

LATE BRONZE AGE AEGEAN SHIPS
AND THE PYLOS TABLETS Vn 46 AND Vn 879*

This article presents a fuller archaeological and pinacological discussion of two Pylos texts that might deal with materials for Mycenaean ship construction. It should be read in conjunction with the articles by Palaima and van Effenterre cited at the end of note*, both of which made clear the need to call upon a specialist in nautical archaeology to provide an expert commentary on technical aspects of Bronze Age ship construction and to sketch out the current archaeological context for the kind of «nautical» interpretation of these two tablets first suggested as a possibility by van Effenterre.

The fullest discussion of the alternative interpretation of Vn 46 and Vn 879, that the two texts refer to materials for the construc-

* A preliminary version of Hocker's contribution to this article was delivered as a lecture at an one-day symposium on Aegean trade in the Mycenaean palatial period held in September, 1991 by the Program in Aegean Scripts and Prehistory of the Department of Classics of the University of Texas, Austin. Palaima has here commented upon the ways in which the procedures and systems for recording information on Linear B tablets affect possible interpretations of items in the texts. This paper has benefitted from discussions with Shelley Wachsmann. Hocker would also like to thank Cemal Pulak for unpublished information on the Uluburun wreck and his thoughts on the size and construction of the ship. Palaima thanks N. Hirschfeld and J. R. Steffy for first inducting him into the mysteries of ancient ship reconstruction. Any errors that remain are ours. We use the following abbreviations in addition to those which are standard for readers of *Minos*:

Basch = L. Basch, *Le musée imaginaire de la marine antique*, Athens 1987.

Palaima = T. G. Palaima, «Maritime Matters in the Linear B Tablets», in R. Laffineur and L. Basch, eds., *Thalassa: L'égée préhistorique et la mer* (= *Aegaeum* 7), Liège 1991, pp. 273-309.

Tropis I = H. Tzalas, ed., *Tropis* I. 1st International Symposium on Ship Construction in Antiquity, Proceedings, Athens 1989.

Tropis II = H. Tzalas, ed., *Tropis* II; 2nd International Symposium on Ship Construction in Antiquity, Proceedings, Athens 1991.

van Effenterre = H. van Effenterre, «Un navire mycénien?», in M. Mollat, ed., *Sociétés et compagnes de commerce en Orient et dans l'Océan Indien*, Paris 1970, pp. 43-53.

tion or repair of a major room of a Mycenaean building, is L. Baumbach, «Further Thoughts on PY Vn 46», *Minos* 12, 1972, pp. 383-397. Baumbach's chief objections to van Effenterre's nautical interpretation are based on her criticisms of his imperfect understanding of ship architecture —at a time when no one, Baumbach and van Effenterre included, had a sound knowledge of Bronze Age ship-building techniques and most interpretations proceeded by means of later historical and even modern analogies—and on her insistence that the Mycenaean term *ka-pi-ni-ja* cannot be related to *σκάφος*. It has been demonstrated elsewhere (Palaima, pp. 297-298, n. 105) that the latter argument is not valid. This paper presents more probable nautical identifications of the lexical items in Vn 46 and Vn 879, thus invalidating Baumbach's first argument.

There are other problematical points in Baumbach's analysis, for example: (1) her dismissal of van Effenterre's interpretation of *ta-ra-nu-we* as rower's benches on the contextual grounds that the term is associated with *ka-pi-ni-ja*, for which supposedly «the most likely interpretation... is still a derivative of *καπνία* = *κάπνη*» [this is simply a blunt refusal to consider a reasonable alternative theory in its own terms]; (2) her proposal that *ta-to-mo* and *ki-wo* are either synonymous [citing a 6th century poetic literary parallel, as if this were even remotely comparable to entries on consecutive lines of a Mycenaean bureaucratic document from the 13th century B.C.] or designate a free-standing vs. an attached column [without establishing which would be which and citing as comparanda *wooden* columns like those from the central *megaron* and engaged *green stone* columns like those from the Treasury of Atreus: to my knowledge, the Palace of Nestor has no engaged columns, wooden or stone]; (3) her objections to interpreting *e-pi-^{*65}-ko* and *pe-^{*65}-ka* with the value ^{*65} = *ju* [this runs against the current evidence]; (4) the suggestion that other tablets, once belonging to a fuller set, are now lost and that these would have explained how the items recorded on Vn 46 and Vn 879 would have been used in building repair [there are many comparanda for tablets without explanatory headings and the beginning of Vn 46 is fragmentary, so this entire line of reasoning is either untenable or superfluous]; (5) the assumption that unspecified repair to a major feature of the palace (one having columns —there is no attempt to identify a unit with two different kinds of single columns!— and doors, e.g., a *megaron*

or propylon) is a more reasonable hypothesis than the construction or repair of ships which would have been essential in the palatial trade and naval defense of the territory of Pylos throughout the late Mycenaean period. In addition, Baumbach, p. 397 n. 43, claims, «That repair work was going on in the palace at the time of its destruction, is suggested by Blegen and Rawson, [*Palace of Nestor* I, Part 1], pp. 256 and 423». What Blegen and Rawson discuss in the passages cited is that «the front wall of Hall 65 represents a reconstruction or remodeling of a preceding structure» (p. 256) and that «[t]he repair of the western angle and enclosing of Courts 42 and 47 are, however, surely structures of the final phases» (p. 423). Neither passage implies that repair work was going on at the time when the palace was destroyed, just before which the two tablets under discussion must have been written. In both cases, the remodeling of and alterations to the existing building plan had been completed before the destruction. Repair work was not *in progress*. For a full treatment of how the Palace of Nestor was altered through time, see J. C. Wright, «Changes in Form and Function of the Palace at Pylos», in T. G. Palaima and C. W. Shelmerdine eds., *Pylos Comes Alive*, New York 1984, pp. 19-29. Wright, p. 28, concludes, «Perhaps the process of transforming the palace occurred piecemeal over the life of the palace».

Again our point is not that the idea of the need for almost constant minor, and sometimes major, repairs to a complex building like the Palace of Nestor is untenable, but that: a. Baumbach has misrepresented the passages from Blegen and Rawson; b. Baumbach has provided no evidence for repair of a major unit of the palace contemporary with tablets from the destruction phase; c. the theory of building repair is no more compelling than that of ship construction and repair which Baumbach dismisses out of hand. Tablets from Pylos refer to the drafting of rowers according to an organized system, to the allocation and absence of groups of rowers, to shipbuilders, and to a coastal defense system, while texts from Knossos may monitor ships from specific regions (Palaima, pp. 285-289, 301-309). Thus it is hardly unreasonable to think that some surviving texts might refer to the component parts or raw materials used in ship-building. Our surprise that there are not more tablets like Vn 46 and Vn 879 referring to basic structural elements or component architectural parts should be equal whether the tablets are treated as referring to building repair or ship

construction. We should note, by way of comparison, that only one tablet from Pylos (Vn 10) lists raw materials for chariot construction, despite the fuller series (from Pylos and Knossos) referring to chariot wheels and pieces of chariots in different stages of assembly. Finally, however, we agree with Baumbach, p. 383, that «[t]o re-examine a tablet with as many uncertainties as PY Vn 46 needs no justification». Hence the present article.

Even without the ample direct evidence of shipbuilding and seafaring in the eastern Mediterranean of the Late Bronze Age, it is abundantly clear from the wealth of «foreign» objects found on Late Bronze Age sites that long-distance exchanges of goods and ideas were an important aspect of Mycenaean, Egyptian, Cypriot, Syro-Canaanite, and Hittite culture. The sea offered the best avenue for such exchanges, and only the Hittites lacked ready access to the Mediterranean. The Amarna and Ugaritic texts further testify to the volume and variety of goods exchanged by sea, and the *Tale of Wenamun* provides an entertainingly tragicomic account of sea travel at the end of the period. The ships themselves are depicted in numerous Aegean and Egyptian representations and models (with some Cypriot and Syro-Canaanite additions) from the Early Bronze Age onward.

Despite the importance of ships to a complete understanding of Late Bronze Age trade and the large number of surviving representations, we know surprisingly little about them. How big were they? How many were engaged in long-distance trade? How were they built? Who built them? Governments, private individuals, or commercial groups? To what degree were they specialized for specific routes, cargos, or functions? How seaworthy were they? The representations do not tell us, although they do give us a general impression of the basic configuration of ships in the Late Bronze Age Aegean and eastern Mediterranean.

From the representations it is possible to identify two general types of Aegean vessels¹. The first is a long, low, oared vessel with possible roots in the Early Bronze Age. Such ships are shown on the

¹ Lucien Basch, who has studied ship iconography in the ancient world extensively and published a thorough study of most of the known material, organizes the Minoan representations into eight distinct groups (Basch, pp. 94-140), but most of the representations can be assigned to one of two main groups: symmetrical hulls and asymmetrical hulls. The asymmetrical hulls are characterized by one end higher and more angular than the other. Further classification is based largely on provenience and decorative detail.

so-called frying pans from EC II Syros and other Aegean sites², although interpretation of these extremely schematic depictions largely consists of arguments over which end is the bow, with current scholarship preferring a «high bow» by a narrow margin³. By the Late Bronze Age, the possible descendants of these vessels can be seen in representations on pottery from the Cyclades and the mainland⁴. These vessels are characterized by a high, plumb stem sur-

² Representations from these votive objects have been carefully studied and published since they first were discovered by Tsountas in the 1890's. The actual function of the objects is uncertain, but it is clear that they were not frying pans. Approximately 200 such objects are known from the Aegean and Anatolia; most are in terracotta, but stone and metal examples are known. See J. E. Coleman, «'Frying Pans' of the Early Bronze Age Aegean», *AJA* 89, 1985, pp. 191-219, for a recent catalogue of 124 examples and a discussion of their form, decoration, and possible function. Of the known examples, at least eleven are decorated with stylized representations of paddled or oared ships. Line drawings of all the representations except a fragmentary example can be found in Coleman, ill. 5, p. 199. Photographs of all the complete representations are collected and discussed in Basch, pp. 80-89, and figs. 159-168.

³ The literature on this topic is extensive, with arguments following two main lines. The first concentrates on the comparison of the frying-pan ships with later and less ambiguous Aegean ship representations, such as the nearly contemporary models from Naxos and Mochlos and LC Ia ships depicted in the West House at Akrotiri; the second follows a functional argument, based on the aero- and hydrodynamics of the apparent or hypothesized hull forms, often on the presumption that the depicted hulls are similar to that of an EM II clay model from Palaikastro. The first approach largely leads to a «high bow» interpretation, although it is difficult to find comparative evidence that is both unambiguous and clearly related to the frying-pan representations. The second line of reasoning is less conclusive, as most evaluations of ancient boat performance are highly subjective, especially when the three-dimensional shape of the hull is unknown: see Y. Vichos, «L'extrémité haute des navires à l'âge du bronze en mer Égée: La poupe ou la proue? Une approche nautique au problème de l'identification des extrémités des navires cycladiques représentés sur les 'poelons' de Syros», in *Tropis* II, pp. 363-370. The Palaikastro model, although apparently similar in shape, is of little help, as the asymmetrical hull form is suitable for propulsion in either direction and there is no inherent indication in which direction it was intended to travel. A recent summary of the arguments can be found in P. F. Johnston, «Bronze Age Cycladic Ships: An Overview», *Temple University Aegean Symposium* 7, 1982, pp. 1-8, with a good bibliography. The relevance of the models is discussed in P. F. Johnston, *Ship and Boat Models in Ancient Greece*, Annapolis 1985, pp. 5-34. C. Broodbank, «The Longboat and Society in the Cyclades in the Keros-Syros Culture», *AJA* 93, 1989, pp. 319-337, manages to rise above the relatively unimportant bow-stern controversy to explore the possible social and economic implications of the use of such craft.

⁴ The Pylos vessel, on a ceramic LH III C 1/2 pyxis from Tragana, is well known, although only recently has it been correctly restored: G. S. Korres, [Greek title] «Representation of a Late Mycenaean Ship on the Pyxis from Tragana, Pylos», in *Tropis* I, pp. 177-202. The

mounted by a bird or bird-head ornament⁵, a raised, possibly open structure in the bow, a long, low hull, possibly with bulwarks, a high, upsweeping sternpost, and another light, raised structure in the stern. Most of these characteristics persist in Geometric and later Greece and define the basic Aegean warship of Classical times. Related vessels can be seen in the mortuary temple of Ramses III at Medinet Habu in the relief of the battle with the Sea Peoples; the ships of the Sea Peoples differ only in their symmetrical, vertical stems and sternposts, both of which carry bird-head finials⁶.

A different type of vessel is depicted in a large series of Middle Bronze Age seals but is best known from the stunning miniature fresco from the West House at Akrotiri, Thera⁷. The fresco shows a procession of highly decorated ships being paddled and sailed from one coastal town to another, with smaller, simpler craft rowed in their midst. The hulls are long and «crescentic», with a long, raking stem carrying a variety of ornaments; the stern is less elongated and supports a small cabin, as well as a stern projection of uncertain purpose. In the waist of each major vessel is a party of dignitaries shaded by an awning. Each ship is equipped with a mast and square sail, but only one of the vessels is under sail; the others are propelled by a large number of paddlers leaning far over the rail. Many of

vessel resembles a large representation on a LM III C larnax from Gazi-Herakleion and small depictions on LH III C stirrup jars from Asine and Skyros: see Basch, pp. 140-147. On the recently discovered Kynos fragments, see F. Dakoronia, «Warships on Sherds of LH III C Kraters from Kynos», in *Tropis* II, pp. 117-122.

⁵ On the continuity of ornithological motifs in Aegean ships and ship representations, see S. Wachsmann, *Seagoing Ships and Seamanship in the Late Bronze Age Levant*, diss. Hebrew University, Jerusalem 1989, pp. 144-159.

⁶ H. H. Nelson *et al.*, *Medinet Habu I: Earlier Historical Records of Ramses III* (*Oriental Institute Publications* 8), Chicago 1930. On the relief of the naval battle, see H. H. Nelson, «The Naval Battle Pictured at Medinet Habu», *JNES* 2, 1943, pp. 40-45; L. Casson, *Ships and Seamanship in the Ancient World*, Princeton 1971, pp. 36-38; S. Wachsmann, «The Ships of the Sea Peoples», *IJNA* 10, 1981, pp. 187-220, comments explicitly on the similarity to contemporary Aegean ship representations.

⁷ On the miniature frescos generally, see L. Morgan, *The Miniature Wall Paintings of Thera: A Study in Aegean Culture and Iconography*, Cambridge 1988, which supercedes earlier reports; much of what follows can be found there. The ship procession has been the subject of intense debate since the discovery of the fresco in 1972, with many theories, some plausible and some fanciful, advanced on the ships, their passengers, and the occasion depicted. Fortunately, Morgan (pp. 121-145) has collected and summarized most of the relevant discussion, although her references are not by any means exhaustive.

these features, particularly the basic shape of the hull and the stern cabin, or *ikrion*, are seen on other Aegean ship representations, such as the seals. Because the Thera fresco is extremely detailed and makes sense mechanically, it appears to provide more information than it actually does. The hulls appear to be fuller aft than forward, both on the evidence of apparent shape and lading⁸, and the details of the sailing rig are both logical and within the traditions of Mediterranean single square-sail rigs. The ceremonial nature of the procession, the important passengers, the excessive decoration, the enigmatic stern projection, and the paddlers all suggest that these ships are unusual, or at least put to unusual use, and may not represent typical Aegean ships except in general form. Certainly the paddling cannot be taken as normal for seagoing ships, especially since small craft of more common appearance are rowed in the same scene. It may be that the ships are deliberately archaized (either by their operators or the artist) by the choice of paddling and the addition of the stern projection, which can be seen on many Aegean ship representations (thus the projection seen at one end of the frying-pan ships is cited as evidence that this is the stern).

Even though it provides by far the most informative ship representations from the Bronze Age Aegean, and rivals some of the Egyptian representations for clarity and detail, the Thera fresco answers few if any of the key questions concerning Aegean ships and shipbuilding. Little if any structural information can be derived from the painting, nor is there any reliable indication of size, capacity, ownership, or seaworthiness. They do confirm, in more realistic fashion, earlier interpretations of the more schematic seals.

Some help, at least on structure, is offered by models from Egypt⁹. These, along with one of the few Egyptian representations

⁸ T. Gillmer, «Theories on Ship Configuration in the Bronze Age Aegean», in *Tropis* I, p. 130. Gillmer's articles on the Thera ships, of which the above is only the latest, illustrate quite graphically the dangerous temptation to over-reconstruction presented by the frescoes. He has provided line drawings of a hull, as well as performance calculations. While Gillmer is an accomplished naval architect, and many of his suggestions on the details depicted in the painting are of considerable merit, it is simply not possible to produce a valid reconstruction from a two-dimensional representation.

⁹ Of particular interest are wooden models from the tombs of Amenhotep II (M. G. A. Reisner, *Models of Ships and Boats*, Cairo 1913, p. 96, figs. 348-349, no. 4944) and Tutankhamen (H. Carter, *The Tomb of Tut-Ankh-Amun* III, London 1933, p. 60 and fig. 63b).

of seagoing ships (Hatshepsut's Punt ships from her mortuary temple at Deir el Bahri)¹⁰, do indicate that at least some eastern Mediterranean ships were built on a heavy, longitudinal timber well on its way to becoming a keel. This timber appears to project inside the hull rather than outside amidships and so contributes less to directional stability under sail than a modern external keel, but it does provide significantly more longitudinal strength and stiffness than a keelplank or central strake. Unfortunately, there is no way to know if this advance had reached the Aegean by the Late Bronze Age.

The same sort of keel or proto-keel has been found on the Ulu-burun shipwreck, which has produced the first intelligible hull remains from a seagoing ship of the Bronze Age¹¹. Little survives from this ship, dated to the late fourteenth century BC, but even these fragments fill in major gaps in our knowledge. The surviving cargo indicates a minimum size of 12 metric tons deadweight capacity¹² and a length of perhaps 15 to 18 meters. In addition, the concreted copper ingots that form the primary cargo may preserve the approximate shape of the hull amidships. The keel is a heavy timber sided (or wide) 27 cm and moulded (or thick) perhaps the same, projecting both above and below the garboards¹³. The planks, 6 cm thick, are fastened to the keel and each other by pegged mortise-and-tenon joints, spaced approximately 21 cm apart, center to center, very similar to the joints found on large Roman merchantmen of the first centuries BC/AD¹⁴. The woods used are silver fir (*Abies sp.*) for the keel and planks, and oak (*Quercus sp.*) for the tenons and pegs. Prior to this discovery, the earliest evidence for pegged mortise-and-tenon joinery in Mediter-

¹⁰ E. Naville, *The Temple of Deir el Bahri III: End of the Northern Half and Southern Half of the Middle Platform*, London 1898, plates LXXII-LXXV.

¹¹ G. F. Bass, «The Construction of a Seagoing Vessel of the Late Bronze Age», in *Tropis I*, pp. 25-35, is the best source on the hull remains, although individual campaign reports in *AJA* provide most of the same information.

¹² G. F. Bass and C. Pulak, personal communication. The original estimate of eight to ten tons has been revised upward with the discovery in 1991 that the cargo of copper ingots is much larger than previously thought.

¹³ The underside of the keel is as yet inaccessible, but Cemal Pulak reports that the keel does extend below the outboard surface of the garboard.

¹⁴ Compare the joinery of the Madrague de Giens vessel, an enormous amphora carrier of the mid-first century BC: A. Tchernia, P. Pomey, A. Hesnard *et al.*, *L'épave romaine de la Madrague de Giens (Var) (Campagnes 1972-1975)* (= *Gallia Supplement 24*), Paris 1978, pp. 78-80.

ranean ships was from the end of the fifth century BC¹⁵; although widely spaced, unpegged mortise-and-tenon joints were characteristic of Egyptian riverine boatbuilding since the Old Kingdom¹⁶. Pegged mortise-and-tenon joinery was known throughout the Mediterranean by the Roman era and remained a primary feature of seagoing ship construction in the region until Byzantine times. Although the nationality and builder of the Uluburun ship are as yet unknown, the cargo, personal effects, and find spot all strongly suggest that the ship was involved in trade with the Aegean¹⁷ and thus that Mycenaeans might well have been acquainted with this form of construction. Homer's description of the boat built by Odysseus has been interpreted as describing both this method of construction¹⁸ and stitched or lashed construction, possibly similar to that seen on a series of Classical wrecks from the western Mediterranean¹⁹.

In any case, the Uluburun remains demonstrate that as early as the fourteenth century BC, some shipbuilders in the eastern Mediterranean were not only familiar with pegged mortise-and-tenon joinery, but relied on an already sophisticated form of it in the primary structure of their hulls. This method of construction is slow and labor-intensive in comparison to other methods of wooden ship construction in use in the West today, but as we have no knowledge of alternatives available to craftsmen of the period, it is not possible to judge how great an improvement it represented at the time. Mortise-and-tenon joinery produces a strong, rigid, although heavy, hull, but it limits hull forms to relatively easy curves.

¹⁵ C. J. Eisemann and B. S. Ridgway, *The Porticello Shipwreck: A Mediterranean Merchant Vessel of 415-385 B.C.*, College Station, Texas 1987, pp. 10-16.

¹⁶ P. Lipke, *The Royal Ship of Cheops (BAR International Series 225/National Maritime Museum, Greenwich, Archaeological Series 9)*, Oxford 1984, pp. 104-121; D. C. Patch and C. W. Haldane, *The Pharaoh's Boat at the Carnegie*, Pittsburgh 1990, pp. 27-43; C. W. Haldane, «Boat Timbers from El-Lisht: A New Method of Ancient Egyptian Hull Construction», *Mariner's Mirror* 74, 1988, pp. 141-152.

¹⁷ Bass (*supra* n. 11), «The Construction of a Seagoing Vessel of the Late Bronze Age», pp. 26-28.

¹⁸ L. Casson, «Odysseus' Boat (*Od.* V, 244-257)», *AJP* 85, 1964, pp. 61-64.

¹⁹ S. E. Mark, «*Odyssey* 5.234-53 and Homeric Ship Construction: A Reappraisal», *AJA* 95, 1991, pp. 441-445 argues convincingly for a laced or sewn construction, although Hocker believes that Mark places too much emphasis on the sequence of construction. On the other hand, Mark's flat insistence that both the Greeks and Syro-Canaanites of the Bronze Age were familiar with pegged mortise-and-tenon joinery cannot be directly supported by the evidence, nor can his claim that such joinery requires a society that can support full-time, specialized shipwrights (p. 444).

Although the Uluburun remains answer some basic structural questions about Late Bronze Age shipbuilding, they do not provide much help with larger issues of economy and the organization of shipbuilding. The Linear B tablets from Pylos, Vn 46 and Vn 879, if they in fact describe ship timbers, thus present an exciting opportunity to examine Mycenaean shipbuilding from both a technological and an administrative viewpoint. The question that remains is whether these tablets actually refer to ship timbers or to components for some other structure, such as a megaron.

Because the heading is missing from both documents, there is no direct indication of the nature of the contents. Contextual interpretation largely concerns the reading of *ka-pi-ni-ja* in lines 2-4 of Vn 46. This has traditionally been read as *kapnia*, a sort of ceramic chimney, and the remainder of the tablet interpreted as a list of timbers for a building, but van Effenterre suggested that *ka-pi-ni-ja* could be related to *skapbos* in its later meaning of «ship». He then went on to interpret the succeeding entries as different parts of a ship and to try to make sense of the numbers associated with those parts²⁰. Unfortunately, he wrote before nautical archaeology had revealed how different ancient Mediterranean shipbuilding was from modern wooden shipbuilding. While his specific interpretation requires extensive revision to accommodate the knowledge gained from the excavation of shipwrecks such as the one at Uluburun, his suggestion of a nautical context is still philologically acceptable and deserves consideration in any study of Late Bronze Age shipbuilding in the Levant.

Before the interpretation of specific terms can be tackled, something must be said about the purpose of the document as a whole, as this directly affects the relevance of the numbers of items. The tablets are, like many Linear B documents, lists kept at some sort of administrative center. If Vn 46 is a list of ship timbers, there are several possibilities, several with clear parallels in other administrative documents. The most attractive possibility is that (a) Vn 46 is a «cookbook» or «shopping list» of the timbers necessary for the construction of a single ship; this would give some meaning to the numbers of items and suggest a rational organization of the list, based possibly on order of importance or assembly. Alternatively,

²⁰ Van Effenterre, pp. 43-53. On the problems of interpretation of *ka-pi-ni-ja*, see Palaima, pp. 297-298.

(b) the list could be a record of timber given or assigned to a shipwright for use in the construction and repair of one or more ships²¹. It is also possible that (c) the list is a more general order for timbers of certain kinds and sizes (thus Vn 46.2 might be read «6 timbers of sufficient size to make the *a-ti-ta* of a ship»). A fourth possibility is that (d) the list represents an inventory of existing timber stocks identified by the components for which they are intended or suitable. Records of supplies issued to craftsmen survive from contemporary Egyptian dockyards²², and inventories (rather than orders) seem to be the most common form of Linear B list²³. In any case except the first, the numbers probably do not represent the actual quantity of components needed for a single ship, but may reflect general proportions, i.e., a small number of keel timbers, larger numbers of planks, and plenty of tenons, etc.

Regardless of the actual purpose of the document, its most important contribution to the study of Mycenaean ship construction would be as a clear indication of palace interest in the material aspects of shipbuilding. Whether Vn 46 records a unique event, a special project, an ongoing program of state-controlled shipbuilding, or a pervasive elite influence on the shipbuilding «industry» remains to be seen, but if the document records existing stocks rather than a shopping list, it suggests a continuing program of palace involvement in a craft essential to both basic transportation and the supply and exchange of imported goods in a maritime culture. Other Linear B documents from Pylos (the *na-u-do-mo* texts) and Mycenaean Knossos record palace supervision of the personnel involved in building and operating a sizable fleet of ships, but Vn 46 and 879, if read as nautical texts, are the first evidence of palace involvement in the management of «naval stores». This should

²¹ See PY Vn 10 for a clear parallel for alternative (b). Saplings and *a-ko-so-ne* are delivered *a-mo-te-jo-na-de* for use in chariot manufacture.

²² The most intriguing, because of its detail, is papyrus BM 10056, originally published in S. R. K. Glanville, «Records of a Royal Dockyard of the Time of Tuthmosis III: Papyrus British Museum 10056», *Zeitschrift für Ägyptische Sprache und Altertumskunde* 66, 1931, pp. 105-121, 1*-8*; and vol. 68, 1932, pp. 7-41. Like van Effenterre's work on Vn 46 and 879, Glanville's interpretation of the timbers listed in the papyrus predated the discovery of ship remains and thus depends heavily on a modern approach to ship construction. Now that more is known of the technical details of Egyptian shipbuilding, BM 10056 should be re-examined.

²³ For inventories of items described by component elements and/or materials, see the PY Ta series, PY Tn 996, the PY Sh series, and the KN Sk and So series.

come as no surprise, as similar involvement can be seen in other crafts mentioned in the palace texts (e.g., cloth manufacture; armor, chariot and weapon production) but the scale and logistics of timber management are somewhat greater than those of raw materials such as wool.

Specific interpretations of the items listed in Vn 46 and 879 are at best problematical, as the terms lend themselves to a wide range of meanings, and the numbers cannot be relied upon as corroborating evidence. That said, there are some possibilities that bear mentioning. It should be noted that there is little correspondence between the two texts; they share only one or two words, but one of them, *e-to-ki-ja*, is at least one of the terms with a secure etymological explanation. What follows is an attempt at interpretation of the individual terms, but it must be remembered that, just as with the theory linking the items to domestic architecture, our proposals begin with an ultimately unprovable hypothesis about *ka-pi-ni-ja* namely that it can be read as «boat», «ship», or «hull», as opposed to the equally unprovable meaning «chimney». Due to lacunae, some of the terms are uncertain²⁴. The texts are presented below with the most recent readings by Emmett L. Bennett, Jr. (ELB). Variants from the text used by van Effenterre are in italics.

We have in mind a representative ship of the period (LH III B ca. 1300-1200 BC)²⁵ as discussed by Hocker above. We proceed by looking for a bureaucratic logic in the texts. If these texts are orders or inventories, then *a priori* their lists of ship parts might be specified by: (a) order of installation; (b) order of acquisition; or (c) order of structural importance of the elements of the ship(s). Since there are obvious natural sections in the texts of both Vn 46 and Vn 879, it is not illogical to think that these sections might be based on some practical logic:

Vn 46: .1 / .2-.4 / .5-.6 / .7-.8 / .9-.10 / .11-.12 and

Vn 879: .1-.2 / .3-.4.

The text of Vn 879 is in its structure distinct from the text of Vn 46 except for lines Vn 46.9-.10. We should note that Vn 46 and Vn

²⁴ The reader should consult Palaima, pp. 296-301, for a first stage of analyzing these tablets.

²⁵ The exact date of the destruction of the Palace of Nestor at Pylos has now been questioned by M. Popham, «Pylos: Reflections on the Date of Its Destruction and on Its Iron Age Reoccupation», *OJA* 10, 1991, pp. 315-324, who raises the possibility that the major destruction that preserved the tablet archives took place very early in LH III B.

879, although not found together, do belong to the same palaeographical class (Cii), which leaves open the possibility that they might be by the same scribe or by scribes belonging to a bureau dealing with the subject of ships and their materials²⁶.

Vn 46	.0	<i>supra mutila</i>	
	.1	pi- <i>ṛa</i> ₃ -[
	.2	ka-pi-ni-ja , a-ti- <i>ṭa</i> , 6[(ELB)
	.3	ka-pi-ni-ja , e-ru-mi-ni-ja , 4[
	.4	ka-pi-ni-ja , ta-ra-nu-we	12[
	.5	*35-ki-no-o 81 o-pi- <i>ṛa</i> ₃ -te-re	40[
	.6	e-to-ki-ja 23[]-ke-te-re	140
	.7	pi- <i>ri-ja</i> -o , ta-ra-nu-we	6
	.8	qe-re-ti-ri-jo 2 me-ta-se-we	10
	.9	e-po-wo-ke , pu-to-ro	16
	.10	*35-ki-no-o , pu-to-ro	100
	.11	ta-to-mo , a-ro-wo , e-pi-*65-ko	1
	.12	ḫ-ṛu-mi-ni-ja 2 ki-wo-qe	1
Vn 879	.1	a-ti[] , pe-*65-ka	8
	.2	ko-ni-ti-ja-ja , pe-*65-ka	24
	.3	e-to-ki-ja , qa-ra-de-ro	10
	.4	pa-ke-te-re , qa-ra-de-ro	86

Vn 46

.1 pi-*ṛa*₃-[

There is no real clue to the meaning of this word. We should note that, if the preserved line 1 is an entry like those that follow and not somehow part of a heading—which the tablet may or may not have had—then some item must have preceded those which in lines 2-4 are part of the *ka-pi-ni-ja*.

.2 ka-pi-ni-ja , a-ti-*ṭa* , 6[

As with lines 3 and 4, line 2 begins with the presumed word for boat *vel. sim.* (a noun of the -*ia* class later replaced by σκάφος)²⁷. *ka-pi-ni-ja* is read by van Effenterre and others as a

²⁶ See Palaima, p. 300, for a brief discussion of the scribes and locations of tablets dealing with materials for chariot manufacture and repair.

²⁷ An alternative possibility, especially given the alternatives for practical reconstruction proposed by Hocker (see, for example, line 7), is that the term *ka-pi-ni-ja* refers not

genitive singular, thus the line would mean «6 *a-ti-ta* of (for?) the boat [or hull]». An important question here is whether the genitive «of the boat [or hull]» is simply part of the common name for this item or if it distinguishes *a-ti-ta* for a boat from a similar item used for other purposes. A modern parallel for the former might be «boatswain»; for the latter, «ship's biscuit». The use of *ka-pi-ni-ja* at the beginning of three succeeding lines, but not for the rest of the text, is also puzzling. Was the term only necessary for the first three items (not counting *pi-ra₃-[]*), or did the scribe decide after three lines that it was clear enough that the tablet dealt with boatbuilding?²⁸ Unfortunately, *a-ti-ta* itself has no clear etymology. However, it should be noted that it may appear in the first preserved line of Vn 879 (see below). If the order of the list reflects some sort of hierarchy inherent in boatbuilding, it may be that these timbers are either the first assembled or the most important, structurally. It is tempting, in either instance, to read *a-ti-ta* as «keel» or perhaps some other backbone component (posts?).

.3 *ka-pi-ni-ja* , *e-ru-mi-ni-ja* , 4[

The second word was read by van Effenterre as «wales» or «stringers», the principal longitudinal timbers of the ship, although one etymological derivative, *elumniai*, refers to beams (conceptually transverse members), as for a roof. There is no great logical impediment to the shift in meaning, and the mention of beams or thwarts in the next line suggests that *e-ru-mi-ni-ja* may simply refer to a heavy, important timber such as a wale. The root connotation is of something «driven along», suggesting a longitudinal orientation.

generically to «boat», but specifically to the «carved out» structural component of the boat, i.e., the «hull» *vel sim*. The use of *σκάφος* in the sense of 'hull of a ship' is met with first in Herodotus.

²⁸ See the abandonment of the repeated descriptive term *a-ka-na-jo* in the middle of the fourth entry on Cn 328, a tablet with ten subsequent entries. Working against this explanation of *ka-pi-ni-ja* on Vn 46 are the facts that: (a) entries in lines 5-12 do not have formats parallel to the format in lines 2-4 (as is the case on Cn 328); (b) at least one subsequent term in the genitive (*pi-ni-ja-o* in line 7) fills the same slot as *ka-pi-ni-ja*; and (3) *ka-pi-ni-ja* does not occur in the first preserved line of the text. The third point would not be so critical if one could establish that line 1 were part of the heading of Vn 46.

.4 ka-pi-ni-ja , ta-ra-nu-we 12[

ta-ra-nu-we (from θρᾶνος) has an accepted nautical meaning of «benches» for rowers, but here probably refers to beams or thwarts, the ultimate origin of rowers' seats. The genitive *ka-pi-ni-ja* and the high position in the list suggest that these *ta-ra-nu-we* are some of the principal timbers of the hull, rather than mere thwarts. If we accept that the schematic iconographical evidence is reliable, it is entirely reasonable to assume that these beams are the principal transverse members tying the sides of the hull together. As there is as yet no hard evidence for well-developed frames in the Late Bronze Age²⁹, Mycenaean ships may have resembled the Middle Kingdom Dashur boats in structure. These consist of a frameless, edge-joined shell reinforced by a series of thwarts or beams at the sheer³⁰.

.5 *35-ki-no-o 81 o-pi-~~ra~~₃-te-re 40[

There are no etymological indications of the meaning of the former term, but the latter has the meaning «fittings on». This could refer to fastenings of some sort, such as the tenons of mortise-and-tenon construction, or it could refer to a component added to the hull after the primary structure had been defined. Van Effenterre, who worked with a reading of the second word as *o-pi-te-te-re*, translated it quite directly as *epithēteres* and suggested a nautical meaning of «frames»³¹. The numbers of both items in line 5 suggest either that large quantities of them were required or that large quantities could be acquired or stockpiled, but one should not make too much of the apparent proportion of 2:1³². If Vn 46 is a list of ship timber, then at least one of the entries should be for planking or stock suitable for planking, probably in large quantity. Based on its position high in the list, directly after the major components of the *ka-pi-ni-ja* (and its recurrence with a modifier in

²⁹ Some of the models show transverse banding on the interior, but Hocker cautions against making too much of this. There are no frames preserved in the excavated portions of the Uluburun hull, but this is a relatively small area. Cemal Pulak reports that excavation in 1991 revealed the end of a heavy timber lying athwartships, but it may only be more rough lumber, as has already been found.

³⁰ C. W. Haldane, *The Dashur Boats*, M.A. thesis, Texas A&M University, pp. 16-19.

³¹ Van Effenterre, p. 49.

³² Palaima, p. 299.

line 10), a case could be made that *35-*ki-no-o* denotes planking stock, but the exact meaning of *o-pi-ra₃-te-re* is clouded by its broad etymological meaning. Line 5 and lines 6, 8, and 12 each list two distinct items. Does the juxtaposition of items imply some relationship between them (cf. items and terms in PY An 607 and Vn 10)?

.6 e-to-ki-ja 23[]-ke-te-re 140

The etymological derivative of the first term (*e-to-ki-ja* = *en-toikbia* «fittings for insertion in walls» has to do with pieces fixed in a wall. If the «wall» is here construed as the side of a ship, these 23 pieces could be any of a number of timbers: planks for the sides, or tenons, which are quite literally «fixed in the wall». They could also be thole pins, or pieces of a caprail. The second word is less enigmatic, as it may be plausibly restored as *pa-ke-te-re* (from πῆγνυμι), some sort of fastening elements. Since a number is given, it is assumed that these are discrete units rather than a length of cord. If such is the case, these could be tenons, tenon pegs, or other fasteners, such as were used to fasten frames and planking together. The problem with the interpretation is tied closely to the nature of the document as a whole. If this is simply an inventory, it is very thorough to count the exact number of items such as fastenings. Could this be an indication that these fastenings were somehow special, e.g., that they were made of some expensive material, such as metal? This is not at all a necessary hypothesis. Mycenaean bookkeeping is marked by meticulous attention to exact details and numbers, since the control and handling of products and materials involved personal responsibility, and a knowledge of specific quantities was needed for allocation, delivery, or distribution. Round numbers are generally reserved for production targets or taxation quotas. However, the general impression left by a study of tenons from ancient ships is that they could be easily produced in relatively large numbers, so there seems to have been no need to keep a large or long-term supply on hand. On the other hand, the Ma'agan Michael ship, wrecked on the coast of Israel in the late 5th century BC, was carrying a relatively large number of unused, partially finished tenons³³. Perhaps this entry in Vn

³³ E. Linder and J. P. Rosloff, personal communication.

46 does not refer to the number of finished items, but the number of pieces of wood suitable for making fasteners³⁴. If the list is a «cookbook», then 140 tenons or pegs are not nearly enough even to build a small vessel in the style of the Uluburun ship. In Hocker's opinion, this entry is the best evidence that this list is not a complete list of the components for a single ship, as van Effenterre supposed.

.7 *pi-ri-ja-o* , *ta-ra-nu-we* 6

Here again is the word for «bench» or «beam» (from θρᾶνός) but preceded by a qualifying noun in the genitive (*pi-ri-ja-o* = *phliāōn* «door-posts») with a general meaning of «posts». Even without discussing the precise nuances of *pi-ri-ja-o*, it is clear that these beams are differentiated from those «of the hull» (*ka-pi-ni-ja*) in line 4. Thus *pi-ri-ja-o* must refer to some other parts of the ship requiring seats or beams. Representations indicate that Mycenaean oared ships often had raised platforms in the bow and stern (apparently directly against or fixed to the stem and sternpost) on which men could stand. The representations, which are admittedly extremely schematic, suggest that these platforms were open or only lightly built. If such is the case, the beams used to support these light decks should have been of smaller scantling than those lower in the hull and thus distinguishable from them. On most later ships with multiple levels of beams and/or decks, the beams do tend to decrease in scantling higher in the hull. Can *pi-ri-ja-o* be construed to refer to these structures? If so, perhaps the best reading of this line is «6 beams [thwarts, seats] of the correct size for the castles».

.8 *qe-re-ti-ri-jo* 2 *me-ta-se-we* 10

While there is no indication of the meaning of the first term, the second denotes intermediate pieces (cf. the *me-ta* element). Van Effenterre and Palaima suggested that these might be intermediate or half-frames between floor timbers³⁵. This is entirely possible, if frames existed at all. Framing timbers must be curved, and the curves for floor timbers and half-frames (the

³⁴ Compare *a-ko-so-ne* on PY Vn 10, probably meaning «pieces of wood for axles» delivered by woodcutters to the chariot assemblers.

³⁵ Van Effenterre, p. 49; Palaima, p. 300.

normal components of Classical and later Mediterranean ship-building) should be distinctly different, so that even in an inventory they might be distinguished.

.9 e-pō-wo-ke , pu-to-ro 16

There is neither etymological nor contextual evidence for the meaning of the first word, but the similarity of lines 9 and 10 to the formulaic pattern of Vn 879 suggests the possibility that *pu-to-ro* is a kind of wood. If so, the lack of other such designations in the rest of the text implies that *pu-to-ro* was an unusual material used specifically to make *e-pō-wo-ke* and *35-*ki-no-o*. Problematical is the form *pu-to-ro*³⁶. *Docs*² conjectures that it is perhaps a genitive plural. This would make it less likely that the item was a material and would make us think of another alternative: *pu-to-ro* could refer to a subsidiary structure for which the two sets of items (*e-pō-wo-ke* and *35-*ki-no-o*) were intended. *pu-to-ro* would thus be parallel to *ka-pi-ni-ja* in lines 2-4 and *pi-ri-ja-o* in line 7 (which also provides a parallel for a subsidiary structural element in the plural). However, the variation from the established pattern of listing the subsidiary structural elements in first position in four of the preceding lines (2-4 and 7) is troublesome; and thus the parallel with the pattern of Vn 879 has more to recommend it. The form itself could be a consonant stem genitive singular (parallel to *pe-**65-*ka* interpreted as «of pine» in Vn 879.1-.2) or it and the items *pe-u-ka* and *qa-ra-de-ro* in Vn 879 could be explained as «nominatives of rubric» or «unmarked» lexical elements in a list.

.10 *35-ki-no-o , pu-to-ro 100

This is the second mention of *35-*ki-no-o*, here distinguished from the occurrence in line 5 by the qualifying term *pu-to-ro*. The quantity is similar to that in line 5, where it was suggested that it might mean planking stock. If this in fact is the case, then the planks of line 10 are either for some other purpose or of some other material.

³⁶ The same problems apply to the equally ambiguous form *qa-ra-de-ro* in Vn 879.3-.4, for which *Docs*² simply conjectures «Possibly name of a material?» without commenting on its case or number.

.11 ta-to-mo , a-ro-wo , e-pi-*65-ko 1

This is apparently a complex description of a single element. Etymological derivatives for the first and last terms are σταθμός and ἐπίζυγος, suggesting the ideas of «standing» and «being attached». Could this refer to a maststep, which in later Mediterranean vessels was a single, heavy timber to locate the heel of the mast?

.12 e-ru-mi-ni-ja 2 ki-wo-qe 1

As in line 3, the first entry refers to items that are «driven along», here 2 as opposed to 4 in number. The second entry means «and the column», presumably describing either a mast or possibly a heavy stanchion. If the juxtaposition of these terms does indeed imply a structural relationship, the *e-ru-mi-ni-ja* may be longitudinal supports for the mast, the maststep, or the partners (the structure higher in the hull that provides much of the horizontal support to the mast).

The arrangement of the text as a whole also suggests possibilities of interpretation. The use of *ka-pi-ni-ja* in lines 2-4 strongly implies some sort of internal organization. It is possible that these lines refer to the primary structure of the hull, with later lines listing components of a more general nature and for secondary structures, such as the raised fore- and afterdecks seen in contemporary representations. Line 7 would seem to support such an interpretation³⁷. The text would conclude with the mast (and its supporting elements) for a single ship.

Vn 879

.1 a-ti[], pe-*65-ka 8

Based on the parallel position and similar quantity in line 2 of Vn 46, the first word might be restored as *a-ti-ta*. *pe-*65-ka* is read «of pine», indicating that the *a-ti-ta* and *ko-ni-ti-ja-ja* of line 2 were both made of pine. Pine is a common shipbuilding wood in the Mediterranean from ancient to modern times,

³⁷ Lines 9 and 10 would also support this idea, if *pu-to-ro* were a part of the ship, rather than a type of material. But see the discussion above which prefers the latter alternative.

although its use in the Bronze Age is not yet attested by archaeological evidence (Egyptian ships tend to be built of cedar and a wide variety of local woods, while the Uluburun vessel is built primarily of fir).

- .2 ko-ni-ti-ja-ja , pe-*65-ka 24

It should be pointed out that *ko-ni-ti-ja-ja* (presumably a nominative plural in -αιο-) are new elements not appearing in the long list on Vn 46. This would imply: (a) that Vn 46 is not a complete «shopping list» or inventory of all necessary parts for a single ship or (b) that Vn 879 contains supplemental elements, or (c) that the items on Vn 879 have to do with another kind of ship.

- .3 e-to-ki-ja , qa-ra-de-ro 10

- .4 pa-ke-te-re , qa-ra-de-ro 86

It may be suggested that *qa-ra-de-ro* is another type of wood (etymologically undetermined) based on parallelism with the structure of lines 1 and 2 (cf. n. 35 and related discussion). It may also be significant that the two items made of this wood, *e-to-ki-ja* and *pa-ke-te-re* from lines 3 and 4, are noted together on line 6 of Vn 46 (following the reasonable restoration of the second word there) in approximately similar proportions as are listed here. If either of these terms denotes tenons for mortise-and-tenon joinery, then *qa-ra-de-ro* should be a hardwood, preferably oak, the dominant material for tenons outside of Egypt; the tenons in the Uluburun ship are of oak.

To sum up, while there is no incontestable internal evidence that the tablets describe shipbuilding materials, such an interpretation requires neither far-fetched explanations nor the mangling of etymology and syntax. The true nature of these tablets will only become known through the discovery of the heading for Vn 46 or of comparable texts from other sites (like Khania: a major center of trade and industry in mid-III B that has now produced significant finds of Linear B tablets³⁸). Still the possibility that these lists describe shipbuilding forces ship historians working in the period to

³⁸ See E. Hallager *et al.*, «New Linear B Tablets from Khania», *Kadmos* 31, 1992, 61-87.

re-evaluate the iconographic and archaeological evidence and to approach it in a new way³⁹; and historians of technology should be intrigued by the possibility that an administrative system for the management of timber supplies for shipbuilding existed over three thousand years ago.

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³⁹ Hocker notes that after staring at these words for quite some time, he has no strong intuitive preference for the texts referring to ship architecture rather than house architecture. It should be worthwhile for experts in Mycenaean palatial architecture to examine these texts anew.