of the amphorae produced a few fig seeds, but it is possible that they are intrusive since fig seeds were previously found in amphorae containing large amounts of resin.

Eight amphorae contained one potsherd each, while two others had several small, apparently joining sherds. Bass suggested that they were placed in the amphorae intentionally because they appeared too large to have fit through the jars' necks without guidance. It is more probable, however, that the sherds supported wet sealing clay while it was shaped over the jars' mouths; sherds placed deep inside resin-filled amphorae would more likely have survived intact. Jar and amphora sealings recovered from Eighteenth-Dynasty Malkata clearly indicate that before sealing, a stopper of reed, mud or pottery was
placed over the container's mouth. Reed or grass stoppers continued to be in use nearly two thousand years later. Several stoppers, a potsherd over a reed plug for example, could be employed in combination. In rare instances leaves and bungs of chopped chaff mixed with an adhesive or mud were substituted. The stopper's main purpose apparently was to prevent the wet mud of the sealing from contaminating the amphora's contents. That a similar sealing practice may have been employed on the Ulu Burun amphoras is strengthened by the presence of copious organic detritus in the bottoms of some jars. This organic layer, sometimes found directly under a potsherd and comprising primarily grass blades, leaves, seeds and resin chips, is probably the remains of a grass stopper or bung. When the ship sank, the unbaked clay sealing dissolved and water pressure may have forced the grass stopper, and in some instances the potsherd, into the jar. That an implosive force was felt by some jars, almost certainly after being structurally weakened by impact, is demonstrated by the occurrence of their rim and neck fragments embedded deep inside. It must be remembered, however, that not a single amphora raised from the wreck gives any positive indication of the technique by which it was sealed, and that reconstructions remain speculative.

It is reported by Cheryl Haldane, who is studying the contents of the amphoras, that nearly all the organic
deposits recovered in substantial amounts contained many leaves and, especially, the fruits of a Pistacia tree (Pistacia cf. terebinthus). A few amphoras also contained ovine and caprine digital bones (phalanges), as well as shells of land snails. It is possible, therefore, that some or most of the organic detritus may be remnants of previous contents, in which case these amphoras were in re-use when filled with their final cargo of resin.

Preliminary research by Curt Beck, of Vassar College's Amber Research Laboratory, has shown the resin samples from amphoras to probably represent the family Burseraceae, which includes frankincense (Boswellia ssp.) and myrrh (Commiphora spp.). Beck, who is directing the study of the various resins from the Ulu Burun shipwreck, now reports that thin-layer chromatography conducted by E.M. Hairfield and H.H. Hairfield, Jr., at Mary Baldwin College, has identified the resin as frankincense. A few samples recently submitted to John S. Mills of the National Gallery of London, however, have been reported to be a Pistacia resin, probably from the cultivar P. atlantica (also known as P. terebinthus var. atlantica), which yields the so-called Chian turpentine. This identification appears to be further strengthened by the presence of Pistacia remains in the amphoras, mentioned above. Chian turpentine is a sticky and semifluid resin which has to be stored in containers such as jars or, as may be the case on the Ulu
Burun wreck, in amphorae. Mastic (obtained from *P. lentiscus*) and frankincense, both harvested in the form of dry tears,69 on the other hand, would probably be more conveniently transported in lighter containers such as baskets in the manner they are handled today. The possible presence of Chian turpentine in Egyptian tombs may indicate the resin's ritual significance in antiquity,70 but in modern times it is substituted for chewing-gum, and in the eastern Egyptian desert it is used in the preparation of perfumes.71 We hope that on-going chemical analyses will eventually resolve the nature of this evasive resin.

One amphora, KW 8 in area J/K-12, was filled with originally blue colored glass beads, solidly concreted together. Another amphora (KW 48) in area M-12, contained orpiment, or yellow arsenic, a substance commonly used as pigment in ancient Egypt.72 Some orpiment was also discovered on the 11th-century A.C. shipwreck in Serce Limani, Turkey, which carried a cargo of glass cullet destined for recycling.73 Another "glass wreck" of approximately the same period, discovered less than 15 miles from the first site during INA's 1984 survey, also carried abundant orpiment.74 Glass ingots were also found on the Ulu Burun wreck. The presence of orpiment on three ancient shipwrecks carrying raw glass, although separated by nearly 23 centuries suggests a connection between the two materials. Arsenic, however, has not been observed in
the analysis of ancient glass, although Bass refers to an 8th-century recipe which may suggest its use in coloring glass. Pliny mentions an encaustic paint made by staining wax with orpiment for use on naval and commercial ships; orpiment also appears to have been mixed with beeswax in the preparation of wax writing surfaces for diptychs.

Pithos KW 251, the largest of six storage jars visible on the wreck, is so overgrown with concretion that it is not possible to study the jar's shape in detail before cleaning. Except for sediment collected in its lower body, the jar appeared to be empty, but when tipped during lifting, several ceramic vessels buried in the sediment spilled out. Eighteen pieces of handmade Cypriot pottery, mostly intact, comprising five "milk-bowls," at least three of which are White Slip II, three Base-ring II bowls, three White Shaved juglets, three Bucchero jugs, and four saucer-shaped oil lamps were recovered. Most of the open vessels of matching types were found still stacked inside one another as they were originally placed inside the pithos serving as a protective container. Whether the pithoi on the ship constituted cargo as well as containers for cargo, however, remains unknown.

Hemispherical bowls, or milk bowls, are represented on the wreck in two sizes. The fabric of the small type (e.g. KW 20: ill 8; h. 0.06; max. diam. 0.14) consists of a white-gray slip applied with a brush, the strokes of which
Ill. 8. Cypriot milk-bowl KW 20. 1:2

Ill. 9. Cypriot White Slip II bowl KW 11. 1:2

Ill. 10. Cypriot Base-ring II bowl KW 18. 1:2
are evident, over its reddish brown fabric. Its arched-wishbone handle attached at about a third way down the rim, rises obliquely beyond the rim. The slip has suffered considerably from submersion and it is impossible to determine if the bowl was originally decorated with paint.

The only White Slip bowl (KW 11: ill. 9 on p. 46; h. 0.09; max. diam. 19.8) partially cleaned of encrustation to reveal surface decoration, appears to be of Popham's White Slip II normal stage, contemporaneous with Mycenaean IIIA:2 pottery of the 14th century B.C.E.80 This ware, becoming progressively rougher in style and execution and with be made until the end of the L.C. IIB period, corresponding approximately to LH IIIA:21.81 White Slip II bowl KW 11, with its shallower bowl, thick bordered ladder pattern,82 and subsidiary decoration consisting of hatched parallel lines and rows of dots, but not lozenge patterns, is more at home in the latter part of Popham's normal stage, though probably not at its very end. White Slip II bowls from the earlier part of this phase, such as those found at Amarna, on the other hand, still exhibit the lozenge decoration.83 A fragment of another White Slip II bowl was found in the rich deposit of the southern gulley, and a second complete bowl lies concreted to copper ox-hide ingots in area N-16.

The Base-ring II bowls, represented by KW 18 (ill. 10
on p. 46; h. 0.065; max. diam. 0.173), are of wet-smoothed, pink-brown clay coated with a thin, matte gray-brown slip. The marked ridge at the transition of the concave upper exterior side with the lower body, and an upswinging arched-wishbone handle terminating in a fork below the level of the rim, are in imitation of their metallic prototypes. Apparently, the convex profile of the Ulu Burun examples represent the form’s latest development, for the bowl’s profile evolves from a slightly convex to an angular concave shape. The only other Base-ring wares at Ulu Burun include two fragmentary bowls of similar type found in area K-13 (KW 123), and in grid square L-12 (KW 277). A trail of sherds from other Cypriot vessels between KW 277 and the position on the site of pithos KW 251, may point to the storage jar’s original upslope position before it rolled downslope.

The White Shaved juglets (e.g. KW 26: ill. 11; h. 0.185; max. diam. 0.073), of dark buff fabric and gray-white slip, had the lower ends of their handles attached by the typical Cypriot method of pushing the handle completely through the vessel wall. The juglets' necks, handles, and lower bodies were vertically pared or shaved with a knife, hence its name, while the clay was still wet, and their rims pinched slightly to form a spout. Juglet KW 13 was the only vessel damaged when pithos KW 251 was moved. White Shaved wares have not been found elsewhere
Ill. 11. Cypriot White Shaved juglet KW 26. 1:2

Ill. 12. Cypriot Bucchero jug KW 38. 1:2
on the wreck.

Red-brown Bucchero jugs, represented by KW 38 (ill. 12 on p. 49; h. ca. 0.15), appear to be coated with a brown-gray slip. The medium-sized piriform bodies are joined to necks which widen slightly upwards and terminate as flat rims. Decoration consists of regularly spaced vertical ridges in imitation of their metallic prototypes, and a single band or ridge encircling the vessels at the body-neck juncture. Apart from their curious backward tilt, the jugs are rather regular in shape for handmade forms. The three examples from the pithos represent the type's entire repertory on the wreck.

The dark-brown fabric and grayish-brown slip of the four saucer-shaped lamps from pithos KW 251 (e.g. KW 23: ill. 13; h. 0.05; w. 0.133) contrast sharply with the typical Syro-Palestinian lamps on the wreck with coarse red-orange fabric and reddish-brown surfaces (e.g. KW 59: ill. 14; h. 0.06; w. 0.144). The latter also differ from the lamps recovered from the pithoi in shape, their fabric is more crumbly while their nozzles are straight-sided and deeply pinched. One of the lamps of the latter category has a fire-blackened nozzle, perhaps indicating its use aboard the ship, while those from the pithoi are pristine. It would appear, then, that lamps stored together with the obviously Cypriot wares in a large jar were also of Cypriot origin, which, in turn, would increase the likelihood of
Ill. 13. Lamp KW 23. 1:2

Ill. 14. Lamp KW 59. 1:2
the pithoi, themselves, being Cypriot. Although similar lamps found on Cyprus are considered to be locally made by some, they are extremely rare and their Cypriot origin must remain questionable until further study.89 The best Cypriot parallel so far reported by Bass dates from the end of Level IIIC at Enkomi, or between 1125/1100 and 1075.90 Apparently the Canaanite lamps also are not helpful in dating the wreck more closely for, as pointed out by Amiran, the differences between lamps of LB IIA and IIB periods are difficult to discern.91

A unique concave bottom on lamp KW 485 (Ill. 15; h. 0.054; w. 0.14), enabling it to sit flat on its base, is unlike the usual thickened, flat bottoms of later types which, according to Amiran, made their first appearance in the Near East in LB IIB.92

Wedged between and concreted to the side of the upper end of the southern gully, smaller pithos KW 250 contained little sediment and no visible artifacts. While transferring the sediment into plastic bags for later examination, however, we found 21 lead fishing-net weights, a perfectly preserved ceramic lamp (KW 437) and a pilgrim flask (KW 438). The lamp is identical to those from pithos KW 251, but the pilgrim flask is a new addition to the ceramic repertory from these containers.93 The pithos was chiseled free from bedrock and raised to the surface.

Before the pithoi are cleaned of encrustation and
Ill. 15. Lamp KW 485. 1:2

Ill. 16. Wall Bracket KW 650. 1:5
drawn, their profiles cannot be studied. One of the larger jars (KW 252) is decorated with a fine, raised ridge at the juncture of its neck and body, and three wider but faint ridges circumscribe the body between its neck and maximum diameter. The smaller pithos (KW 250: h. ca. 0.80; diam. ca. 0.62) appears to be plain. Except for its shorter neck and squatter profile, it has the same general form as its larger counterpart. These large storage jars are similar to the ovoid pithoi with widened shoulders from Athienou94 and Minet-el-Beida; KW 250 is somewhat like the smaller jar from the latter site.95 The general type is found in L.C. II-III contexts,96 but comparable material appears to date to the 13th-12th centuries B.C.E.97

Three wall brackets (e.g. KW 650: ill. 16 on p. 53; l. ca. 0.40, h. of bowl 0.17) have been found within a 1.5 m. radius of pithos KW 251, but it is not known if they were initially inside this jar together with other Cypriot pottery. Each consists of a long, flat bracket pierced on one end for suspension, and provided with a scoop-like cup on the other. The purpose of these curious objects has been much debated; although their use as torch holders, incense burners, and ember scoops have been proposed, the usual theory is that they served as hanging lamps.98 The shape, probably based on metal prototypes,99 must have evolved in Syria-Palestine or Cyprus, for they are virtually unknown in the Aegean; two examples in Mycenae should be regarded
as imports.100 In Cyprus they occur in L.C. IIB to IIIB contexts,101 contemporaneous with examples from the Near East, and continue in later periods in bronze and terra cotta.

Of the ten pilgrim flasks raised, five were of small size with their dimensions varying from h. 15.3 cm., max. diam. 12.3 (KW 604) to h. 17.5 cm., max. diam. 13.3 cm. (KW 438: ill. 17). One was of intermediate size (KW 651: ill. 18; h. 22, max. diam. 17.1), so far unique. The large flasks also vary considerably in size: KW 600; h. 30 cm., max. diam. 24 cm., to KW 114 (ill. 19); h. 36.6 cm., max. diam., 29.7.

Two flasks (KW 438: ill. 17, and KW 604) display a slightly different rim. On these the typical heavy, triangular section lip has been replaced by a funnel-shaped mouth with a much smaller rim, which appears to sprout from the plastic V-like decoration formed by the join of the circular handles to the short neck.

At least four of the pilgrim flasks contained fig seeds. Bass has cautioned, however, that rather than representing contents, the seeds may be the remains of dried-fig stoppers in the flasks' mouths.102

Good parallels for the flasks have already been noted from Tell Abu Hawam and Hazor.103 Others are from Akko tombs,104 although some of the smaller Akko vessels appear more rounded around the edges where the separately formed
Ill. 17. Pilgrim flask KW 438. 1:2

Ill. 18. Pilgrim flask KW 651. 1:3
Ill. 19. Pilgrim flask KW 114. 1:4
halves of the body are joined, and Lachish, where the
funnel-shaped mouth is represented fairly closely by a
flask from Level VI.105 The Ulu Burun pilgrim flasks appear
to be undecorated, but conservation may reveal painted
decoration as on other seemingly undecorated vessels from
the wreck.

Seven Mycenaean vessels comprising a kylix, four
painted stirrup jars, a coarse-ware stirrup jar, and a cup
have been found on the wreck so far.

Kylix KW 57 (ill. 20; h. 0.117; max. diam. 0.125),
recovered from the southern gully among the rich assemblage
of artifacts including, among others, elephant and
hippopotamus ivory; glass ingots; gold, silver, amber, and
faience jewelry; Canaanite, Cypriot, and Mycenaean pottery;
and a Mycenaean lentoid seal, has a red-brown fabric
decorated with red paint. The paint has suffered from
submersion and it is impossible to recognize the complete
design. The kylix conforms to Furumark shape (FS) 256 for
decorated kylikes of the LH IIIA:2e period.106 Bass notes a
similar example from New Tomb 7 at Ialysos, dated by
Furumark to the LH IIIA:2 period.107 Several parallels for
the shape, from Attica may also be mentioned.108 Jeremy
Rutter, who will be studying the pottery from the Ulu Burun
wreck, believes the best parallels for the kylix, as well
as the other Mycenaean pieces, come from Attica and
Rhodes.109
Ill. 20. Kylix KW 57. 1:2

Ill. 21. Stirrup jar KW 137. 1:2
Conical-piriform stirrup jar KW 137 (ill. 21 on p. 59; h. 0.168; max. diam. 0.137), uncovered in area J-13, only about a meter downslope of the kylix, has been broadly dated to the LH IIIA:2 period.\textsuperscript{110} Bass cites as a parallel an example from New Tomb 51 at Ialysos on Rhodes.\textsuperscript{111} The floral design on the jar's handle zone, completely revealed during later conservation,\textsuperscript{112} however, appears to point to the latter part of this period. The stylized Mycenaean unvoluted flower with stamen and anther represented as a single hook-like line (FM 18.122 or 126) is seen during LH IIIB.\textsuperscript{113}

Recently restored globular stirrup jar KW 305 (ill. 22; h. ca. 0.12, max. diam. ca. 0.12), of FS 171 in profile, is decorated down its body with fine line groups flanked by single wide bands, and on its shoulder zone with the multiple stem motif (FM 19:25).\textsuperscript{114} Stirrup jar KW 171 (ill. 23; h. ca. 0.12 and max. diam. ca. 0.105) is similar in decoration to the preceding vessel, but its profile, FS 178,\textsuperscript{115} is more squat. The larger, fragmentary stirrup jar (KW 308) is also decorated with bands. Details of the design on its upper body will become clear after conservation; the jar is globular, probably conforming to FS 170,\textsuperscript{116} and has a false neck with concave profile similar to that of KW 305. The disc of the false neck is flat on KW 171 and KW 308 and slightly convex on KW 305. Fabric is cream buff and well refined. Their surfaces,
Ill. 22. Stirrup jar KW 305.  1:2

Ill. 23. Stirrup jar KW 171.  1:2

Ill. 24. Cup KW 334.  1:2
covered with a slip of the same color, are decorated with red-brown paint.

A large coarse-ware stirrup jar (lot no. 158) was discovered in the southern gully near kylix KW 57, while a second identical, but intact jar, not yet raised, appeared in area M-17, between the second row of copper ox-hide ingots and the boulder-like outcrop.

These large, closed vessels, apparently containing oil (sometimes perfumed) or wine, were used in both domestic storage and trade.117 Some of the best parallels for our stirrup jars come from the House of the Wine Merchant at Mycenae, the destruction of which is no later than the end of LH IIIA.118 Recent analyses have shown the majority of these jars to be manufactured in western Crete.119 The examples at Mycenae represent the earliest large-scale exportation of the jars to the Greek mainland; their shipment in significant quantities to the Levant, appears to have begun at the same time, and which continues throughout the LM IIIB period.120

The deep semi-globular cup (KW 334: ill. 24 on p. 61; h. 0.055, max. diam. 0.085) is well rounded below, and the fusing of its slightly closing sides with its lip in a continuous curve forms a bell-shaped profile; the base is hollowed out, and the single handle rises a little above the rim. The decoration of the usual heavy red-brown bands on the cup's outer surface are placed around the rim, the
lower body at the handle attachment, and the base. The intermediate zone between the two upper broad bands is undecorated while the region between the middle and base is filled with seven more or less equally spaced thin lines. The shape of the cup conforms to FS 214:d, but it may also be a deep version of FS 220.\textsuperscript{121}
THE GLASS

Area M-12 yielded all but two of the intact glass ingots from the wreck. Many fragmentary pieces were also found there and in adjacent areas. Two glass ingots, KW 3 (ill. 25, fig. 1; max. diam. 0.154; min. diam. 0.125; th. 0.055 to 0.069; weight 2343 gm.) and KW 4 (ill. 25, fig. 2; max. diam. 0.156; min. diam. 0.141; th. 0.056 to 0.068; weight 2607 gm.),122 found just downslope of pithos KW 250, almost certainly were stored in the same area of the ship as the other glass pieces. These two ingots were unusually clean, with few traces of concretion or weathering (patina) layers; scarcely buried and protected by sand, they were presumably abraded by sea-bed action. The ingots are truncated cones; their lower (smaller) faces are rounded and relatively smooth while their upper (larger) faces, with sharp and irregular edges, are rougher. In some examples the two faces are not parallel. The largest ingot (KW 373) has a maximum diameter of 0.155 m., a minimum diameter of 0.125 m., and a thickness of 0.055 m.; and the smallest (KW 383) a maximum diameter of 0.138 m., minimum diameter of 0.122 m., and a thickness of 0.06 m. An unusually irregular ingot (KW 385) has a maximum diameter of 0.149 m., and a thickness of 0.035 m. Their cobalt blue coloring could be observed in most cases despite extensive encrustation and patination covering many ingots. Three
Fig. 1. KW 3.

Fig. 2. KW 4.

Ill. 25. Glass ingots. 1:2
intact ingots, however, were green with black and white variegation, and several large ingot fragments were light brown or amber. It is almost impossible to ascertain the original color of these last pieces since they have been completely hydrolyzed and no true glass remains.

Chemical analyses of the Ulu Burun glass by Robert H. Brill, of the Corning Museum of Glass, have identified cobalt as the coloring agent. The extensively "weathered" green, black, and amber glass, on the other hand, is more difficult to interpret. According to Brill, at least the green coloring appears to result mainly from copper, perhaps as part of the original colorant or perhaps as contamination from nearby copper ingots; the latter explanation is plausible since the green ingots were found directly below copper ox-hide ingots. The core of at least one green ingot, on more recent testing, proved to be blue. Because the amber glass contains neither cobalt nor other metals such as nickel, zinc and manganese that accompany cobalt in the blue ingots, its original color was probably amber or another color.

Black and amber colored glass beads from amphora KW 8, also studied by Brill, were apparently manufactured from the same deep blue glass as the ingots, but their original blue coloring was lost from years of submersion; their chemical homogeneity suggests that both products probably originated from the same workshop. The beads were made by
winding a thin thread of molten glass around a solid core, probably of wire, which was later removed; the beads' striations and occasional gas bubbles are still evident.

According to Brill, the chemical composition of these earliest known glass ingots are identical to Egyptian cored-vessels, particularly to those from Amarna, and to glass amulets from Mycenae, but markedly different from glass manufactured in Mesopotamia. Since Mesopotamia and Egypt were the two known glass making centers of the second millennium B.C.E., analytical evidence would suggest a flow of blue colored glass from Egypt to Mycenae, perhaps by way of Syria and/or Cyprus. As Bass has already noted, if the probable West Semitic word *mekku* and Hurrian *ehlipakku* of Akkadian texts refer to raw glass, as Oppenheim suggested, then Egypt was obtaining raw glass from the Palestinian coast, most likely a special variety that could not be made locally. The popular dark blue glass in Egypt, for example, had to be imported in some form, for the basic ingredient, cobalt, is not found naturally in Egypt. Perhaps the Ulu Burun ingots represent the form by which cobalt glass was exported to Egypt and the Aegean.

Based on the presence of blue glass in Shaft Graves and the closeness to the Aegean of cobalt-bearing silver ores of the Bohemian Erzgebirge, Dayton *et al.* claim a Mycenaean origin for cobalt glass, and maintain that blue glass reached Western Asia and Egypt from the Aegean. It
is difficult to ascertain whether the few early blue glass spacer beads found in LHI tombs at Mycenae, having close parallels on many North Mesopotamian and Syro-Palestinian sites, are imports or local imitations, but the occurrence in the Aegean of slightly later molded blue glass disc pendants and nude female plaques, almost certainly imported from Northern Mesopotamia, suggest that the Aegean glass industry was stimulated by Mesopotamia. Furthermore, copper mines at Ergani Maden in SE Turkey yield cobalt mineralization in concentrations up to 3 percent. It is more likely, therefore, that ancient Near Eastern glass workers initiated the methods of using cobalt-rich slags produced from copper smelting, or from some other source, in the production of dark blue glass, and exported their products to Egypt and the Aegean in the form of disc-shaped ingots as suggested by the Ulu Burun finds.
THE IVORY

A section of elephant tusk sawn off at both ends, and with scars of missed saw strokes still evident near the cuts, was recovered in the southern gully just upslope of a hippopotamus incisor. The tusk is in a relatively good state of preservation except for some surface exfoliation and longitudinal cracking, all ingrained with a black-green stain covering most of the tusk's surface (KW 162: ill 26; pres. l. 0.201, max. d. of smaller oval end 0.126; larger oval end 0.146).

The Asian elephant (Elephas maximus) is quite different in appearance from its African relative (Loxodonta africana), but it is impossible to separate their tusks; although some dealers are reputed to be able to detect the difference in raw modern ivory samples, this is probably not possible with archaeological specimens. Deraniyagala maintains that in the Asian elephant, the tusk usually has a flattened plane of wear at its apex, whereas in the African elephant it is generally conical. The Ulu Burun tusk is incomplete, and we cannot examine its apex for possible clues of origin, but since Syria once hosted herds of elephants, need we look towards Africa for the source of our tusks?

The earliest elephant tusk known in the Near East is from an ivory workshop in Bir es-Safadi near Beersheba,
Ill. 26. Elephant tusk section KW 162. 1:2
dated to 3320+300 B.C.E. Other early finds include a tusk from Chagar Bazar in the Jezirah dated ca. 2000 B.C.E., 137 five tusks from the 18th century B.C.E. Level VII palace at Alalakh, 138 and several others from Megiddo. 139

In the 16th century, it is documented that during his Asiatic campaign, Tuthmosis I mounted the first great elephant hunt in Northern Syria, nearly fifty years before Tuthmosis III’s possibly exaggerated claim of killing 120 of these huge beasts in the same region for their ivory. 140 Not too long afterwards, an elephant calf is included in the tribute from Syria to Egypt; 141 but during this time and even earlier, Egypt was also obtaining ivory from African lands to the south. 142

The susceptibility of cut ivory to fracturing and adverse effects of humidity and temperature fluctuations, such as those likely to be encountered on long sea journeys, favors its transportation as complete tusks. 143 While this appears to be the case for the hippopotamus tusk on our ship, the section of ivory, cut to the approximate size for pyxides of the type found at Mycenaean Athens, led us consider that they were carried as precut blanks for such containers. Krzyszowska, however, has pointed out that a section lower down the tusk, with the root cavity partially forming the central hollow of the pyxis, would be a less wasteful utilization of this valuable material for
making such objects. This observation appears to be strengthened by her recent examination of virtually all extant ivory pyxides, all but two of which were provided with separate bases, a clear indication in her mind, that they were not carved from solid blocks. She does not state whether the lamellae patterns on all these containers also support such a conclusion. It is just possible that the removal of a cylindrical plug during carving may be easier and less wasteful of ivory, and the resulting ivory tube would then be fitted with a separate bottom and lid to form a container.

About a meter downslope of the elephant ivory lay a hippopotamus incisor or tusk (KW 167: ill. 27; l. 0.334; max. dia. at proximal end 0.046). Barnett notes that hippopotamus ivory is denser, harder, and whiter than elephant ivory, and that lower hippopotamus canines produced "the whitest and most resplendent ivory obtainable anywhere," perhaps partially explaining its popularity and wide distribution. Many skeletal finds of hippopotamuses in Syria-Palestine suggest that these animals once thrived in local marshes and that their range extended possibly as far north as the Orontes river in northern Syria. Hippopotamus teeth have been discovered in Near Eastern archaeological contexts ranging from the 4th-millenium B.C.E. Cave of the Treasure in Nahal Mishmar in the Judean Desert, to 8th-century B.C.E. Tell Qasile in
Ill. 27. Hippopotamus tusk KW 167. 1:2
Israel, after which time it is believed that hippopotamuses became extinct in Western Asia. They have also been found on numerous Bronze Age eastern Mediterranean settlements extending from Crete and Mycenae in the Aegean, to Kition and Hala Sultan Tekke on Cyprus, to Minet el-Beida and Ras Shamra (Ugarit) in Syria; many are also known from Egypt. It appears that hippopotamus tusks reached Crete as early as the pre-palatial period, but the frequency of their use over elephant ivory during this period remains to be investigated. The increasing number of hippopotamus teeth found on ancient sites has initiated a reexamination of ancient ivories, and a recently completed study of a collection has revealed that a far larger portion of the objects had been fashioned from hippopotamus rather than elephant ivory.
THE TOOLS

A large assemblage of tools, found mainly in areas L-11, M-11 and K-14, includes sickles, axes, adzes, chisels, drill bits and/or awls and a pair of tongs.

The sickles, varying in length from 11 to 18 cm., have yet to be cleaned of encrustation to reveal the exact shapes of their blades and the manner of attachment to their handles. Of four blades found, none have long tangs or sockets for hafting, but it is possible that sockets have broken off; the apparently square-butt ends on two of the blades, when cleaned, may prove to be short tangs with rivet holes. Another blade type (KW 188: ill. 28; 1. 0.213, and KW 344: ill. 29; 1. 0.191), curved like a sickle but with its cutting edge on the outer edge, is probably a razor.

The wreck yielded four flat axe and adze blades of two distinct types, all now cleaned and conserved. The distinction between an axe and an adze blade, especially in earlier periods, is rather thin. Petrie lists six distinguishing features for the separation of the two tools.153 The situation is complicated, however, by blades that are identical in form, differing only by the manner in which their cutting edges are sharpened. Here we adopt the commonly accepted view, without passing judgement on its validity, that if a non-socketed blade, regardless of its
Ill. 28. Bronze razor KW 188. 1:2

Ill. 29. Bronze razor KW 344. 1:2
thickness and length, has beveling or chamfering on both of its faces, it is called an axe; if this beveling is confined to only one face, it is identified as an adze.

KW 587 (ill. 30; l. 0.195; w. 0.062; max. th. 0.009) from area L-15, and KW 218 (ill. 31; l. 0.195; w. 0.052; max. th. 0.01) are lugged or trunnion axes of the same approximate dimensions and general shape, save for the slightly more slender proportions and somewhat rounded butt of the former. The latter blade, although chamfered on both faces, appears to have an asymmetrical cutting edge and may, in fact, be an adze blade. Its "top" surface, the face with the least chamfer, is incised with what is probably a stylized fish.

Lugged axes were widespread during the Bronze Age, but axes from the Ulu Burun site are of Maxwell-Hyslop's Type II with flat blade and small shoulder protrusions for lugs. This is by far the most common form in Palestine, although it is also found in Egypt, Syria, Cyprus and Anatolia. Sites in Palestine and Cyprus have produced blades somewhat resembling ours. The closest parallels for KW 218 are from Hazor, dated by its excavator to the 14th century B.C.E.; and for KW 587, from the treasury of the Great Priest at Ras Shamra-Ugarit, dated to the same century by its excavator, but lowered to the second half of the 12th century by Catling. The length of the Ras Shamra blade, the shape and relative position of its lugs
Ill. 30. Bronze lugged axe KW 587. 1:2

Ill. 31. Bronze lugged adze KW 218. 1:2
and the blades's semi-rounded butt-end are features which approximate the Ulu Burun material most closely. The Ras Shamra blade, however, is a typical adze by our definition. Among the bronzes found on the Cape Gelidonya wreck of approximately 1200 B.C. were at least four lugged blades.162 Although smaller in size, blades B107 and especially B108 from the Gelidonya wreck are good parallels for the Ulu Burun examples; the latter blade appears to be beveled on only one face and is probably an adze. Fragmentary axe blade B110 from Cape Gelidonya, when intact, probably had the same dimensions as the Ulu Burun tools. It is too early to ascertain whether the Ulu Burun lugged axes constituted part of the ship's cargo, or were for shipboard use only. Together with the Gelidonya wreck, the Ulu Burun ship may provide clues to the westward spread of this predominantly Near Eastern blade type.

Blade KW 576 (ill. 32; l. 0.205; w. 0.063; th. 0.009) is of the type designated by Petrie as a "necked adze." This tool has a unique, well formed butt-end which may have been used to lash the blade more securely to its handle. The type appears to be confined mainly to Egypt, its evolution traced by Petrie from the Third Dynasty to the Nineteenth Dynasty.163 The blade, distinctly splayed and widest at the cutting edge, becomes narrower towards the butt and forms angular shoulders just below the rounded, semi-circular head. The head is separated from the rest of
Ill. 32. Bronze necked adze KW 576. 1:2

Ill. 33. Bronze necked adze KW 141. 1:2
the blade by a pronounced undercutting (neck). No good parallels for this adze have been found, but there is some similarity between our blade and one from Gurob in Egypt, dated by Petrie to the Eighteenth or Nineteenth Dynasty.  

Although both blades splay out towards their cutting edges, the Ulu Burun piece is more slender and its head more rounded. A blade from the South Rooms at Amarna is of similar shape and proportions, with the exception of its flattened butt.  

Blade KW 141 (ill. 33 on p. 80; l. 0.215; w. 0.052; th. 0.008) proved after conservation to be a necked blade. It differs from KW 576 by its straight sides, narrower blade and absence of flaring towards the cutting edge. The cutting edge, sharpened on both faces, suggests that this is, according to our classification, an axe. The head, although somewhat rounded, is smaller and is not undercut distinctly as is that of KW 576. If the necks of these blades were intended to facilitate lashing to hafts, then the handle type best suited for the purpose would probably be that of an adze mount. Hence, the blade may be classified more appropriately as an adze despite the profile of its cutting edge.  

Some affinity, without specific parallels, may be observed between KW 141 and copper models of necked blades from the foundation deposits of Tuthmosis III.  

All four models have straight sides and shallow neck indentations,
but their heads have flat butts, unlike the slightly rounded head of our blade. Perhaps the best parallel for its head is found in an incomplete stone mold from the turquoise mines of Serābīr el-Khādim in the Sinai, where a number of stone molds for tools were recovered, including a fragment containing the butt for another necked-adze blade. The site has been dated by its excavator to the New Kingdom, probably the Eighteenth Dynasty. The next group of tools comprises a series of six broad-chisel blades. In their encrusted state these tools were assumed to be flat axe blades, but when cleaned, all proved to have relatively pointed butts. Some of the blades have minor splaying near their cutting edges while others are straight sided. Two blades, fused together by encrustation, were uncovered in the southern gully. In the gully's lower reaches, a second pair was discovered under a Canaanite amphora and next to a Syrian pilgrim flask. The lengths of these tools vary, KW 376 being the longest (ill. 34; l. 0.201; w. 0.043, th. 0.0065), and KW 423 the shortest (ill. 35; l. 0.169, w. 0.036, th. 0.004), although most are closer to 20 cm. in length.

This blade type is apparently rare or nonexistent in the Near East, but there are many parallels from Crete, Greece and the Aegean Islands. The tool is treated by Petrie as an adze, whereas Catling and Deshayes classify it as a chisel. Deshayes suggests that his chisel sub-type
Ill. 34. Bronze broad chisel KW 376. 1:2

Ill. 35. Bronze broad chisel KW 423. 1:2
C3, which the Ulu Burun examples resemble most closely, approaches a true adze blade because of its broad cutting edge. Based on the shape of the tapering tang that forms the chisel's narrow butt, this sub-type is divided further into two groups. With the exception of chisel KW 264, which best fits Deshaye's category C3a, all of the Ulu Burun finds have shouldered tangs and belong to his sub-type C3b; chisel KW 86 is more slender and approaches his type C1.

The few dated examples of Deshayes' type C3 chisels are from the 14th to 12th centuries B.C.E. With a single exception from Mycenae, all are from Crete. Although the number and close association of the chisels on the Ulu Burun wreck might suggest that they were cargo, the discovery of large tool kits on wrecks is not unknown. Three deep-bar chisels of varying lengths form the second chisel series. The largest is KW 276 (ill. 36; l. 0.255; w. 0.027; th. 0.010), while KW 307 is slightly shorter but of heavier construction (ill. 37; l. 0.214; butt w. 0.035); KW 536 is the smallest (ill. 38; l. 0.12; w. 0.003). With their uniform thickness and wide blades that rapidly converge to form the tools' cutting edges, which are perpendicular to the plane of the wider faces of the blade, the Ulu Burun deep-bar chisels belong to Deshayes' category Alb, the Egyptian type. Chisel KW 536 with its tapering butt, on the other hand, may be of Deshayes' group B1.
Ill. 36. Bronze deep-bar chisel KW 276. 1:2

Ill. 37. Bronze deep-bar chisel KW 307. 1:2

Ill. 38. Bronze deep-bar chisel KW 536. 1:2
According to Petrie, this lance-shaped and peculiarly Egyptian tool was used from the First to the Nineteenth Dynasty to cut and lever out wood chips from narrow mortises, a job for which its rectangular-sectioned shank was especially well suited. That deep-bar chisels were also used outside Egypt, albeit rarely, is illustrated by two Twelfth-Dynasty examples, closely resembling KW 276, found in Byblos. Two earlier chisels from the beginning of the Middle Kingdom, also from Byblos, are of the same type; chisel no. 340 from the temple foundation deposit somewhat approximates the general shape of KW 307, which has a straight, non-tapering butt. A small deep-bar chisel with a partly preserved wooden handle still adhering to its butt was recovered from the Cape Gelidonya wreck. Another chisel, from the Trésor de Bronzes at Enkomi, has the same general form as the Ulu Burun pieces but differs from them by its angular shoulder taper; the hoard has been dated to the final stages of Cypriot Iron I (1150-1050 B.C.E.) by its excavator and to the second half of the 12th century by Catling. The gradually tapering butt of KW 536 closely resembles butts of a small 14th-century chisel from Ras Shamra and two larger blades from Crete, however; these chisels, and the blade from Enkomi, are of Deshayes' sub-type Bla.

Another type of bronze chisel, KW 566 (ill. 39; l. 0.203), has a circular shaft and a tapering square butt for
Ill. 39. Bronze chisel KW 566. 1:2

Ill. 40. Bronze drill bit KW 579. 1:2

Ill. 41. Bronze drill bit KW 381. 1:2
hafting.

No less than a dozen long and slender bronze tools of square and circular sections have been found, most still covered by encrustation. One cleaned piece, KW 579 (ill. 40 on p. 87; l. 0.13; 0.01 square), is probably a large drill bit. Its tip has been forged into a lozenge-shaped point placed diagonally to the shank, and its butt end tapers slightly for the fitting of a socket. Catling suggests that similar pointed objects were bone or wooden hafted hand tools, and not machine tools.180

These tools are found in the Near East,181 the Aegean, and Cyprus.182 The best parallel for the Ulu Burun example is perhaps a drill bit from Enkomi having the same approximate dimensions and dated to Late Cypriot III (1220-1075 B.C.E.).183 KW 381 (ill. 41 on p. 87; l. 0.149), similar to KW 579, but with a straight, untwisted point, is like an example from Enkomi that has been dated to about the same period.184

Uncovered among copper and tin ingots, arrowheads, lamps, and a dagger at the western, uppermost part of the site, were a pair of bronze tongs (KW 378: ill. 42; l. 0.525; th. 0.006). Cast as one long, narrow piece, the tool was given its present central loop, broad shoulders, and parallel blades by bending. Its purpose aboard the ship is not understood, but it is shaped differently than, for example, smaller tongs with diverging blades which spread
Ill. 42. Bronze tongs KW 378. L. 42 cm.
out immediately below the top loop. The latter tools can be manipulated conveniently with one hand, and are well represented in the Aegean, on Kos and Crete, and in the eastern Mediterranean in Cyprus. The are also commonly represented in Egypt, both in tomb paintings and as archaeological finds.

The broad shoulders of the Ulu Burun tongs probably required both hands for use. Similar tongs from the Late Bronze Age have been found in Cyprus, Syria, and Palestine. Six tongs are known from Sardinia, all with broad, marked shoulders. Deshayes lists several from Iran. Each of these has a collar between the open loop at the top and the broad shoulders below, with the exception of two Sardinian tongs and the Akko find; the Akko tongs are dated by their excavator to the 14th century B.C.E. and, with more gentle shoulder bend, resemble the Ulu Burun pair most closely. The Ulu Burun tongs show no evidence of a collar.
THE WEAPONS

The wreck has produced a wealth of weapons including short swords, a dirk, daggers, spearheads, arrowheads and stone mace-heads.

Bronze short swords KW 301 and KW 275 are of different, unrelated types despite their close proximity, which may point to their having been stored together. Nearly identical in length, both weapons are shorter than conventional swords of the period, and, although they should perhaps be classified as dirks, we will refer to them as short swords because of their borderline lengths.193

Sword KW 275 (ill. 43; l. 0.454) is cast in one piece. The excellently preserved pointed blade becomes widest at about mid-length, after which it tapers inwards slightly towards the hilt. At the base of the double-convex sectioned blade are two decorative bands running across the blade, each comprised of three finely incised longitudinal grooves. The widening of the blade at its juncture with the hilt forms two protuberances which serve as a hand guard. The edges of the hilt are raised or flanged for the framing of hilt-plates. These plate inlays, fully preserved by a protective layer of encrustation on one side of the sword and partially on the other, are a composite of wood, shaped to fit the contours of the hand guard and pommel, and a
Ill. 43. Bronze sword KW 275. Ill. 44. Bronze sword KW 301.

L. 45.4 cm. L. 45.5 cm.
long bar of ivory for the grip. A short third piece of wood and another small piece of ivory placed between the grip and pommel inlays probably wedged the whole assembly between the flanges. In addition to the wedging, a black substance around the inlay edges may have been used for affixing the pieces to the hilt. There are no rivets on the sword.

Daggers or swords usually cast in one piece and having simple flanged tangs are of Maxwell-Hyslop's type 31.194 That flanges as a hafting device originated in the Near East rather than in the Aegean, as initially thought, is demonstrated by Sandars.195 The type is fairly common on the Late Bronze Age Syro-Palestinian coast as reported from a number of sites, including Ras Shamra, Megiddo, Beth-Shan, Shechem, Gezer, Bahan, Tel Mor, Tell Par, and Tell el-Ajjul.196 Daggers from Cyprus with similar flanged grips and crescentic pommels are attributed to the Levant.197 A good parallel, although shorter, comes from the 14th-century tombs near the Persian Garden, just north of Akko's ancient tell.198

The second sword (KW 301: ill. 44 on p. 92; pres. l. 0.455, max. blade th. 0.006) is a typical Aegean product. With its single-piece construction--tang and blade cast together--ribbed blade, flanged grip and cruciform shoulders with rounded lobes, the sword seems to fit Sandar's Class Di of later Aegean types.199 Unfortunately,
the sword's pommel is missing, but close examination of the badly deteriorated end has shown the pommel-tang to be most probably of the unflanged type, typical of Di swords. The sword's hilt-plates have not survived, but one rivet hole in the grip and two others low in the blade affixed the plates to the hilt. Since the ivory inlays of "Levantine" sword KW 275 have survived, and those made of semi-precious materials would be virtually indestructible, the hilt-plates of KW 301 probably were fashioned from a less durable material such as wood. The sword is shorter than the average length for its class, and its blade has a broad flattish midrib with three very fine ribs outlined by fine grooves instead of the characteristic well-marked high midrib. Other short weapons of this class without midribs, or with only a broad flattish midrib, each with or without central ribs and grooves, do exist.200

A third, poorly preserved sword (KW 155: ill. 45), possibly of a third type, has now been cleaned and conserved. The blade's preserved length is 0.37 m. and its maximum thickness 0.009 m., but its tip and most of its tang are missing. The position of the hilt is revealed by three large rivets. The rivets are of the large sizes found on some typologically earlier swords of its class.201 Cylindrical in shape, but slightly constricted at the middle where they pierce the blade, they are forged into conical caps at their ends. Two of the rivets are placed at
Ill. 45. Bronze sword KW 155.  
Ill. 46. Bronze dirk KW 189.

1:2
shoulder level and the third is centrally located above the other two, an invariable arrangement for Sandar's Class Ci swords. Unfortunately, almost nothing remains of our hilt, let alone the pommel, for positive identification. Furthermore, the blade is far too poorly preserved to reveal its original section, although a well-defined midrib is still in evidence. The total length of the sword may have been over 0.60 m., about the minimum size for Class Ci.

Both Sandars and Catling believe that the finest specimens of Ci and contemporaneous Di swords were made at LM II Knossos and continued until the fall of Knossos, when the long phase of luxury sword-making in the Aegean came to an end. Macdonald suggests the possibility of other mainland production centers which may have continued to make the same type of swords. Whatever the case, elaborately decorated examples became more efficient and utilitarian during the 14th century. Although the variant of Di swords without high midribs is confined mainly to dirk-sized weapons not exceeding 50 cm. in length, the loss of the midrib is recognized as a development leading to the moderately thickened double-convex blades without true midribs. Typologically, therefore, the variants of the Di type which stand at the end of the ornamental sword-making of the 15th and early 14th centuries, to which we may add the Ulu Burun example,
form the transition to later swords. 206

An incomplete but well preserved dirk (KW 296: ill. 46 on p. 95; pres. 1. 0.335) was recovered with bronze tongs KW 378, terra-cotta lamps KW 262 and KW 485, and a number of small Type 1b copper and fragmentary tin ox-hide ingots in areas M-10 and N-10. A few arrowheads were also reclaimed from among these objects. The dirk's hilt and blade are cast in one piece; the grip side flanges near the hilt and blade juncture have been extended and folded over the hilt-plates in the shape of wings. The wooden hilt-inlays are partially preserved, but the pommel is missing.

This dagger type, Maxwell-Hyslop's Type 32, 207 appears to be confined mainly to Syria and Persia. In its developed form it is found in Syria during the 15th to 13th centuries B.C.E. and later in Iran. In addition to good but late parallels from Iran, a nearly identical dirk, also incomplete, comes from a 14th-century hoard at Ras Shamra 208

Daggers KW 1 (1. 0.285), KW 621 (ill. 47; 1. 0.284), incised with a pentagram (five-pointed star) near the hilt/blade juncture, and slightly larger KW 189 (ill. 48; 1. 0.32), with two thin parallel grooves running longitudinally along the middle of the blade, are all of the same general type. Similar daggers are found in Egypt, 209 but the closest parallels from Palestine are found at Tell el-Ajjul where
Ill. 47. Bronze dagger
KW 621. 1:2

Ill. 48. Bronze dagger
KW 189. 1:2
they are described as Canaanite types based on Egyptian prototypes.\textsuperscript{210}

Thirty-two arrowheads have been recovered, mainly in two concentrations. Their poor preservation and extensive encrustation make their identification difficult, and the actual number of arrowheads may be slightly higher. The larger group, with 17 pieces, was in and around grid square M-10; the smaller concentration, of about 11 arrowheads, is mainly from J-10. Most of the few better preserved pieces appear to be narrow and long, with long tangs of square or rhomboid section. The only seemingly complete arrowhead devoid of encrustation (KW 572: ill. 49) is approximately 0.096 m. long and 0.01 m. wide at the blade. The general blade type is well known in Egypt, Palestine,\textsuperscript{211} and Cyprus, where Catling ascribes his sub-elliptical barbless category to the Near East.\textsuperscript{212} That these arrowheads were also manufactured on Cyprus, however, is demonstrated by a limestone mold found at Hala Sultan Tekke.\textsuperscript{213}

Several of the longer and more slender points may well be for javelins instead of arrows.\textsuperscript{214} One such blade, KW 286 (ill. 50), has a preserved length of 0.107 m., but was originally at least 0.12 m. long.

Blunt-headed arrowhead KW 429 (ill. 51) is basically a cone with a square-sectioned tang attached to the cone's apex. The blunt head, designed to strike rather than to penetrate, was probably used for fowling.\textsuperscript{215} Blunt-headed
Ill. 49. Bronze arrowhead KW 572. 1:2

Ill. 50. Bronze javelin-head KW 286. 1:2

Ill. 51. Bronze arrowhead KW 429. 1:2
arrowheads are known from a number of sites in the Near East, including Tell el Ajjul,216 Gezer,217 Megiddo,218 Beth Pelet,219 Akko,220 and Lachish.221

The southern sand gully yielded four more spearheads, in areas K-12, K-13 and J-12, with a fifth farther downslope in I-14. Almost all are heavily encrusted and fragile, especially around their sockets. At least three types of spearheads are represented. All are socketed and all have a central ridge with midribs. One spearhead, relatively clean of encrustation on its lower half, appears to have a closed or undivided socket.

Ovoid mace-head KW 2 (ill. 52; l. 0.092, max. diam. 0.071) was found near fragmentary mace-head KW 278 (ill. 53; l. 0.067, max. diam. 0.086) in area L-11, and smaller mace-head KW 486 (ill. 54; l. 0.061, max. diam. 0.067) was recovered only about a meter distant in grid square M-10. The last two pieces are of the same slightly flattened spherical form with a raised collar around one end of the haft socket. KW 2 and KW 278 appear to be a hard limestone or marble, while KW 486 is of a polished blackish stone, perhaps diabase.

A collared mace-head was also found on the Cape Gelidonya shipwreck; other specimens are noted from Anatolia, Palestine, and Cyprus.222
Ill. 52. Stone mace-head KW 2. 1:2

Ill. 53. Stone mace-head KW 278. 1:2

Ill. 54. Stone mace-head KW 486. 1:2
THE JEWELRY

Amber, faience and stone beads were found in quantity. The 20 amber beads on the wreck vary greatly both in shape and size. Many appear to be in the form of pierced, naturally occurring "pebbles" with minimally worked surfaces.223 The pebbles, as originally collected, often have a flat side and a dome, or an irregular, lopsided shape with flattened surfaces. A thoroughly worked piece with an artificially carinated edge can be described as a flattened biconical disc (KW 111: ill. 55).

Nine of the amber beads were found in the lower part of the southern gully (grid square K-13), the upper reaches of which yielded the majority of exotica recovered. Three beads are from area K-14, directly below the gully, and two others, probably strays from the main cluster, are from adjacent areas. A small bead fragment was found inside Canaanite amphora KW 428 in area L-12. A rock ridge separates the southern gully from this jar and other rich artifacts to the jar's north in L-11, M-11, and N-11. This single fragmentary bead is one of the strongest clues to associate the objects from these two seemingly different regions as coming from a common area on the ship before it broke apart. It is possible that all of the amber beads were part of the same necklace, but whether the other bead types found nearby belonged to the same necklace is not
Ill. 55. Amber bead KW 111. 1:1

Ill. 56. Faience bead KW 32. 1:1

Ill. 57. Agate bead. 1:1
known. The amber bead from amphora KW 428 has been identified as of Baltic amber by Curt Beck of Vassar College.224

Seventeen pale, gray-blue faience beads are of two types. The more common is lentoid or biconical with impressed spokes radiating from the centers of both faces. In some examples one face is more worn than the other (i.e., KW 32 (ill. 56 on p. 104), and in others only one face appears to be decorated. In better preserved specimens (KW 522, d. 0.0185, th. 0.009), however, the impressed fluting is deep and well defined on both surfaces and forms pronounced crenations around the bead edges. Biconical faience beads of the same general form, but with more closely spaced flutes, are found commonly in Late Bronze Age contexts in Cyprus,225 the Syro-Palestinian coast,226 and the Aegean.227 The second type, of the same bluish color, is ovoid or olive-shaped with incised longitudinal grooves. Similar examples are again from Cyprus,228 Syria-Palestine,229 and Greece.230 Many of the faience beads have been found on the wreck with delicate objects such as gold jewelry fragments, the bone scarab, and the stone plaque, as well as with small balance-pan weights.

Area K-13 also yielded nearly half a dozen stone cylindrical beads, with the remaining stone beads collected from adjacent grid squares. This limited dispersal suggests a single source, perhaps a bag or necklace string. The
beads are cut from a white or cream-colored stone, perhaps agate, with each piece having its own pattern of white, brown, or black patches and striations (ill. 57 on p. 104). Most are irregular in section and vary in size: d. 0.6 cm. to 1.1 cm. and th. 0.3 cm. to 0.6 cm. Others include a cylindrical rock crystal (quartz) (KW 379: l. 0.023, diam. 0.012), a bead of an unidentified white stone, perhaps meerschaum (KW 359: l. 0.023, th. 0.004 on narrow side), and a cylindrical bead of bone (KW 496: l. 0.015, diam. 0.006).

Five silver bracelets or bangles were recovered from the southern gully. Open ended bracelets. KW 92 (max. diam. 0.007) and KW 284 (ill. 58) of identical size, are decorated with a series of chevrons below incised threads at each end. This design is paralleled in gold at Tell el-Ajjul,231 and in bronze at Byblos,232 but similar bracelets and armlets without chevrons are also found in gold and silver at Tell el-Ajjul;233 and in silver at Megiddo and Gezer.234 Silver bracelet KW 273 (ill. 59; max. diam. 0.005), paralleled on Cyprus,235 is decorated with cross-hatching between a pair of incised lines, the innermost pair of which have a series of chevrons below. Fragmentary bracelets, fragments of silver bars, and a crumpled silver plate recovered from the wreck are clearly scrap silver intended for recycling, but whether the intact bracelets are part of this scrap hoard cannot be
Ill. 58. Silver bracelet KW 284. 1:1

Ill. 59. Silver bracelet KW 273. 1:1

Ill. 60. Shell ring KW 414. 1:1
ascertained at present.236

Nearby were two rings, most likely fashioned from top shells. A central groove inscribed completely around each ring preserves a black, bitumen-like substance probably intended for affixing pre-cut inlay parts to the ring. On at least one ring (KW 414: ill. 60 on p. 104; diam. 0.02, th. 0.003), an impressed zigzag pattern in this black material may correspond to the triangular shapes of missing inlay pieces. Top shell rings are found in Late Bronze Age contexts in the Aegean and Cyprus.237

Excavators discovered a few small gold items mainly in and around area L-11. A badly deformed gold flower (KW 361), perhaps the finial for a pin, is decorated with granulation on the inner surface of its petals. The cluster of unopened petals inside also are granulated.

Scrap gold from a disc pendant (KW 551: ill. 61; diam. ca. 0.036), perhaps part of an earring because of its small size, was found in the same general area. Its central design, comprising horizontal petals or leaves with two vertical lines through their centers, all worked in repousse and delineated with a single irregular row of gold granules, represents a highly stylized and crudely executed lotus palmette of McGovern's Type IV-F.4.238 The medial line on the left center petal or leaf was undoubtedly destroyed during cutting; two other lines, inserted between the petals, radiate outwards. A single rolled-over ribbon
Ill. 61. Gold disc pendant KW 551. 1:1

Ill. 62. Gold pectoral KW 94. 1:1.5
loop for suspension, worked with banded edges, is affixed to the top. The lotus palmette on the Ulu Burun pendant is similar in design to eight identical examples, probably worked in repoussé, found together at Beth Shemesh in LB IIB context. The poorly made pendant KW 551, about 0.036 m. in diameter, had been deliberately cut in two in antiquity, with each half then folded over and beaten flat, in one case with bits of gold foil and wire inside; the spherical granules had been reduced to irregular discs during this beating. It was originally formed of two sheet-gold discs with the edges of the slightly larger, undecorated back plate folded around and crimped over the front plate, as were the edges of gold pectoral KW 94 (ill. 62 on p. 109; h. 0.035; l. 0.063; max. th. 0.002; wgt. 12.5 gm.), demonstrating a technique common in the LB IA hoard jewelry at Tell el-Ajjul, which, in fact, includes more than one folded plaque-pendant "forming a mere dump for the melting pot." The falcon or wryneck earrings from hoard 277 at Tell el-Ajjul appear in a photograph to be joined in a similar manner, the crimped edges around the peripheries of the decorated front plates being clearly visible. The similarity of manufacturing tradition between Tell el-Ajjul falcon earrings and the Ulu Burun pectoral have been noted. Two other earrings of unknown provenience in Leiden, also suspected to be products of Tell el-Ajjul workshops, are even closer parallels to pectoral KW 94.
It is unlikely that the Ulu Burun piece is contemporaneous with these much earlier examples; the former was probably manufactured at a later date and at a different center, perhaps Ugarit, where it is believed the eclipsed gold-jewelry working tradition of Tell el-Ajjul may have prospered from the early 15th century until the end of the 14th century. The similarity of workmanship between pectoral KW 94 and pendant KW 551 may suggest a common school for both.

Similar circular pendants with single ribbon loops for suspension, but made from a single sheet of gold, are common to many Western Asiatic sites. Their common theme is a star with varying numbers of points or rays, all in repoussé. These roundels have been regarded as amulets representing divine symbols, perhaps combining the apotropaic qualities of the deities they represented.

Such may also have been the function of large circular star-pendant KW 138 (ill. 63; diam. ca. 0.075), probably of McGovern's geometric form category VI.G.2.c for eight-rayed star discs with dots inserted between the rays. The Ulu Burun star pendant differs from other examples of this category in having only four straight rays with a pair of opposed curved rays between them, totaling 12 in all. The interstitial dots between the incised rays and the central dot on the star are rosettes of small repoussé dots; similar single dots also ring the periphery
Ill. 63. Gold disc pendant KW 138. 1:1

Ill. 64. Gold signet ring KW 603. 2:1
of the disc. Circular pendants at the necks of Syrians in
the merchant fleet depicted in the Tomb of Kenamon at
Thebes probably represent similar devices.249

Part of an inscribed gold signet ring (KW 603: ill 64
on p. 112; h. of bezel 0.014), purposely cut from an intact
ring, was uncovered less than a meter away from the
pendant. Its color, palest of any gold object recovered
from the wreck, may derive from the ring's alloy. That the
ring suffered the same fate as pendant KW 551 is obvious
from chisel scars along the cut; the ring clearly was a
part of a hoard of scrap gold aboard the ship. The ring may
have been cut in half to prevent its unauthorized use, but
it is not yet known if the other half was also on the ship,
as were the two halves of the circular pendant. Three
engraved figures on the bezel have been damaged by the
cutting. From photographs and a cast, James Weinstein has
suggested that although the ring's composition and general
shape reflect an Eighteenth-Dynasty date, the crudely
incised signs are not indicative of the high-quality
workmanship generally expected of New Kingdom artisans; a
definitive interpretation of the signs cannot be made.250

Nearby, a bone scarab framed in gold, an empty frame
for another scarab, and a rectangular stone plaque carved
with hieroglyphs were uncovered.

The scarab (KW 338: ill. 65; l. 0.025, th. 0.019),
carved of bone or ivory, is perforated longitudinally. The
Ill. 65. Scarab KW 388. 2:1

Ill. 66. Stone plaque KW 481. 3:1
piece is set in an oval frame formed of sheet gold; at either end, surrounding the perforation, is a rolled cylindrical sleeve of gold. On the scarab's base is an ornamental assemblage of hieroglyphs, but the prominent gold frame around the scarab probably rendered it unsuitable for use as a seal. It was more likely an amulet. Weinstein informs me that the placement of hieroglyphs in three columns is common to the second half of the Second Intermediate Period. The fact that the hieroglyphs themselves form an apparently unreadable combination of signs, the smooth back, the small nicks cut along the sides to indicate the division between the prothorax and elytra, and schematically rendered trapezoidal head and clypeus are also typical of Late Second Intermediate Period scarabs.²⁵¹

In Syria-Palestine, however, the scarabs of LB IA continue Middle Bronze Age traditions down to the early 15th century when Eighteenth-Dynasty scarab types become common. Hence, if the scarab is a Levantine rather than an Egyptian product, it could have been made at any time during this period or even slightly later. The Ulu Burun scarab is similar to an example from Palestine with a different combination of signs.²⁵²

The empty gold frame (KW 479), for a smaller scarab, is similar to the frame of KW 338. Slightly distorted, it possibly was part of the scrap gold on board.

Rectangular plaque KW 481 (ill. 66 on p. 114; 1.0.016;
w. 0.01; th. 0.006) was cut carefully from a soft gray-green stone, probably steatite. It is pierced longitudinally for suspension, and neatly executed hieroglyphs on both of its wider faces refer to the god Ptah with accompanying standard phrases: Lord of Truth, and Perfect in Favors. According to Weinstein, most of the small New Kingdom plaques are inscribed for Amun or Amun-Re and the naming of Ptah makes this piece unusual. It probably does not belong to the very beginning of the Eighteenth Dynasty, when hieroglyphs were more sharply cut, thinner, and somewhat crudely executed; it is likely of 15th- or 14th-century manufacture.253

Weinstein refers to the Eighteenth-Nineteenth Dynasty scarab and plaque from Lachish as having the same general inscription.254 To this reference we may add the rectangular plaque, again with the name Ptah but accompanied by a different series of signs, from Tomb 982 of the late Nineteenth Dynasty at Beth-Pelet,255 and a specimen also reading "Ptah, Lord of Truth," dated by Petrie to the mid-Eighteenth Dynasty.256

Lentoid seal KW 134 (ill. 67; l. 0.018; th. 0.006) was among the unique assortment of objects recovered from the southern gully. Shaped from a soft, mottled black stone, probably steatite, the sealstone has on its surface, in simple lines and drilled points, a schematically rendered but badly worn figure of an animal probably representing a
Ill. 67. Lentoid sealstone KW 134. 1:1

Ill. 68. Bronze pin KW 570. 1:1
goat or a bull.

The sealstone is of Younger's Mainland Popular Group, representing a series of sealstones probably manufactured on the Greek mainland and later carried to other areas by their owners. A few examples of this group are datable to the LH IIIA:2 period, but the remaining sealstones come from LH IIIB and IIIC:1 contexts; the exceedingly worn condition and varying style of the latter suggest that they were probably cut in different workshops during a relatively short period of time during LH IIIA:2-IIIB:1. The considerable wear on sealstone KW 134 suggested to Younger a possibly later date for the sinking of the Ulu Burun ship. Bass cites a similar example from Krissa; another sealstone of same size and sketchy design, rendered in curved lines, but without drilled decorations, comes from Phyloko.260

The most unexpected find from the wreck is bronze pin KW 570 (ill. 68 on p. 117), broken during excavation. Two fragments join cleanly, while the third, globed section does not. Either the break has suffered subsequent damage, or a smaller fourth piece, now lost, is responsible for this discrepancy. The shank and its slightly prolate globe were cast as one piece; the pin's head and lower shank were lost in antiquity. The original length of the pin cannot be reconstructed, but the existing pieces, when joined end-to-end, are about 10.7 cm. long, the maximum shaft
diameter being 2 mm.

Long pins were popular in Central Europe during the 14th and 13th centuries B.C.E., but appeared in Greece only at the end of the LH IIIC period and beginning of Submycenaean, becoming more common during the Dark Ages. Most scholars now agree in deriving the general shapes of the Greek pins from some region to the north of Greece, although pins of these two regions are not identical. Whether the appearance of long pins (and fibulae) in Greece heralds, as has been suggested, a change in clothing fashion—possibly due to a change in climate and/or a change of population—remains speculative. Of the long pins, the type with a small nail-like head and a globe towards the top of its shank, to which the Ulu Burun example conforms most closely, appears to be confined to central Submycenaean Greece during its early period. The Greek pins differ from similar pins from Anatolia, Cyprus, the Balkans, Italy and Central and Eastern Europe, by the placement of their globes farther down their plain shanks. Thus, Greek pins appear to be independently produced even though their general form is probably of foreign inspiration. Some authors, however, suggest a possible connection between this form with the much earlier composite pins from Shaft-Grave Circle B at Mycenae. The earliest examples in Greece of this globed type, apparently preceding other types of long pins, come from several LH
IIIC contexts. One earlier exception may be a pair of large bronze pins from Chamber Tomb 61 at Mycenae. Akerstrom, however, rejects the general LH II-IIIA dating for this series of tombs. He assigns the pins and associated fibulae to later, secondary burials within the same tomb, partly on the basis of the Submycenaean character of the long pins. Bouzek, on the other hand, emphasizes these pin's reversed globe-to-head proportions and sets them apart from the typical globed type; based on the associated fibulae, he dates the material to ca. 1200 B.C.E.

The fragmentary dress pin from Ulu Burun, if found elsewhere, would have been dated to the 12th century at the earliest.
THE MISCELLANEOUS FINDS

The 22 balance-pan weights of hematite, other stone, and bronze were found mostly in grid squares K-14 and M-1. Most are of common sphenondoid and domed types, but "sugar-loaf" and discoid examples are also represented. Solid-cast zoomorphic bronze weights (ill. 69) in the shape of a recumbent bovine (KW 335), a duck (KW 350), and a couchant sphinx (KW 468) found close together in K-14, complement a pair of bronze frog weights excavated some distance away in area O-14, but not recognized before laboratory conservation (KW 237: ill. 70; weighs 6.6 gm.; lead-filled and badly corroded KW 220 has a surviving weight of 19.5 gm.). A sixth bronze weight (KW 582: ill. 69), found further upslope, was adorned with human and animal figurines on its upper surface.

The bovine, most probably a bull-calf, lies with its head positioned on the same axis as its body. The animal has the typical humped shoulder and heavy build of a bull, yet its horns are not fully developed. The legs are drawn up under the body and the tail appears in relief, curled over the hindquarters. Despite its small size (l. 0.032), the form is executed with a great degree of naturalism. With a preserved weight of 16.1 grams, it may correspond to two shekels of the Babylonian standard.

The less detailed and smaller bronze duck (l. 0.022),
Ill. 69. Bronze zoomorphic balance-pan weights: sphinx KW 468, duck KW 350, bull KW 335, and shephard weight KW 582.

Ill. 70. Bronze frog-shaped balance-pan weight KW 237, 1:1
weighing 8.3 grams, is perhaps a Babylonian shekel. Its head faces forward and its bill is pressed tightly against its neck in a simple but graceful composition.

The sphinx, recovered with a hematite sphendonoid weight concreted to its head, has a typically feline posture and tufted tail. Measuring 6.8 cm. in length, it weighs about 80.6 grams, perhaps corresponding to ten Babylonian shekels.

The remarkable bronze weight with figurines, best described as a reversed truncated cone with domed top, is hollow cast and filled with lead. Expansion of the corroding lead has extensively damaged the piece, which now weighs 410 grams. On the upper surface of the weight's domed top are skillfully rendered bronze figurines of a man, probably a shepherd dressed in a cloak and cap, and two sheep (a large lacuna next to the sheep probably held a third animal). The shepherd sits on his left leg with the left hand resting on his knee. The rather short right leg is tucked up against his chest and the right hand is spread, palm down, on the ground. Although the nose has suffered some damage, other facial features are still clear. The facing heads of the recumbent sheep are turned almost at right angles to the axes of their bodies.

Zoomorphic weights in use are recorded in tomb paintings and representations of New Kingdom Egypt. That recumbent bovines are the most widespread of the zoomorphic
shapes is attested by many finds from the eastern Mediterranean. In Ras Shamra (Ugarit) alone, more than a half dozen pieces, some filled with lead, have been found.273 Cyprus has produced similar weights. A remarkable collection of 14 weights recently discovered in Kalavassos comprises three hematite sphendonoids; a cast-bronze calf and two bull heads; an incumbent bull, a boar, and what appears to be a lioness; a duck; a negroid head; and three cylindrical bronze weights, two of which have crossed animal figures in relief on their upper surfaces.274 Bovine weights, however, are extant all along the Syro-Palestinian coast and in Egypt.275 Most of those found in stratified contexts appear to date mainly from the 14th century, but some may be slightly later.

Duck-shaped weights are commonly found in the Near East, although few are of bronze.276 A small bronze duck-weight attributed to the Babylonian weight system and composed with the bird's head turned backward in the sleeping position, typical of this system, was found at Enkomi.277 A second bronze duck-weight (more likely a goose), much heavier and with a forward facing head on an extended neck, was in the Kalavassos cache.278

Frog-shaped weights appear to have similar distribution, having been found in Alalakh, Larsa, Enkomi and Egypt.279

Sphinx figurines, mainly pendants, beads, and seals,
are found commonly in Egypt, on the Syro-Palestinian coast, and to a lesser extent on Cyprus.\textsuperscript{280} To the best of my knowledge, however, no bronze figurine in the form of a sphinx has been previously identified as a weight; weight-like bronze examples appear to have been used as votive figurines.\textsuperscript{281}

Although the cylindrical body of the shepherd weight bears some resemblance to the lead-filled bronze weights with crossed animal figures on their upper surfaces from Kalavassos,\textsuperscript{282} the Ulu Burun weight remains unparalleled.

Three of the Ulu Burun zoomorphic weights were used frequently enough to warrant their storage with the more common types; even the smallest of these forms, we may now be sure, were used for weighing and were not mere amulets or the like as has been suggested.\textsuperscript{283} Because the weights have not been fully conserved, and because we expect to find many others on the site, they have not been studied in detail.

Pierced lead disc KW 298 (ill. 71; diam. 0.05, th. 0.012), with a crudely scratched spiralling spoke design on its surface, and the similar KW 459, not yet cleaned of concretion, may be weights of Aegean origin.\textsuperscript{284}

Another possible weight is hematite disc KW 325 (ill. 72; diam. 0.028, th. 0.012). Pierced longitudinally, it is reminiscent of lentoid seals, but its thickness, weight and unmarked surfaces make it also suitable for use as a
Ill. 71. Lead disc weight KW 298. 1:2

Ill. 72. Hematite disc KW 325. 1:2
balance-pan weight.

Other finds include fragments of faience vessels, mainly from the sandy area below the southern gully. The precise shapes of the vessels will not be known until more pieces are found, but a series of fragments comes from a rhyton in the form of a ram's head (KW 565). That at least a second rhyton was aboard the ship is known through a second muzzle and a large section of the vessel. The two rhyta appear to be similar in shape and probably in size. Other fragments, now being assembled in the Bodrum Museum of Underwater Archaeology by Jane Pannell, are from a female head. Both forms are closely paralleled in faience at Enkomi and Tell Abu Hawam.285

Two hundred and twenty-four folded lead strip fishing-net weights or sinkers were recovered from the site in two clusters: 21 inside pithos KW 250 and 64 from an area between grid squares L-11 and M-11; the remaining pieces were found mostly downslope of the latter cluster. Since all the lead strips are folded and crimped, with crimping impressions still visible on some, they must have been assembled on nets and were not simply spares or trade items. One net seems to have been inside the pithos; if all 21 weights are from a single net, we may be able to reconstruct its length. Similar net weights have been found on Cyprus at Enkomi and Athienou.286 The Governor's Tomb at Tell el-Ajjul also yielded a large quantity of net sinkers
in groups mostly based on multiples of 17, leading Petrie to conclude that 17 or 18 lead weights were normal for a light net. A collection of 18 net weights concreted together, presumably from a single net, was recovered from the Cape Gelidonya shipwreck.

A large, pyramidal lead weight (KW 267; h. 0.10), pierced at its narrow upper end by a hole for suspension, was found with the net weights in area L-11. Although rectangular in section, its basal corners have been deformed and rounded by heavy use. The weight may have served either as the heavy foremost sinker of a fishing net or perhaps as the ship's sounding lead.

Apart from the single stone weight-anchor raised in 1984, no anchors have been moved. Seven of the eight anchors uncovered to date are grouped between the two uppermost rows of copper ingots. Although some of the anchors are still partly buried, they seem to come in three sizes: three large, two intermediate, and one very small. The last, probably of marble or other light colored limestone, is too small to be an effective ship's anchor, and perhaps served as a hawser weight or a spare for the ship's boat. The eighth anchor, of the largest size, lies amidst copper ox-hide ingots at the deeper end of the wreck.
THE HULL

The distribution of artifacts on the site suggests a length of about 15 m. for the ship and a total weight of about 12 tons for the cargo, but it is not known what percentage of the ship's entire cargo is represented by the exposed objects. Any estimates regarding the ship's basic dimensions, therefore, must remain speculative. At this early stage in the excavation, we have not even been able to establish positively the end of the ship we are excavating, although the assemblage of artifacts recovered suggests that it is the stern. A row of seven anchors, originally stacked in pairs, was uncovered between two rows of stacked copper ingots. Similar stone anchors sometimes have been found built into walls and floors of temples and as isolated deposits under water, but the Ulu Burun examples represent the only anchors of its type to be directly associated with a shipwreck.

Raising one of the anchors revealed a section of the ship's keel (ca. 0.21 wide or sided), garboard strake (0.2 wide), second strake (0.26 wide and ca. 0.06 thick), and fragments of the adjacent third strake. The garboard strake is fastened to the keel, as well as to the second strake, by mortise-and-tenon joints. One filleted mortise appears to be 7 cm. wide and ca. 17 cm. deep. The tenons, placed 21 cm. apart, are secured with pegs ca. 2.2 cm. in diameter,
ILL. 73. Exposed section of the hull. 1:10
to prevent the planks from separating (ill. 73). The constructional features thus far uncovered on the Ulu Burun ship are similar in many respects to those of classical Greek ships of a millennium later. 289

No further work was done in this area, but after the removal of several ox-hide ingots and amphoras slightly upslope of this section, in square P-14, a large, curved timber was exposed. Because of a stone anchor lying partly above it, we could not determine if the piece was a large frame, the endpost, or the curved end of the ship's keel.

Donna Christensen of the Center for Wood Anatomy Research, U.S. Forest Products Laboratory, reports that keel and probably the second strake are fir (Abies sp.), the tenons of a species of oak (Quercus sp.), and the pegs of hardwood, probably oak.

The availability of long, knot free pieces, straight grain (similar to cedar), lightness, and ease of working made fir the preferred timber of ancient Greeks and Romans for use in buildings and ship construction. 290

In the eastern Mediterranean coastal mountain ranges, cedar, the dominant species of the upper zone (ca. 1000-2000 m.), grows with Cilician fir (Abies cilicia). Although fir represents a major component of the modern Taurus and Amanus forests, its importance in these areas in antiquity is still uncertain. In Lebanon they are considerably less conspicuous, but good fir forests mixed
with cedar still stand in the northwest section of the range. Fir also grows in central and southern Greece (Abies cephalonica), and although differences in appearance are slight, it is the common European or silver fir (Abies alba) to the north in Macedonia that is regarded to be superior over the two southern species.

If the Ulu Burun ship was built in an area close to fir forests, then it is reasonable to assume that it was constructed from locally available sources rather than from imported timber. The widespread occurrence of fir in the eastern Mediterranean and the Aegean, however, prevents us from isolating the source of the timber used in the Ulu Burun hull. If microscopic studies are able to differentiate between various wood structures in the future, we may then be in a better position to surmise on the origin of our ship.
DISCUSSION AND CONCLUSION

The wealth of artifacts recovered from the shipwreck at Ulu Burun, mostly chiseled from rock-hard concretion, reveal the years of excavation ahead. Thus it remains early to attempt an accurate dating of the ship or a resolution of her course.

A 14th-century B.C.E. date for the wreck has been suggested previously on the basis of ceramic evidence. The most precisely dated object, kylix KW 57, has been ascribed to the early phase of LH IIIA:2, but it could have been in use for years before its loss. Stirrup jar KW 137 has been broadly dated to LH IIIA:2; the shape, however, becomes popular early in LH IIIA:21, and the floral design (FM 18:122 or 126) on the jar's handle zone is a late feature, which, in a slightly more stylized shape, becomes the common form of the unvoluted flower in LH IIIB.

Dating of other painted stirrup jars is less precise, for squat KW 171 (FS 178), and small globular KW 305 fall into the general LH IIIA:2 period. Large globular stirrup jar KW 308, on the other hand, represents a shape which may have already become rare by the LH IIIA:21 phase.

The bell-shaped profile of semi-globular cup KW 334 is characteristic of LH IIIA:21-IIIB, and large coarse-ware stirrup jars, not yet studied in detail, appear to be broadly dated to LH IIIA-IIIB periods.
The Mycenaean ceramic assemblage so far recovered, therefore, would be more at home during the second half of LH IIIA:2 than its first half. Kylix KW 57, on the other hand, is most likely of an earlier style—presumably a treasured possession—and not of contemporary manufacture.

Hankey and Warren, in their study of Aegean chronology based on Mycenaean pottery, have determined that the LH IIIA:21 period corresponds to the reign of Akhenaten, and that pottery of this period may not be dated any later than the time of Tutankhamun.297 Thus, it would appear that the Ulu Burun ship sank sometime during, and probably at the end of, the Amarna period, or slightly later. There really is not much evidence for a refinement of this date, but the Cypriot White Slip II Ware recovered from the site, although the type's chronological sequence has not been worked out satisfactorily,298 appears to favor the later date. For the period marked by late Mycenaean IIIA2 wares, Popham has observed in his normal stage, White Slip II ladder pattern bowl category (to which our KW 11 belongs), an increasing tendency towards shallower bowls, degeneration of style, and reduction of subsidiary decoration. At the end of this period, the subsidiary decoration in most cases consists only of pendant dots, as in our KW 11.299 The beginning of the subsequent L.C. IIC period (ca. LH IIIB) seems to be marked by the occurrence of coarser, late stage bowls.300 Normal stage White Slip II
bowl fragments from Akhenaten's capital city at Amarna, however, still exhibit the lozenge pattern as subsidiary decoration; this design is presumably associated with slightly earlier examples of this stage. It would appear, therefore, that the Cypriot pottery suggests a post-Amarna date for the Ulu Burun ship, but because these wares represent freshly manufactured items, unlike the Mycenaean wares which were in use at the time of sinking, a date not much later than this is likely.

If our type attributions are correct, the Aegean swords, however, appear to corroborate the dating suggested by the kylix. Although not all are securely dated, the contexts in which similar swords have been found are chronologically confined to LM/LH II–IIIA:2; but the smaller flat bladed weapons, perhaps comprising transitional forms to later Dii type swords of late LH IIIA:2 and IIIB periods, 301 may have been manufactured for a longer time than previously believed. Furthermore, more valuable and durable than pottery, bronzes, especially swords, would have been treasured heirlooms. The Near Eastern sword also fits comfortably in the LH IIIA:2 range.

Most of the tools are of types with long histories, but a few, namely the deep-bar chisels, heavy chisels, and necked adzes, become relatively scarce after the 14th and 13th centuries B.C.E., although later, rare examples do exist. A useful chronology for dating tools, however, has
not yet been developed, and doubts are even raised about using typology to establish ethnic origins of tools.\textsuperscript{302}

The Mycenaean lentoid sealstone KW 134 has been dated to the second half of the 14th century, but the excessive wear on the sealstone from extended use suggests a later date for the sinking of the ship. With some finds tentatively dated to LH IIIA:2, and more likely to the late phase of this period, the discovery of globed pin KW 570 was unexpected, as pins of this type do not otherwise appear until well into the 12th century. Present evidence is too scanty, the finds being only partially studied, to date accurately the demise of the ship, but based on evidence presented so far, a date at the end of LH IIIA:2, or after the Amarna period but still sometime in the Eighteenth Dynasty, would not be unrealistic.

Although a post-Amarna date is preferred for the Ulu Burun ship, it is still close enough in time to this well-documented segment of history to assume that the general economic structure of the Levant had not changed appreciably,\textsuperscript{303} and that inferences from the Amarna letters as well as the evidence from tomb paintings could aid us in understanding the circumstances surrounding our ship.

The only extant depiction of a Mediterranean merchant venture from the 14th century B.C.E. is the scene from the tomb of Kenamun at Thebes illustrating the arrival of a Syrian merchant fleet at an Egyptian port.\textsuperscript{304} Porters
unload cargo including Canaanite amphorae and a pilgrim flask similar to those found on the Ulu Burun wreck. The roundels on the necks of some of the crew may represent star-disc pendants of the type already recovered during excavation. Pithos KW 251, recovered with its contents of mostly intact Cypriot pottery, allows us to speculate about the pithoi shown on ships' decks, perhaps also filled with pottery as well as other goods. Other tomb paintings depict tribute bearers carrying not only elephant tusks, Canaanite amphorae, and other vessels of the types found on the wreck, but also copper ox-hide ingots.305

The exact amount of copper on the ship will not be known until all is excavated, but a total of 200 ox-hide ingots is not an unreasonable estimate. If we assume that each ingot has an average weight of 25 kg., this would correspond to approximately 183 talents of copper in the shape of ox-hide ingots alone, reminding us of the Amarna letters mentioning shipments of 100 (EA 34) and 200 (EA 33) talents of copper from Alasia to Egypt.306 If the 500 talents of copper mentioned in one Amarna letter (EA 35), ironically accompanied with an apology for the small quantity of copper sent, represents instead, as Zaccagnini believes, only 500 shekels of copper,307 then the Ulu Burun ship consignment corresponds to the largest quantity of copper ever recorded! The Amarna letters also mention possible glass ingots, elephant tusks, gold jewelry and
silver, and weapons among others, all of which are again matched on our vessel. Could this cargo then, represent a royal shipment of the type exchanged between the Syro-Palestinian coast, Egypt and a land called Alasia, all of which is vividly described in the Amarna letters? This certainly seems plausible considering that the single largest hoard of ox-hide ingots prior to the discovery of the Ulu Burun ship came from the Gelidonya wreck, which yielded only 34 ingots. The artifact assemblage from the latter site led Bass to assign the wreck to itinerant entrepreneur-smiths sailing westward along the coast in search of goods and markets wherever available. The nature of trade in the Bronze Age, and of ancient economy in general, is not fully understood, but the Ulu Burun ship, carrying some of the major resources and luxury items of Asia and Cyprus, contrary to the Gelidonya venture, may represent a single shipment destined for a specific port, and may in fact be our first direct evidence for state-administered trade based of gift exchange.

The bulk of the cargo, comprising copper and tin ingots, glass ingots, Cypriot pottery, ivory, and Canaanite amphorae filled with resin, all certainly taken on at a Syro-Palestinian or Cypriot port, points to the ship's east-to-west sailing route. If the Canaanite amphorae contained frankincense, as originally believed, then they could have been taken on at a port such as that at Ugarit.
Frankincense was probably placed in the amphoras before its export by sea, for it is unlikely that these heavy jars were originally used in transporting the resin overland on pack animals from distant sources to the south, perhaps somewhere near Oman. The nature of the Ulu Burun resin, however, remains enigmatic and organic material recovered from some amphoras may indicate that these containers were in reuse. That the amphoras may have been refilled elsewhere presents a temporary problem in establishing the dispatch point of their contents, but scheduled neutron activation analyses on their clays, including those of the stopper sherds found inside some of the jars, should help us in resolving this problem.

The large pithos containing Cypriot export pottery may also be of Cypriot origin. The saucer-shaped lamps stored in this pithos, however, appear to be of the type commonly found on Syro-Palestinian sites, although they are different still from the similar fire-blackened examples also recovered from the ship; the latter lamps, again of Syro-Palestinian type, were obviously for shipboard use and not cargo. If the new lamps inside the pithos were Syro-Palestinian, then it is possible that the pithos may have been packed at an Asiatic port such as that at Ugarit where large quantities of Cypriot pottery and Canaanite amphoras have been found in storage, perhaps for export. If neutron activation identifies the lamps as being
Cypriot, on the other hand, then it is more likely probable that the pithoi, themselves, were taken on at Cyprus.

The pilgrim flasks are most likely of Syrian origin, but a pilgrim flask found with a lamp in another pithos complicates the matter again.

The lesser goods such as glass ingots almost certainly originated in Syria-Palestine, as did most of the weapons, tools, and gold and silver jewelry. Ivory too must have come from Syria, although Amarna tablets also mention their shipment from Alasia to Egypt, most probably in transshipment from Syria in this case.

The copper ingots probably originated on Cyprus as the island's abundant copper supplies have been recognized as a major source throughout antiquity.

The tin may have been taken on at Syrian ports, most likely at Ugarit which had at an earlier date received tin from Mari, some for Caphtorite merchants perhaps to be later shipped to the Aegean.310

Newly excavated half ox-hide and bun ingots verify that tin was cast and traded in the same forms as copper ingots. Most tin ingots on the Ulu Burun ship were cast originally in the ox-hide shape, and most are fragmentary. These are the earliest tin ingots known, and their shapes strengthens Bass' identifications of various gray and white ingots in Egyptian tomb paintings as tin.311 They probably represent the form in which tin was shipped from primary
smelting areas near mines or from other processing centers reasonably close to tin sources. Since the tin trade described in ancient texts from Western Asia hints at a source of tin located somewhere to the east, in Iran and even beyond in Afghanistan or Central Asia, then these ox-hide ingots presumably represent the preferred form in which tin was transported overland by donkey caravans, lending weight to the supposition that the type was designed for ease of handling and transportation by animals. Hence, it is unlikely that tin ingots were broken down into smaller sizes for convenience of handling. It also seems unlikely that the Ulu Burun tin ingots had been cut into pieces during the voyage, as trade goods at ports along the way, for that would not explain why no intact tin ingots were found among the dozens of cut fragments on the wreck. It has been suggested that fragmentary copper ox-hide ingots, such as those at Gournia and on the Cape Gelidonya wreck, were broken into pieces at the ateliers where they were forged or cast into copper and bronze implements. Likewise, tin ingots may have been broken down at their point of receipt not only for melting down, but also perhaps for use in commercial transactions. If this is indeed the case, then we may assume that the Ulu Burun tin ingots do not represent ingots of a single shipment procured directly from a single source, but are rather a collection gathered by barter,
levies or gifts.

One of the quarter ox-hide ingots of tin is apparently incised with the same sign that is seen on most of the copper bun ingots. Copper and tin are usually mined in different geographical regions, so the presence of the same sign on ingots of these different metals suggest that these marks were incised at the point of receipt and/or export to the west rather than at the production end of the metals. That the signs were more or less centered on the tin ox-hide ingot fragments may also indicate that they were incised after the ingots were broken up. Whether the tin ingots were loaded on the Syro-Palestinian coast or on Cyprus has yet to be determined. What is known, however, is that the tin was destined for a port somewhere to the west of Cyprus. It has been suggested that from the Middle Helladic period onward, the Aegean world was using tin from northwest European sources, especially those in southwest England and Brittany.\(^{317}\) The presence of blue glass ingots chemically identical to glass amulets from Mycenae aboard a ship laden with tin and copper ingots may indicate that the Aegean tin market was at least shared, in part, by imports from the east.

Almost all of the items on board the ship, cargo or otherwise, could have been taken on either at a Cypriot or Syro-Palestinian port, with some of the goods probably in transshipment, making it impossible to determine the ship's
point of departure. It is just possible that port calls in both areas were made before the ships sailed westward along the Anatolian coast.

The Ulu Burun ship was undoubtedly sailing to a region to the west of Cyprus, but her ultimate destination can be surmised only from the distribution of objects matching the types carried on board. It has been suggested that the Dodecanese played an important role as a commercial entrepot for Aegean and Levantine goods, and it may not be just mere coincidence that several swords similar to KW 301 come from this region, and that the Mycenaean pottery assemblage from the wreck finds some of its closest parallels on Rhodes, the largest island in the group.

Ancient texts as well as archaeological evidence reveal that Mycenaean settlements imported goods from the Near East in quantity, but it is noteworthy that Cypriotic pottery is relatively scarce at Mycenaean sites. Since the Ulu Burun ship demonstrates that Cypriot wares of various forms did reach the Aegean, the simplest explanation of their near absence at these sites is that the cargo of pottery was not originally destined for the mainland. Could it be that after unloading its primary cargo of copper, tin, resin, and glass on the islands, or the mainland, or even at one of the settlements on the Anatolian coast, the voyage continued? Recent discovery of Cypriot and Canaanite pottery at Kommos nominates Crete as
another possible port of call. Primary cargoes could have been originally destined for Crete as well. We already know that at about this time Ugaritic ships visited Crete, for we are reminded of one such venture returning home with a cargo of grain, a fermented beverage, and oil. After delivering most of her raw material in the Aegean, would the Ulu Burun ship then have sailed south to Egypt, perhaps the natural harbor on the small island of Marsa Matruh, where quantities of Mycenaean, Cypriot and Palestinian pottery has been uncovered? The investigators of the site believe the island served as a port of call for ships sailing from Crete towards the Nile Delta and the coast of Palestine. Could the Cypriot pottery have been intended as trade goods for final provisioning of the ship before tackling the trip home or a later venture to these regions by way of the desolate North African coast? The limited quantity of pottery so far uncovered, comprising 18 assorted vessels from the pithos, and perhaps a little more than a dozen other pieces scattered about the Ulu Burun shipwreck, certainly does not represent a cargo of any significant commercial value and may lend some credence to this hypothesis.

The nationality of the vessel, however, remains uncertain. We have yet to fully uncover and identify the pottery used aboard the ship, but seven pieces of Mycenaean pottery raised to date, all different with the exception of
two stirrup jars, suggest shipboard items. Furthermore, kylix KW 57 and cup KW 334, unlike the Cypriot open containers comprising part of the ship's ceramic cargo, must have been personal drinking cups, for the forms are hardly suitable for use as containers. Along with a few other coarse-ware bowls not yet studied, it is almost certain that these Mycenaean ceramics constituted shipboard items. But were they in reuse by a Near Eastern crew or did they belong to a Mycenaean crew aboard the ship? The purpose of this pottery is uncertain, but the Mycenaean merchant's seal suggested to Bass the presence of a Mycenaean on board. The recently discovered globed pin (KW 570), so far unparalleled in the Near East, is of the type worn by Mycenaeans as part of their clothing. Cast of bronze, hence of negligible scrap value, the pin probably belonged to a Mycenaean, perhaps even the person who owned the seal. Was this person an official on a royal mission, a merchant of enormous wealth returning from a successful trading venture, or was he only a passenger merchant of moderate means with possibly a very small share of the cargo? The excavation raises many questions which we may never be able to answer. In the case of our Mycenaean, however, the evidence of the crude sealstone may offer a hint. Younger notes that sealstones of this type are usually found in simply furnished tombs, suggesting that "their owners were, for the most part, of humble means."
Whether or not the presence of a Mycenaean on the Ulu Burun ship suggests a like origin for the vessel itself remains unknown, but the available evidence appears to tilt the balance slightly in favor of a Mycenaean home port for the ship. It will take several years to completely excavate the site. Every campaign uncovers new and exciting information almost daily, reshaping our conception of the story. The material presented above should be reviewed with caution, and the conclusions, for the most part, should be regarded only as representing a mental exercise.
NOTES


4.  Bass' response to major disagreements are in Bass (supra n. 3) passim.


13. The 1983 survey is reported fully in Bass et al. (supra n. 12) 271-79.

14. Bass et al. (supra n. 12) 277.

15. The excavation was financed by the Institute of Nautical Archaeology Board of Directors and the National Geographic Society in 1984 and 1985, with additional funding from the National Science Foundation in 1985.

Excavators for the 1984 campaign comprised George F. Bass, director; Cemal Pulak, assistant director; Donald A. Frey, photographer; Robin C.M. Piercy, chief of operations; Tufan Turanlı, captain of the Virazön; Murat Tiley, ship's engineer; Yancey Mebane and Karl Ruppert, physicians; Donald M. Rosencrantz, adviser for photogrammetry; Aşkın Canbazoğlu and Yaşar Yıldız from the Bodrum Museum of Underwater Archaeology; and INA directors Jack W. Kelley and Claude Duthuit. Staff also included archaeologists Feyyaz Subay, Faith Hentschel, Lisa Shuey, Cheryl Haldane, Douglas Haldane, and Texas A & M graduate students Joe Simmons, Denise Lakey, Michael Halpern, Michael Fitzgerald, and Aleydis Van de Moortel. Bahadır Berkaya represented the Turkish General Directorate of Antiquities and Museums.

In 1985, excavators included the following personnel from 1984: Cemal Pulak, Donald A. Frey, Robin C.M. Piercy, Tufan Turanlı, Murat Tiley, Yancey Mebane, Karl Ruppert, Faith Hentschel, Douglas Haldane, and Michael Halpern. New
staff comprised Texas A&M graduate students William Lamb, Ralph Pederson, and Steve Vinson, and conservators Jane Pannell and Robert Payton; Aşkın Canbazoğlu represented the Turkish General Directorate of Antiquities and Museums. Photographs are by Donald F. Frey. Illustrations are by Netia Piercy, except for ills. 1, 5, and 6 by Sema Pulak; ills. 2 by Jack Kelley, and ills. 3 and 4 by the author.

I would like express my gratitude to Professor George F. Bass for permitting me to study and publish this material. Without his perpetual support and help, this thesis would not have been completed.


18. Most of the objects from the southern gully and others recovered during the 1984 excavation campaign have been studied and reported by G.F. Bass, "A Bronze Age Shipwreck at Ulu Burun (Kaş): 1984 Campaign," AJA 90 (1986) 269-96. For these objects, the present work will simply refer to this article.


20. Reese, 1979-1980 (supra n. 19) 85, citing Pliny; and Pliny, NH (32.120).

22. Seltman (supra n. 21) 1-2; C. Seltman, Greek Coins (London 1955) 5-10. Bass (supra n. 2) 69-72, discusses this issue in detail and, based on the study of Cape Gelidonya ingots, argues against these views.

23. Muhly (supra n. 5) 81 with n. 52.

24. Buchholz (supra n. 6) 2,4; see also Bass (supra n. 2) 69-70.

25. Bass (supra n. 2) 69.

26. Bass (supra n. 2) 71.


30. Buchholz (supra n. 6) 1, fig. 2 on 7 for ingot typology. Bass modified this typology slightly by the addition of three subtypes from Cape Gelidonya ([supra n. 2] 53, fig. 55).


32. Bass (supra n. 2) 69.

33. For the poor state of preservation of the Ulu Burun ingots, see Bass (supra n. 18) 276.

34. Based on a poorly preserved, incomplete ingot raised in 1982, the Ulu Burun copper ingots had been initially identified as of Buchholz's Type 2 and perhaps Bass' Type 2c (Bass et al. [supra n. 12] 273 fig. 2). Most of the examples raised in 1984 and 1985, on the other hand, approximate more closely Buchholz's Type 3. The wide variety of ingot shapes at Ulu Burun now demonstrate gradations between the two types, making distinctions between them most subjective. It seems that all three of
Buchholz's types are present on the site, but we caution that most of the ingots remain to be raised, conserved and studied.

35. Buchholz (supra n. 6) 28-29; Bass (supra n. 2) 57, 61-62, 75 fig. 92; Bass (supra n. 3) 29-31, 38 figs 1-6; and H.W. Catling, Cypriot Bronzework in the Mycenaean World (Oxford 1964) 267-68, with two miniature ingots of Type 3 from Enkomi on p. 269. Another miniature ingot of Type 3, alleged to have been found at Makarska in Dalmatia (Buchholz [supra n. 6] 37 no. 57, 35 pl. 5.5), is probably also from Cyprus (L. Vagnetti, "Osservazioni sul cosiddetto ripostiglio di Makarska," Studi ciprioti e rapporti di scavo I (Rome 1971) 210-11, 213-14 with English summary on 216). Thus, all ingots of Type 3 known prior to the discovery of the Ulu Burun shipwreck appear to have been found on Cyprus.

36. Catling (supra n. 35) 271-72.

37. Bass (supra n. 2) 69.

38. Bass (supra n. 2) 69, 164.

39. Bass (supra n. 2) 52-57.

40. For representations of Type 1b ingots on Egyptian tomb paintings, see Bass (supra n. 2) 62-66 figs. 62-69, 71, 74-76, 78 and 80.

41. Bass (supra n. 2) 72 fig. 90.

42. Muhly et al. (supra n. 5) 357, 358 table 1.

43. R.F. Tylecote, "The Late Bronze Age: Copper and Bronze Metallurgy at Enkomi and Kition," in J.D. Muhly, R. Maddin and V. Karageorghis, eds., Early Metallurgy in Cyprus, 4000-500 B.C. (Nicosia 1982) 94, also Muhly et al. 1977 (supra n. 5) 354; see, however, Bass (supra n. 2) 78, 80-82 for possible evidence for casting of bun ingots outside the furnace.

44. Bass (supra n. 2) 78, 80-81.

45. See n. 35 (supra). Also Galili at al. (supra n. 6) 32-34 with figs. 7-8; B. Dimitrov, "Underwater Research Along the South Bulgarian Black Sea Coast in 1976 and 1977," IJNA 8 (1979) 70, 73 with fig. 3; and F. Lo Schiavo, E. Macnamera and L. Vagnetti, "Late Cypriot Imports to Italy and Their Influence on Local Bronzework," BSR 53 (1985) 10-13; F. Lo Schiavo, Nuragic Sardinia in its


47. Buchholz (supra n. 6) 2; Bass (supra n. 2) 69 n. 78.


51. Five tin ingots, three marked apparently with syllabic signs, have been reported from an undated context, possibly from a shipwreck, off the coast of Israel (Galili et al. [supra n. 7] 25-32). They were probably cast in shallow pits, some still retaining the debris of the pits. The ingots are flat on top and curved on the bottom, are extremely irregular, and remotely resemble the Ulu Burun ingots in section; parts of them had been cut off in antiquity. Two of four rectangular tin ingots, found offshore near Haifa, were dated to the Late Bronze Age on the basis of engraved signs resembling those of the Cypro-Minoan syllabary (Maddin et al. [supra n. 46] 45-47), but two 5th-century B.C.E. ingots, probably from the same offshore source, suggest a 5th-century date for all (N. Artzy, "Arethusa of the Tin Ingot," BASOR 250 [1983] 51-55).

52. Bass (supra n. 2) 64
53. Bass (supra n. 18) 277.

54. G. Loud, Megiddo II (Chicago 1948) pl. 59.11, found in stratum VIII.


57. Raban (supra n. 56) 6; see also R.E. Jones, Greek and Cypriot Pottery, A Review of Scientific Studies (British School at Athens Occasional Paper 1, 1986) 572-73.


60. Bass (supra n. 18) 278.


63. Hope (supra n. 61) 43 table 2 lists stopper combinations, and p. 41 pl. IV illustrates sealings with potsherds and grass stoppers.

64. C. Haldane, "Archaeological Remains from Four Shipwrecks off Turkey's Southern Shore," presented in Istanbul on 12 September 1986 at the Fifth OPTIMA Conference.
65. Bass (supra n. 18) 277-78.


68. A. Lucas, Ancient Egyptian Materials and Industries (London 1962) 323, where Chian turpentine is incorrectly given as the product of Pistacia terebinthus.

69. Lucas (supra n. 68) 91, 321.

70. Lucas (supra n. 68) 324.


72. Bass (supra n. 18) 278, also notes sources in the Near East.

73. Bass (supra n. 18) 278 with n. 39.


75. Bass (supra n. 18) 278-79 with n. 40.

76. Pliny, NH (35.31); also Bass (supra n. 18) 279.


78. Bass (supra n. 18) 279.

79. Bass (supra n. 18) 279-80.

80. Bass (supra n. 18) 279-80.


82. For degeneration of the ladder pattern, see M.R. Popham, "White Slip Ware," in P. Åström, SwCyprusExp IV. Part 1C (Lund 1972) 456, pl. LXXXVIII.3-8.
83. Popham (supra n. 81) 702.
84. Bass (supra n. 18) 280.
85. E. Sjogqvist, Problems of the Late Cypriote Bronze Age (Stockholm 1940) 41.
86. Bass (supra n. 18) 280.
87. Sjogqvist (supra n. 85) 78.
88. Sjogqvist (supra n. 85) 430.
89. Bass (supra n. 18) 281.
90. Bass (supra n. 18) 281.
92. Amiran (supra n. 91) 190.
94. T. Dothan and A. Ben-Tor, Excavations at Athienou, Cyprus, 1971-1972, (Qedem 16, Jerusalem 1983) 113, 114 fig. 52.2.
95. C.F.A. Schaeffer, Ugaritic II (Paris 1949) 208, 209 fig. 86.24, but without decoration; the larger type is fig. 86.27.
96. P. Åström, SwCyprusExp IV. Part 1C (Lund 1972) 261-64.
97. For a discussion of other parallels and their dates, see Dothan and Ben-Tor (supra n. 94) 113.
98. Bass et al. (supra n. 12) 273, 276; also Åström (supra n. 96) 587.
99. Catling (supra n. 35) 162.
100. Bass et al. (supra n. 12) 276; Åström (supra n. 96) 587 with n.4.
101. Åström (supra n. 96) 587 n. 11.

103. Bass (supra n. 18) 285.

104. Ben-Arieh and Edelstein (supra n. 59) 23 fig. 11.1-4.

105. O. Tufnell et al., Lachish IV. The Bronze Age (London 1958) 217, pl. 84.954.

106. Bass (supra n. 18) 285, 293.


108. F.H. Stubbings, "The Mycenaean Pottery of Attica," BSA 42 (1947) 28-29, 25 fig. 9 his Type C.


110. Bass (supra n. 18) 289, 291 ill. 29.

111. Bass (supra n. 18) n. 113.

112. The final drawing of KW 137, Bass (supra n. 18) 291 ill. 29, its entire decoration cleaned, was added to that article as it went to press and thus was not considered in the published discussion of the jar.


114. Furumark (supra n. 113) 31 fig. 6.171, 33, 299 fig. 47.25. See also P.A. Mountjoy, Mycenaean Decorated Pottery: A Guide to Identification (SIMA 73, Göteborg 1986) 77, 79.

115. Furumark (supra n. 113) 31-32 figs. 5-6; Mountjoy (supra n. 114) 79-80.

116. Furumark (supra n. 113) 31-32 figs. 5-6; Mountjoy (supra n. 114) 77-78.


118. Haskel, "Coarse-Ware Stirrup-Jars at Mycenae,"
119. Haskell (supra n. 117) 121-22.

120. Haskel (supra 117) 122-23.

121. Furumark (supra n. 113) 49-50, 48 fig. 13.214; V. Hankey, letter of 19 February 1987 to George Bass, suggests that it may be a deep version of FS 220

122. Bass (supra n. 18) 274, 281-82 with ills. 15-16. Photographs of two glass ingots have been published in JGS 28 (1986) 118 fig. 2 (the glass beads with the ingots are from a Mycenaean tomb at Müşgebi, near Bodrum, Turkey).

123. Bass (supra n. 18) 282.


125. Brill (supra n. 124).

126. Bass (supra n. 18) 282.

127. Lucas (supra n. 68) 282.


130. Muhly et al. (supra n. 5) 354.

131. Dayton et al. [(supra n. 128) 326-29 passim] rule out cobalt sources in Central Persia on the grounds that they contain neither silver nor tin, which usually exist in Egyptian blue.


134. P.E.P. Deraniyagala, Some Extinct Elephants,
Their Relatives and the Two Living Species (Colombo, Ceylon 1955) 116.


136. Reese (supra n. 135) 399.

137. R.D. Barnett, Ancient Ivories in the Middle East (Qedem 14, Jerusalem 1982) 6; Miller (supra n. 135) 30; Reese (supra n. 135) 399.

138. L. Woolley, Alalakh, An Account of the Excavation at Tell Atchana in the Hatay, 1937-1944 (Oxford 1955) 102, pl. XVIb; Miller (supra n. 135) 30; Reese (supra n. 135) 399.

139. R.D. Barnett, A Catalogue of the Nimrud Ivories, with Other Examples of Ancient Near Eastern Ivories in the British Museum (London 1955) 165 n.3; Reese (supra n. 135) 399.

140. Miller (supra n. 135) 31.

141. N.de G. Davies, The Tomb of Rekh-mi-Rē' at Thebes (New York 1973) pl. VI; Barnett (supra n. 137) 6; Miller (supra n. 135) 31.


143. O.H. Krzyszowska, "Wealth and Prosperity in Pre-Palatial Crete, the Case of Ivory," in O. Krzyszowska and L. Nixon, eds., Minoan Society (Proceedings of the Cambridge Colloquium, Bristol 1983) 166, contra Encyclopaedia Britannica ([1967] vol. 12, 807) where it is stated that ivory is little affected by heat and moisture, making it most suitable for handles of surgical instruments which need to be sterilized in boiling water, and calibration plates for thermometers designed to operate in extreme conditions. It is likely that only very old archaeological ivories are sensitive to environmental changes.
144. Bass (supra n. 18) 283.


146. There appears to be some confusion regarding terminology. Reese, quoted by Bass (supra n. 18) n. 65 on 283, states that tusks designate canine teeth, and should not be used for incisors; yet in Reese (supra n. 135) 398, they are defined as "enlarged elephant incisors." Krzyszkowska on the other hand (supra n. 145), claims that hippopotamus incisors should be called tusks because they grow continuously just like elephant tusks and hippopotamus canines. Tusk is defined by Webster dictionary as "a very long, pointed tooth, usually one of a pair, projecting outside the mouth and used for defense, digging up food, etc., as in elephants, wild boars, or walruses." Since no reference is made to whether the use of the term is limited to incisors or canine teeth, we will simply refer to our specimen as a tusk.

147. Reese (supra n. 135) 392, citing Barnett.

148. Reese (supra n. 135) 395.


150. These and other finds are conveniently listed in Reese (supra n. 135) 391, 393-393; see also A. Mazar, Excavations at Tell Qasile, II (Qedem 20, Jerusalem 1985) 13 fig. 3.

151. Krzyszkowska (supra n. 143) 166.

152. Bass (supra n. 18) 283 n. 70 referring to a report to appear as A. Caubet and F. Poplin, "Les Objects en matiere dure animale," in M. Yon, ed., Ras Shamra-Ougarit III (Paris 1986), where it is reported that 40 of the 45 pieces from Ras Shamra were made of hippopotamus ivory.


154. Bass (supra n. 18) 292 ill. 32.

155. Inscribed decoration on tools, especially on axe and adze blades, is not uncommon in the Late Bronze Age. For a fish on a different axe-blade type, see Petrie (supra n. 153) pl. IV.127.


158. For similar blades from Palestine, and another similar example from Egypt, see Maxwell-Hyslop (supra n. 156) 81-82 and 85 fig. 5.5-7, 10-11, and for Cyprus see Catling (supra n. 35) 87, fig. 8.11, and pl. 6.g.


161. Catling (supra n. 35) 286, but for a discussion of the dating to the 13th century of these bronze hoards, including that of the Great Priest at Ugarit, see J.D. Muhly, *Copper and Tin* (Transactions of the Connecticut Academy of Arts and Sciences, New Haven 1973) 375 n. 202.


163. Petrie (supra n. 153) 16-17, pl. XVII.

164. Petrie (supra n. 153) 17, pl. XVII.91.


167. I. Beit-Arieh, "Serḥbiḥ el-Khādim: New Metallurgical and Chronological Aspects," *Levant* 17 (1985) 98-100, 102 fig. 9.3, and 95 pl. VII.12; the details of the poorly preserved molds are difficult to discern from the small illustrations. For dating of site, see p. 115.


169. Petrie (supra n. 153) 16; Catling (supra n. 35) 106 heavy chisels; and Deshayes (supra n. 157) vol. I, 88-89.

171. The 7th-century Byzantine wreck at Yassi Ada, Turkey, contained, among many other tools, five nearly identical adzes: Bass and van Doorninck (supra n. 16) 240-42 with ills.


177. Invariably referred to as a cold-chisel (C.F.A. Schaeffer, Enkomi-Alasia [Paris 1952] 43-44, 42 fig. 3.25) or a tanged chisel (Catling [supra n. 35] 95).

178. Schaeffer (supra n. 177) 38. Cypriot Iron I corresponds to L.C. III (C.F.A. Schaeffer, "Enkomi," AJA 52 [1948] 176-77). Catling (supra n. 35) 286, prefers to date this material to the second half of the 12th century. See, however, Muhly (supra n. 161) for a 13th-century dating of these hoards.

179. For the Ras Shamra chisel, see Schaeffer (supra n. 160) 261, 268 fig. 233.12; for the Cretan chisels, see Deshayes (supra n. 157) vol. II, 51 no. 998, pls. XII.3 and LV.4. A few later chisels, of the same general form but attributed to metalworking, are also known from the Aegean (S. Iakovidis, Excavations of the Necropolis at Perati [Institute of Archaeology Occasional Papers 8, Los Angeles 1980] 90 with fig. 106).

180. Catling (supra n. 35) 97 n. 5.

181. Schaeffer (supra n. 160) 262, 268 fig. 233.11 and 13; 273 fig. 237.

182. Catling (supra n. 35) 97.

183. J.-C. Courtois, Alasia III (Paris 1984) 21 no. 166, 22, 174 fig. 4.48, with additional Cypriot references.

185. For Kos, see Catling (supra n. 35) 99. Examples from Crete and Cyprus are conveniently listed in Lo Schiavo et al. (supra n. 45) 23, referring to L. Vagnetti, "Testimonianze di metallurgia minoica dalla zona di Nerokourou (Kydonias)," SMEA 25 (1985) 155-73.

186. E.g., the Tomb of Hepu at Thebes, in H.H. Coglan, Notes on the Prehistoric Metallurgy of Copper and Bronze in the Old World (Pitt Rivers Museum Occasional Papers on Technology 4, Oxford 1951) 68-69, with fig. 10, also in Bass (supra n. 2) 65 fig. 76; and the Tomb of Rekh-mi-Rē', in Davies (supra n. 141) 52, pls. III, LII and LV.


188. Catling (supra n. 35) 99, fig. 11.4-5, pl. 10.a-b; V. Karageorghis, "A Late Cypriote Hoard of Bronzes from Sinda," RDAC (1973) 75-77 with fig. 2.5, pl. VIII no. 5.

189. C.F.A. Schaeffer, "Nouvelles fouilles et découvertes de la mission archéologique de Ras-Shamra dans le palais d'Ugarit (Campagne 1951)," Annales archéologiques de Syrie 2 (1952) pl. III.1.

190. For Megiddo, see P.L.O. Guy and R.M. Engberg, Megiddo Tombs (Chicago 1938) pl. 125.10; for Akko, see Ben-Arie and Edelstein (supra n. 59) 31, 37 fig. 15.3, pl. XI.12.

191. Lo Schiavo et al. (supra n. 45) 23-25 with fig. 9.


193. Swords, dirks and daggers are separated arbitrarily by length. D.H. Gordon classifies weapons between 14 and 20 inches long as dirks; daggers are shorter; swords, called short or long on the basis of their lengths, are longer than dirks: D.H. Gordon, "Swords, Rapiers and Horse-riders," Antiquity 27 (1953) 67. V.R.d'A. Desborough, The Last Mycenaeans and Their Successors (Oxford 1964) 67, retains the same general divisions, but alters the classification somewhat by referring to the
mid-range weapons as short swords.


196. Maxwell-Hyslop (supra n. 194) 35-36; Ben-Arieh and Edelstein (supra n. 59) 33 n. 43.

197. Catling (supra n. 35) 128, pl. 15.1-1.

198. Ben-Arieh and Edelstein (supra n. 59) 33, 40 fig. 18.1, pl. VII.1, dated on p. 36; also B.M. Gittlen, "The Murder of the Merchants Near Akko," *Biblical and Related Studies Presented to Samuel Ivry* (Winona Lake, IN 1985) 64.


200. Driessen and Macdonald (supra n. 199) 73 nos. 6, 9, 10, 20, 22, 25, 35, 36, and (incomplete) 32, 33, 38, none originally exceeding 0.5 m. in length.

201. Sandars (supra n. 199) 120.

202. Sandars (supra n. 199) 119.


204. Driessen and Macdonald (supra n. 191) 64-65.


206. Matthäus (supra n. 205) 169; Sandars (supra n. 199) 130-32.


208. Schaeffer (supra n. 160) 258-60 with figs. 223-224.17.


211. Ben-Arieh and Edelstein (supra n. 59) 35 with ns. 58-59.

212. Catling (supra n. 35) 130-31.


214. Ben-Arieh and Edelstein (supra n. 59) 34.


216. F. Petrie, Ancient Gaza I. Tell el Ajjul (BSAE 53, London 1931) pl. XXI.106; Ancient Gaza II (supra n. 215) 8, pl. XVII.161-68; Ancient Gaza III. Tell el Ajjul (BSAE 55, London 1933) 6, with pl. IX.34.


218. Loud (supra n. 54) pl. 175.30-34; Guy and Engberg (supra n. 190) pl. 126.5-9.


220. Ben-Arieh and Edelstein (supra n. 59) 35, 44 fig. 22.17.

221. Tufnell et al. (supra n. 105) 79, pl. nos. 27, 32, 47.

222. Bass (supra n. 2) 126-28 with figs. 134.ST2 and 136.ST2. A piriform mace-head with raised collar on the lower end of the haft socket was found at Tarsus: H. Goldman, "Excavations at Gözlü Kule, Tarsus, 1937," AJA 42 (1938) 35 with fig. 13.


224. Bass (supra n. 18) 286. For a brief account of

225. L. Åström, SwCypResExp IV. Part 1D, 521, category 2b; Bothan and Ben-Tor (supra n. 94) 128, 129 fig. 59.10; Courtois (supra n. 145) 147 no. 1226, 215 fig. 45.3; M. Yon, Salamine de Chypre II. La tombe T.I du XIX s. av. J.-C. (Paris 1971) 21 no. 42, pls. 16.42 and 17.42.


228. L. Åström (supra n. 225) 521 category 3.


230. Tufnell et al. (supra n. 105) pl. XXXV.63; Rudolph (supra n. 227) pl. 32.14 and 19.

231. Petrie (supra n. 215) 6, pls. I, II; Petrie, Ancient Gaza IV. Tell el 'Ajjul (BSAE 56, London 1934) 7, pls. XV, XVI.68.

232. Dunand (supra n. 177) 174, pl. LXXII.2540 and 2542.


234. Loud (supra n. 54) pl. 226.3; Macalister (supra n. 217) 99-100 with fig. 286.


236. Other hoards of precious metals include intact pieces alongside fragments of folded and cut material: Petrie Ancient Gaza IV (supra n. 231) 5, pl. XII; J.D.S.


238. P.E. McGovern, Late Bronze Palestinian Pendants (JSOT/ASOR Monograph Series, Sheffield 1985) 47.

239. McGovern (supra n. 238) 47.

240. Petrie, Ancient Gaza IV (supra n. 231) 5.


242. The pectoral is discussed in detail by Bass ([supra n. 18] 287-88, pl. 17 fig 3).


244. Negbi (supra n. 233) 37.

245. Negbi (supra n. 233) 34-35; McGovern (supra n. 238) 75-77, his Type VI.G. star disc; T.L. McClellan, "A Syrian Fortress of the Bronze Age: el-Qitar," National Geographic Research 2 (1986) 435 with fig. 15.B-C.

246. Maxwell-Hyslop (supra n. 243) 149; McGovern (supra n. 238) 102.

247. Bass (supra n. 18) 289-90, pl. 17 fig. 4.

248. McGovern (supra n. 238) 77.


250. Letters from James Weinstein of 18 December 1985 and (to G.F. Bass) 16 October 1986. Weinstein comments that the incised signs include a maat-feather (oriented in the wrong direction) on the left of the ring, a crude ba-bird in the center, and on the right a badly cut seated figure, probably of a female as suggested by the long headdress, with a nb-sign immediately above.

252. A. Rowe, A Catalogue of Egyptian Scarabs, Scaraboids, Seals and Amulets in the Palestine Archaeological Museum (Cairo 1936) pl. II.59; I thank James Weinstein for this reference.

253. Weinstein (supra n. 251).

254. Tufnell et al. (supra n. 105) pls. 39-40, 376-377.

255. Macdonald, Starkey and Harding (supra n. 219) 26, pl. LVII.357.

256. F. Petrie, Buttons and Scarabs (London 1925) 19, pl. XI.624.


258. Younger (supra n. 257) 290.

259. Bass (supra n. 18) 284.

260. Bass (supra n. 18) 284; Younger (supra n. 257) 282, sealstone no. 8, pls., 53.a-b.


262. Bouzek (supra n. 261) 167.


265. This pin belongs to Jacobsthal's classical Submycenaean type ([supra n. 263] 1-2); Desborough's type A ([supra n. 161] 296 fig. 33.E, 297), and A.M. Snodgrass' Type I (The Dark Age of Greece [Edinburgh 1971] 226, 227
fig. 81).

266. Bouzek (supra n. 261) 162-63, 166; Harding (supra n. 224) 136; Catling (supra n. 35) 239, pl. 41.1.

267. Harding (supra n. 224) 136-37; Bouzek (supra n. 261) 167.

268. J. Deshayes, Argos, Les fouilles de la Deiras (Études péloponnésiennes IV, Paris 1966) 204-207; Jacobsthal (supra n. 263) 1 n. 1; Snodgrass (supra n. 265) 226.

269. Bouzek (supra n. 261) 167.


274. Courtois (supra n. 273) 117-30, pl. XVII, with other Cypriot weights listed on 120-21 with ns. 23-28; A.K.
281. E.g., Dunand (supra n. 175) pl. CXVI.14499.

282. Courtois (supra n. 273) 123-25, pl. XVII.6-7, 15. A weight from Enkomi, similar in shape to that from Ulu Burun, but with a loop handle, bears a series of animals in low relief on its sides (Schaeffer [supra n. 184] 411, 413, 418 fig. 22.c and d, 420 fig. 23.a and b, 422 fig. 24.2.

283. Ben-Arie and Edelstein (supra n. 59) 58.

284. K.M. Petruso, Systems of Weight in the Bronze Age Aegean (Diss. Indiana University 1978) 204 no. 274 from Kommos provides a possible parallel.


286. Courtois (supra n. 183) 185 figs. 15.15A and 15B; Dothan and Ben-Tor (supra n. 94) 126 fig. 57.18-19, and especially 20 with crimp-marks still evident.

287. Petrie Ancient Gaza III (supra n. 216) 6, pl. IX.35.

288. Bass (supra n. 2) 131, 132 fig. 139.L1.


291. Mieggs (supra n. 290) 56; three other fir species are found in Anatolia, Ἰ. Atalay, Türkiye Vejetasyon Coğrafyasına Giriş (İzmir 1983) 36, 67, 119, 150, 162. Of these, Abies nordmanniana, common and widespread in the eastern Black Sea region, approaches the Macedonian fir in quality (Mieggs [supra n. 290] 56.


293. A sample from Ras Shamra has been identified only

294. Mountjoy (supra n. 114) 77.

295. The final drawing of KW 137, Bass (supra n. 17) 291 ill. 29, its entire decoration cleaned, was added to that article as it went to press and thus was not considered in the published discussion of the jar.

296. Mountjoy (supra n. 114) 77.


298. Gittlen's study of White Slip II Wares in Palestine has shown that the presence of pendant rows of dots alone is not significant in establishing the position of a vessel within the LBA sequence (B.M. Gittlen, *Studies in the Late Cypriote Pottery Found in Palestine* [Diss. University of Pennsylvania 1977] 426).

299. See n. 82.

300. Popham (supra n. 81) 704-705.

301. Sandars (supra n. 199) 130.


304. See supra n.249; Bass (supra n. 18) 293-94 for mention of scene.

305. Bass (supra n. 18) 294

306. Bass (supra n. 18) 293. Zaccagnini ([supra n. 29] 414) noting the variations in phraseology of references to copper in the Amarna letters, translates the passages according to their formulation as "number of copper ingots"
or "talents of copper"

307. Zaccagnini (supra n. 29) 414.

308. Bass (supra n. 18) 163-64.

309. Bass (supra n. 18) 295 n. 163.


311. Bass (supra n. 2) 64.


314. The later transport across Gaul of knucklebone-shaped tin ingots on pack animals is related by Diodorus of Sicily (V 22), as pointed out by Buchholz (supra n. 6) 2, and Muhly (supra n. 161) 262, 270.

315. Muhly (supra n. 27) 95; Bass (supra n. 2) 71-72.

316. Although of an earlier period, i.e., mid-second millennium B.C.E., Middle Assyrian texts show that the price of a field was frequently quoted in terms of so many minas and shekels of tin (Muhly [supra n. 302] 257).

317. Muhly (supra n. 312) 287.

318. Sandars (supra n. 199) 128.

319. Bass (supra n. 18) 295.


323. Bass (supra n. 18) 296.

324. Mostly associated with women, these long pins have often been found in pairs, but single examples as well as those associated with male burials also exist (Desborough [supra n. 263] 295).

325. Younger (supra n. 257) 290.
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