THE BOATBUILDING INDUSTRY OF NEW KINGDOM EGYPT

A Thesis
by
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THE BOATBUILDING INDUSTRY OF NEW KINGDOM EGYPT

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ABSTRACT

The Boatbuilding Industry of New Kingdom Egypt (August 1990)

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This study interprets the evidence pertaining to the construction of ships and large, secular craft during the New Kingdom period (ca. 1570-1070 BCE) of Egypt. It is the author’s intent to contribute in two ways: first, a summary of the information gathered over the last hundred or so years is needed; secondly, a more sober perspective is offered, thanks to the advances made by nautical archaeology in the past few decades. Specifically, information gained from the excavation of a Late Bronze Age wreck at Ulu Burun, Turkey, is frequently compared to the Egyptian material. Four areas are examined independently: first, the personnel, tools and techniques of timber collection are studied via ancient texts; secondly, the workplace, viz. the dockyard workshop, is looked at from the perspective of existing tools, texts and depictions; thirdly, the much-debated role of Egyptian seafaring is addressed in light of the constructional features of boats that appear in art and models; finally, the position of the boatbuilding class in Egyptian society is accessed by means of ancient texts. Egyptian terms relevant to this topic and a list of timbers that may have been employed are provided in appendices. Broadly speaking, it can be concluded that a class of state-employed men, women and children near Memphis were responsible for building ships and boats within a highly organized system. Furthermore, the workplace and technology, though they evolved over a thousand-year period, underwent changes in the New Kingdom, probably instigated by contact with Canaan, the Aegean and Cyprus, that resulted in the adoption of the keel. As regards the social position of the boatbuilding class, it fell somewhere near the bottom of the socio-economic hierarchy.
DEDICATION

This thesis is dedicated to my family (Mom, Dad and Jon), to my "family" in Texas (Marilyn, Ron, Ann, Dan and Gretchen), and especially to Jeanne.
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CHAPTER I
INTRODUCTION

Review

Egyptology has separated the history of pharaonic Egypt into several periods that are, albeit artificially imposed to facilitate our studies, based on real events that brought about major changes in Egyptian society. Of course, anyone attempting analyses within a particular epoch must perceive his subject as the product of an evolutionary process. This author realizes that a study of the boatbuilding industry in New Kingdom Egypt (ca. 1570-1070 BCE) must be cognizant of the development of this industry through the Old Kingdom, First Intermediate, Middle Kingdom, and Second Intermediate periods (ca. 2700-1550 BCE). Therefore to concentrate mainly on the New Kingdom (hereafter NK) requires some form of justification, since earlier developments will be mentioned only summarily where a historical parallel, or anomaly, exists.

One justification is the simple fact that we do not currently have enough evidence concerning the construction of merchant or travelling craft to support any broad or evolutionary theories. The public and academic sectors could easily be misled by articles claiming that Egyptian ship construction is somehow explained by the discoveries of the funerary craft of Sesosiris III and Cheops.¹ That false belief must be disenfranchised if our knowledge in this area is to progress. The painful truth is that we are still in the dark when it comes to understanding Egyptian ships or boats. This is not to say that the information in the hulls from Giza and Dashur will not help us in trying to understand the Egyptian shipwright’s mind; it will, if taken in the proper doses. It is the scholar’s responsibility to resist the narcotic effects these vessels cause while other, less inspiring, evidence is overlooked. The method is painstaking, and so it seems logical to divide the task chronologically, considering the evidence in its own historical context as much as possible.

A second, perhaps more important, justification for such a historico-specific study is the assumption that changes occurred from period to period not only in

This thesis follows the format of American Journal of Archaeology (AJA).
society as a whole but also in the boatbuilding industry. This assumption will be demonstrated throughout the thesis by reference to changes occurring in the Old, Middle and New Kingdoms.

Against that assumption must be balanced a complementary assumption—that certain practices continued relatively unchanged throughout the pharaonic period. Thus it is often valid to fill the gaps in knowledge with historical analogies, although these constructs will be carefully pointed out in an attempt to disarm the trap of circular logic. The concern here is that if any broader history of Egyptian boatbuilding follows, it should not be erroneously supported by statements which are themselves based only on broad historical analogies or extrapolations. As complex as our current problem is, it would serve us well to review briefly the types of evidence we have at our disposal.

The most direct evidence of boatbuilding in Ancient Egypt is existing hulls. From the Old Kingdom (ca. 2700-2200 BCE, and hereafter referred to as OK),2 the preserved barge of a Dynasty IV pharaoh, Cheops (ca. 2600 BCE), is the earliest intact example of the boat builder’s capability to turn timber into a vessel that may or may not have been intended for use on the water.3 Constructional attributes include planking scarves, deck beams, edge-to-edge plank lashing, framing, meticulous and labor-intensive use of carving, central shelf for longitudinal stability, and battens.

The construction of funerary craft from Dashur that date to the reign of a Dynasty XII pharaoh, Sesosiris III (1878-1840 BCE) of the Middle Kingdom (1990-1780 BCE, and hereafter referred to as MK), has also been studied.4 Dovetail fastening, through-beams, thick central plank for longitudinal stability, and planks joined edge-to-edge with mortises and tenons are central features in what could be loosely called a shell-oriented building philosophy. The timbers found at Lisht that also date to the MK contribute the earliest evidence of pegged mortise-and-tenon joinery in Egyptian boatbuilding.5 No examples of actual rigging are known from the OK, First Intermediate, MK, Second Intermediate, or NK periods, but the pictorial evidence is rich in this regard.

The archaeological record has yielded no hull remains that can be dated to the NK in Egypt. However, contemporaneous hull remains have been discovered on the
seabed at Ulu Burun, Turkey, and although it is premature to suggest how these hull remains reflect NK Egyptian boatbuilding, it is not inordinate to say that a technological connection or influence is possible. The lack of hull remains in Egypt that date to the NK compels us to consult other forms of evidence.

Tomb reliefs and paintings that depict boatbuilding yield some evidence of the boat builder’s art. Such evidence exists that dates to the OK and MK periods, but is non-existent in the NK. Why there is no representational art depicting boat construction during a period abounding with scenes of everyday life is an interesting question that has previously gone unaddressed.

Sailing craft depicted on tomb walls and monumental architecture of the NK strongly suggest to us forms the boat builder may have had in mind. Much descriptive literature has been published about the boats depicted in Hatshepsut’s funerary complex at Deir el-Bahari. Studies of the naval battle depicted at Medinet Habu have also been made. Basch’s recent study of the mns ship, as depicted in various contexts in Egypt, is also of interest. Literature is plentiful that discusses the dozens of sailing craft depicted on the walls of rock-cut tombs. Wreszinski’s compilation of tomb depictions and Vandier’s study of depicted wooden boats are both important but leave many aspects of boatbuilding unconsidered. Landström, among others, has put forth reconstructions of these vessels that are not entirely satisfying. These authors are certainly not careless; it is the lack of direct evidence for boatbuilding which makes it difficult to write authoritatively on the subject. The current author is in a better position to interpret artistic evidence than previous students of NK boatbuilding mainly because of the new information brought to light by nautical and terrestrial archaeology; much more is now known about ancient boatbuilding thanks to projects of the past quarter-century.

Models of boats dating to the NK exist but so far have not received due attention in print. Daressy published boat models from the tomb of Dynasty XVIII pharaoh Amenhotep II (ca. 1450-1425 BCE). An analytical study of the boat models found in the tomb of Tutankhamun (ca. 1347-1339 BCE) is still lacking. These models contain a wealth of evidence for hull structure, rigging, and steering, some aspects of which have been recognized by Landström.
Administrative texts, especially dockyard lists, and seafaring tales supply us with many clues to the types of timber, tools, construction features, method, and bureaucracy involved in NK (NK) boatbuilding. Glanville's translation of lists from a royal dockyard is one of the most important pieces of evidence for several aspects of boatbuilding. Critical re-examination of this document is needed to interpret its meaning properly, since Glanville's interpretations are founded partially on tenets about Egyptian watercraft that may no longer be acceptable. This particularly concerns his definitions of specific boat parts and assembly sequence.

The use of tools in boatbuilding is well understood for the OK and MK periods through preserved tools, tool models, and representational art. There are many scenes of tool use that date to the NK, but not one that depicts their use in hull construction. Likewise, no existing tools of the period have been excavated from a boatbuilding, archaeological context (i.e., a dockyard), except for the possible exception of those found on two Late Bronze Age wrecks off the Turkish coast. However, wood-working tools are well represented in the archaeological record of the NK, and there is enough parallel evidence from earlier periods, other regions and related industries using the same tools to support some statements about the tools of the NK boat builder. The works of Petrie and Deshayes stand out among the principal sources of information about wood-working tools. Sufficient commentary on the manufacture and maintenance of wood-working tools exists, although there is much debate over the forms and function of some types. Tool-use in related industries (e.g., furniture and chariot manufacture) is also well documented and helps determine the limits of carving and joining with these tools.

There is much that needs to be synthesized regarding Egyptian sources of boatbuilding materials, particularly timber. Nibbi addresses the question of Egypt's timber resources with a fresh, albeit subjective, perspective. She decries the dogma that has pervaded previous studies and calls upon modern forestry, archaeobotany, and palynology to set the record straight. Despite her efforts, certain aspects are still left unresolved. Therefore, an up-to-date synthesis of materials should be made, incorporating Nibbi's findings with textual sources such as Theophrastus, who has much to say about the pre-industrial environment and industries of Egypt.
authors have analyzed the ancient reports to determine their objectivity and reliability. The current author has not seen a timely work on NK boat materials but offers the available evidence in an appendix in tabular form. The current obstacles before this particular project are inadequate identification of species in wooden artifacts and the wide geographic distribution of many wood species.

Approach

This thesis aims to define a subculture of a larger entity known as Egyptian civilization. Scientific archaeology has taught us that no culture can be defined outside of its own environment, or context. Archaeologists interpret the material culture of ancient Egypt in the context of the environment of the Nile valley and how humans applied technology to this environment for their own benefit. Following that model, this thesis interprets the boatbuilding subculture in the light of a particular technology and the raw materials which the environment offered to those involved in boatbuilding. So instead of occupying ourselves exclusively with the problems of how certain sailing watercraft were constructed or where they were sailed, this student feels it is timely to reexamine the evidence for the industry that produced the vessels. Therefore this thesis focuses not immediately on the techniques of construction or the boats themselves, but is conceived to achieve initially a better understanding of who and what the interacting factors were, i.e., the society and technology that produced these wooden sailing vessels.

There is a two-fold purpose in this approach. The first is to gain some insight into the mind of the NK shipwright and the system within which he worked. Knowledge of that system could have applications going beyond Egypt. As archaeology progresses and we learn more about boatbuilding industries throughout the Late Bronze Age (LBA) Mediterranean World, knowledge of the NK industry may facilitate explaining the similarities and differences exhibited among the various systems, since the LBA and NK periods are roughly contemporaneous. Furthermore, there is good reason to believe that Egyptian shipbuilding technology was influenced by foreign methods brought from as far away as the Aegean. This is important to bear in mind, since we will draw on evidence of boatbuilding that comes from the
shipwreck at Ulu Burun, Turkey. However, one must be prepared to accept that the
shipwreck at Ulu Burun, in its final analysis, may also tell us little or nothing about
Egyptian methods.

The second goal is to revise current conceptions of how NK ships were built and
sailed through consideration of the available archaeological, pictorial, and textual
evidence hitherto unexploited to its logical end. This revision should provide a
sounder foundation for future arguments concerning Egyptian seafaring.

As for construction techniques, two topics will be addressed: the appearance of
the keel in NK times and the method of rigging (this entails a description of several
constructional features). This student feels that current available evidence does not
warrant opening fresh debate in other topics concerned with hull construction.
Likewise there is no point in adding further descriptive literature to an already
sufficient base until new evidence comes to light.

In order to gain understanding of the boatbuilding industry, it is best to begin by
examining evidence for its personnel. This will illuminate the various duties of the
different professions involved and lead naturally into discussions of the tools and
materials required by these professionals.

As a final preface, the reader should remember that for the sake of cohesiveness
and relative brevity this study is limited to wooden vessels of secular and practical
functions only, and one should automatically equate any instance of "boat," "ship,"
etc., to this limited definition.

Wooden boats of the NK as depicted by paintings, reliefs and wooden models
represent the zenith of technology at that time. The collective labor of many
individuals from numerous industries (e.g., wood-collecting, wood-cutting, rope-
making, anchor-making, etc.) contributed to the construction and outfitting of these
craft. To define the profession of every individual even remotely involved with the
construction of a ship could soon lead us away from a discussion concerned ultimately
with seafaring. A similar quandary might befall one today if asked to describe the
jobs of everyone involved in the launching of a space shuttle, our modern
technological acme. The ship and shuttle are analogous because their construction
draws energy from every sector of industry. For cohesiveness, explanations of the
professions of those involved with wooden boatbuilding will therefore be limited to personnel working in, or in the service of, the dockyard workshops; the tasks of those tangentially involved in boatbuilding will be described but in a less painstaking manner.
CHAPTER II
TIMBER COLLECTION

The logical first step in wooden boat construction is the procurement of timber and other raw materials necessary for boatbuilding. The NK has left us with little explicit technical information on this subject when compared to other periods. There are no archaeological sites related to wood-gathering in Egypt—or anywhere else for that matter— from the Bronze Age. We have well-preserved tools and materials from the NK but none from a context that suggests how they were used in the harvest of ship timber. Unlike the period between the OK and MK, in which there are scenes picturing the preparation of timber for boatbuilding,33 not a single NK scene is known where tree-felling or timber preparation is depicted alongside boatbuilding;34 in fact, boatbuilding is not depicted at all in scenes dated to the NK. Several questions are left unanswered by this strange gap in the otherwise richly-illustrated everyday life of the NK Egyptian. We would like to know what species of wood was selected and how it was felled, brought to the construction site, prepared, etc. The present chapter will establish who were the people responsible for these tasks and how they carried them out with the technology of the day.

Lumberjacks were called ẖd-ḥt in the OK,35 while to cut or fell timber was called ẖd or sw3 in at least one NK dockyard workshop.36 It was a physically demanding task probably not endured by those who could avoid it via an education. The attractive jobs—if indeed there were any—in the field of timber collection were held by officials, who were always scribes. In the MK, a dockyard official, the bnv-rt ẖynwty, was in charge of the timber supplies.37 NK sources mention no such title within the context of boatbuilding, though this absence may be explained simply by the nature of the texts upon which we rely. Whereas the MK dockyard lists are purely logistical for administrative purposes, the only known NK texts that cite timber collection are records which served mainly to exalt the pharaoh. For example, the passage quoted below from the Gebel Barkal Stele of Tuthmose III (ca. 1490-1436 BCE) tells us that much timber is being imported; but while we are given the names of certain species of woods (undoubtedly some prized varieties), the system of officials and laborers responsible for receiving it is ignored—naturally, since it would only divert attention
away from the achievements of the pharaoh. The stele reads:

*A wealth of timber comes to me from Kush, consisting of dom-palm baulks and wooden implements without number made of acacia wood of the southland. My army in Kush, which is there in multitudes, has hewn them, except for the shaliyw-ships and transport vessels of dom-palm which my Majesty had carried off in victory. Wood is hewn for me in Djathy each year consisting of real $\frac{1}{2}$-wood of Lebanon, which is transported to the palace, LPH. A wealth of timber comes to Egypt for me, which is taken south... real $\frac{1}{2}$-wood of Negu of the choicest of God's Land and fully grown, spars like firm alabaster for issue to the Residence without the season thereof having been missed (in) any year. My army which is in garrisons in Ullaza comes... which consists of $\frac{1}{2}$-wood (obtained by means of) the victories of my Majesty, in accordance with the designs of my father, Amun-Re....*\(^{38}\)

Given the self-laudatory nature of such historical records, we would expect many specific aspects of timber collection not to be mentioned therein. Therefore one can hope that evidence for an officer in charge of timber supplies during the NK is still awaiting discovery. For the present, we can examine the duties of one who actually collected the timber, viz., the *pry*, whose labor was performed outside the bounds of, but in the service of, the dockyard workshop. From the evidence below it seems likely that the *pry* was supervised by either a timber supply officer or the shipwright in charge of a particular project.

Information regarding the *pry*’s job comes to us from Papyrus Lansing (20th Dynasty, ca. 1200-1090 B.C.E.), the explicit testimony of which is as follows:

*His [the shipwright’s] outworker who is in the fields, that is tougher than any profession. He spends the whole day laden with his tools, tied down to his tool-box. He goes back to his house in the evening laden with the tool-box and the timber, his drinking-mug and his whetstones. But the scribe, it is he that reckons the produce of all those.*\(^{39}\)

Several points in this passage are worthy of discussion. First, we have the term "outworker," Caminos’ translation of *pry*, literally "a goer forth."\(^{40}\) This term is not found in the records of one well-known NK dockyard,\(^{41}\) but this should not be surprising if a *pry* indeed conducted most of his business outside the dockyard. In a late MK dockyard workshop’s records this term has followed two shipbuilding titles, " overseer of the carpenters of the shipyard" and "ship’s hand," both of which suggest a stronger affiliation to the internal operations of the dockyard workshop.\(^{42}\) Its occurrence there as *pr*(y) nb-\(\dagger\), i.e., "Neb-yot, the *pry*-worker," gives us only a name to
identify with the position, since Neb-yot’s duties in this context are unclear; Simpson thinks Neb-yot’s role might have been administrative to some degree.\textsuperscript{43} However, since the occurrence of p\textit{ry} after an administrative title does not necessarily imply that the \textit{p\textit{ry}} was an officer, or scribe,\textsuperscript{44} we must view the matter as inconclusive, although the contemporaneous evidence of Papyrus Lansing strongly suggests a manual, subservient role for the \textit{p\textit{ry}} in the NK.

"In the fields" connotes several possible definitions, depending on the specific workshop or project, and suggests to us two principal roles for the outworker: timber collector and wandering shipwright. For the present, we will consider the former role. "In the fields" could certainly imply a harvesting of timber within the vicinity of the dockyard, as is suggested by our example above. This assertion is not dependent on the assumption that Egypt had indigenous timber resources for boatbuilding (a much-debated issue with no current resolution), but merely accepts the possibility that timber could be gathered in the local vicinity, if not from standing trees, then at least from scrap sources such as an old boat referred to in Papyrus Anastasi IV\textsuperscript{45} or from commercial sources.\textsuperscript{46} In "The Tale of Two Brothers," we are witness to a worker who is sent into the fields near his home each day to gather, among other things, wood.\textsuperscript{47} The worker does not bear the title \textit{p\textit{ry}}, but he does gather wood close to an Egyptian residence.

A second possible sense of "in the fields" is that of an expedition such as undertaken by Wenamun, not a \textit{p\textit{ry}}, \textit{per se} but nonetheless an official sent into the field to obtain lumber, in this case for Ramesses IX’s (ca. 1075 BCE) river bark of Amun.\textsuperscript{48} The idea of an outworker going off to foreign lands to work on a pharaonic preserve as a sort of seasonal or migrant worker is well suited to the stated undesirability of the job; Egyptians greatly feared living or dying in a strange land. The relief at Karnak showing princes of Lebanon felling \text\% timber (also for a sacred bark) for Seti I (ca. 1302-1290 BCE) illustrates some of the techniques that may have been practiced by outworkers stationed "in the fields" of far-away Yenoam (fig. 1). We will discuss in greater detail the tools of the outworker below, but here one should note the techniques employed in bringing down large trees. Two men with axes\textsuperscript{49} are chopping down a tree; the stooping man appears to be doing the heavy
work with his double axe (?) while the erect man trims off the lower branches with his simple axe (probably socketed). They are assisted by two men with ropes who are ingeniously using a neighboring tree as a pulley to ease the fall of the cut tree with a long rope.

A different sort of "fieldwork" for those who gathered timber is also alluded to in the Wenamun report. After much diplomacy, Wenamun convinces the local prince of Byblos to bear the costs of shipping some timber (fir or some other conifer)\textsuperscript{50} to Egypt but with the prince's great resistance to the appallingly high price.\textsuperscript{51} These costs included new yards, ropes and br boats for the return sea voyage to Egypt.\textsuperscript{52}

There is not enough evidence to state unequivocally whether the timber was actually loaded into the ships, towed in barges, or towed in the water.\textsuperscript{53} However, it is reasonable to rule out the last possibility, since the wood was stacked on the shore and dried out for the duration of the Byblian winter,\textsuperscript{54} and here we must digress for a moment.

Although the Wenamun passage has previously been regarded as unreliable,\textsuperscript{55} it is logistically well supported by what is known about open-air seasoning of lumber. Internal moisture is released at a faster rate from the sapwood than it is from the heartwood, which causes cracking and splitting to develop from the outside towards
the core, thereby ruining the wood for boatbuilding. This can be controlled by a slow process of open-air drying using gradually increased temperature, gradual humidity reduction and protection from rain. Taking freshly cut timber from Lebanon to Egypt would undoubtedly cause great damage through shrinkage and splitting due to accelerated drying; cutting in the winter when sap content is lowest certainly helps to prevent this. The best way to season in this instance would be to keep the wood in a cool environment for a month or two, thus allowing the moisture to drain out slowly and the changing seasons to increase the surrounding temperature gradually; then the wood could be safely placed in a hot, arid environment for several more months of drying. These are the exact steps which Wenamun seems to have taken. A slow journey over the sea to Egypt would have guaranteed a gradual transition of temperature and humidity, while the remaining period of drying would certainly be less than the 6-10 months recommended by Desch, given the kiln-like environment of Egypt. If we give Wenamun, or Zeferbaal, the benefit of the doubt by allowing that they covered the wood after stacking it on the shore, then one or both of them knew their business when it came to lumber preparation.

It has been established that the timber was being seasoned properly. Wenamun would surely have not wasted this effort by towing the logs through the water back to Egypt. They had to have been carefully stowed on covered barges or boats. We can practically assume then that the extra boats requested of Zeferbaal served as either barges and/or tugs and the requested rope is either for towing the logs behind Wenamun’s mns ship in the br barges, or for the extra boats to tow barges full of timber. Of course, the rope could also have been needed for the rigging of the ships and tying down lumber.

It seems that Wenamun relied on local workers (perhaps outworkers themselves) for manual labor, since he did not bring his own team of outworkers. According to Wenamun, it took 300 men and 300 oxen an entire winter (the pr/tj season) to cut, haul, stack and dry the timber. We can only imagine the difficulties involved in this task, since Wenamun did not report it in detail. Questions such as what kind of timber was cut and at what elevation are difficult to answer unequivocally. The timber is referred to as ḫ, the most ubiquitous word for timber in Egyptian texts, here
taken as "fir." If $'$ means "fir" (or "pine" or "cedar") in this case, then it was probably gathered at over 1200 meters above sea level,\textsuperscript{41} more evidence for the arduousness of the outworker's task.

The organizer of the work party required for filling this particular order of timber for Wenamun was the "the Master of the Forests," or $r\text{hj r nhw}$,\textsuperscript{42} apparently an officer of Zekerbaal. The title belongs, of course, to a Semitic officer, not an Egyptian, but reason dictates that such personnel were part of the normal system through which Egypt obtained imported lumber. It is quite possible that during a period when Egypt's presence in the timber regions was strong (such as the Thutmosid dynasty), this officer would be on the Egyptian payroll or, less likely, replaced by an Egyptian officer. However, there is no certain evidence which supports this assertion.

Returning to the Papyrus Lansing passage, we are informed that the outworker employed by the dockyard "spends the whole day laden with his tools, tied down to his tool-box." It would seem here that the outworker owned his own tools, but when we examine the economic situation of the personnel closely in another chapter, we will see that he probably did not own, but was assigned, his tools. We do not possess an outworker's tool-box, $dbt$ in Egyptian,\textsuperscript{43} but since his duties are known, it is certain that the tools filling it were heavy, in view of the nature of bronze tools we know from the great body of pictorial and artifactual evidence from Egypt and the Near East during the NK. The tool-box would logically be of a form that was easier to carry than the carpenter's wooden tool-box, preferably a sack or basket like those pictured in tombs (fig. 2) or preserved from antiquity,\textsuperscript{44} as a group of tools in a basket from Eighteenth Dynasty Thebes demonstrates unequivocally.\textsuperscript{45} Baskets made by twining, with vertical primary strands widely spaced, as opposed to horizontal coils closely spaced, were appropriate for carrying objects such as tools that would not spill out through the small gaps in the mesh. All native materials (papyrus, palm, grasses, flax) were used, mostly leaves and strands from local plants and fibers. The techniques used in the NK were the same as in earlier periods, dating back to Neolithic times, and about the same as presently used along the Nile.\textsuperscript{46}

An outworker's tool-box or basket must have contained a variety of tools in order
to facilitate the job and fulfill the notion of being burdensome. We can assume that it included the full complement of carpenter’s tools because the outworker not only gathered timber but was also dispatched by the shipwright to procure pieces of certain dimensions and to perform "house-calls" on boats in need of repair. So we must minimally add the adzes, chisels, saws and mallets to the initial requirement of axes and rope (not carried in the basket, of course, but over the shoulder). Add to this "his whet-stones" mentioned in the Lansing Papyrus above and the basket (or chest) becomes heavier. If we understand the forms and functions of his tools, then his trade will become clearer. For now, only the tools that we consider necessary for timber collection will be discussed: axes, rope, oil and whetstones.

One would judge that the **bronze double axe** was a most efficient tool for the gathering of timber. After all, it is a double axe that the goddess Calypso gave to Odysseus to help him build his boat and escape the island. The simple logic that two edges are better than one might be true for two reasons: first, the axe could be used twice as long before being sharpened by alternating the use of the edges; secondly, the edges could be sharpened at different angles so that one edge might be set to chop while the other was set to split. This would certainly be a convenient tool if splitting in the field was necessary.
In fact, double axes are altogether rare in NK scenes, appearing just once (if at all), in the battle relief of Seti I at Karnak (fig. 1, p. 11). This rarity should come as no surprise, since the Karnak relief is the only timber-felling scene of which we are aware that dates to the NK. It likewise does not appear as a weapon in any NK scene, unlike the simple axe that served in battle and wood-cutting. A recent and extensive study of the axe in Egypt shows most clearly that the double axe was never employed within the native boundaries; not one example of a double axe with Egyptian provenance is known. Unfortunately this anomaly has not captured the attention of recent scholarship.

There is no mention of the double axe in dockyard workshop texts and we have no name for the double axe in the NK or late MK, unless it is the same as that of the simple axe, *mdh*b. The fact that no axes of any kind are mentioned in the NK dockyard workshop texts is not evidence that the timber collectors had become more removed from the workshop’s operations. No bronze tools are mentioned in the NK dockyard workshop records, which are concerned mainly with timber dispersement.

Double axes, although not found in Egypt, are represented throughout the Canaanite, Mesopotamian, Cypriot, Cycladic, Helladic, Anatolian, European and Sardinian centers. The curious absence of this tool—a seemingly widespread and useful one—in Egypt during the NK deserves an explanation. There must be a reason why the Egyptians refused to adopt the double axe for their boatbuilding industry. Perhaps the answer can be found somewhere within four areas of inquiry: utilitarian, religious, environmental and technological.

If the simple axe, either lugged or socketed, worked as well as or better than a double axe in timber-felling, then there would be no need for double axes. Considering only the two tool forms, there is no reason to think that a single axe would be any better than the double; the factors of weight, angle of edge and length of handle could be varied in one form as easily as in the other. Therefore one must look for qualities that would make the simple axe as good as the double to continue this proof.

We said above that two edges were better than one because less frequent
sharpening would be needed. Underlying the former point is the assumption that sharpening would be a hindrance because of the time involved and/or the burden of carrying the whetstones. Both these assumptions may not be valid where bronze or copper tools are concerned. First of all, we know that some whetstones were quite portable, possibly worn around the neck on a loop in some examples and therefore easily employed in the field. They would certainly have been used many times on an average day of cutting timber; compared to our modern iron axe, the bronze or copper axes of the NK would dull rapidly when cutting across the grain as is the case in chopping. A double axe with two chopping edges would stay sharp longer than the single, but sharpening it would, of course, require twice the time.

This leaves us picturing one worker stopping frequently for short periods and the other stopping half as frequently for periods twice as long. But who is the more efficient employee? Actually, the limiting factor in efficiency depends as much on the stamina of the worker as on the time a working edge stays sharp. Let us consider the relationship between these two factors in this way: if the edge of a simple axe dulls faster than the worker becomes fatigued, then efficiency is high since the rest obtained by stopping to sharpen would allow the worker to operate at a higher level of energy, i.e. a better pace; on the other hand, if the worker becomes fatigued before his twin edges dull, he is working less efficiently and would probably have to rest for extended periods from time to time. Therefore in the case of bronze or copper tools that dull quickly, it is possible that the simple axe could be used as efficiently for chopping as a double axe.

Another alleged benefit of the double axe as pointed out above is the specialization of edges for chopping and splitting. Given the peculiar absence of double axes in NK Egypt, the ancients either: a) used the same axe for both tasks; b) preferred to use separate axes for the two tasks and carried twice the number of axes into the field, or c) did not split timber in the field and saved themselves the trouble of carrying an extra axe with an edge of larger angle. We have no evidence to support the third option, but the less weighty claim would be that, given the diversity of wood pieces required in boatbuilding and other industries, they must have split logs in the field in at least some cases. If in fact they did split logs in the field, then
even a simple axe with a chopping edge (relatively large angle) would be preferable to a double axe. Anyone who has split logs knows that it often takes more than just one blow with a wide-angle blade to get the job done, especially if the timber has not lost all of its sap yet. Even with seasoned timber, the first blow often causes the axe to stick in the log, which requires that one either pound the axe deeper with a mallet or hammer or invert the axe and log, striking the back of the axe on a hard surface (chopping block) with a second swing. It is obvious that neither of these methods could be employed with a second edge sticking out of the log. In the first case, a hammer or mallet would either be ruined by the edge and/or the edge would be ruined by the hammer or mallet. Secondly, the force of the blow needed to split the log would be greatly diminished as the second edge drives into the chopping block. Of course the use of the double axe in this capacity would also spell the abuse and ultimate ruin of the chopping block.

Thus we see the utilitarian reasons the Egyptians may have had for not adopting the double axe: 1) The single axe could be used for chopping as efficiently if not more so and, 2) Splitting requires a blunt striking surface for the wooden mallets or chopping block, not the second edge of a double axe. They also may have used the same axes for splitting and chopping, as many do today. The question remains as to why the contemporaneous neighboring cultures seemed to find practical uses for the double axe while the Egyptians did not. It is conceivable that the double axe was at the same time practical and symbolic within these cultures and thus heretical to the Egyptians. The possible religious and environmental reasons remain to be considered.

The occurrence of double axes in tool hoards on two Bronze Age wrecks and on Crete suggests their practical use as tools. Petrie states that the double axe was certainly a ceremonial object as well as a tool and weapon. Some examples with hafting holes that are too small or non-existent are clearly ceremonial. He makes a clear distinction between the effective and ceremonial types based on the hole, and this reveals that Crete seems to have been a center for this symbol, although the entire Aegean seems also to hold origins for effective types as early as Middle Minoan II (ca. 1800-1700 BCE). Cater also cites the Cretan origin of the
ceremonial double axe and the spread of the effective double axe to Cyprus via Aegean settlers towards the end of the NK in Egypt. Throughout the Minoan rise and decline (ca. 2000-1100 BCE), the double axe was diffused broadly, peaking in Late Minoan I and II (ca. 1600-1400 BCE), but its use in cultic ceremony remained restricted to Crete. In later, Mycenaean times it spread as an effective tool throughout the Mycenaean world and undoubtedly came into contact with NK Egypt via the well-established trade patterns woven amongst the centers of the Eastern Mediterranean during the Late Bronze Age.

Although the double axe is the most common cult object in Minoan civilization, its symbolic meaning is unclear. It has been interpreted as the symbol of the sky-god and the mother goddess. In ceremony it may have served as the instrument of slaughter in the sacrifice of sacred bulls and calves. The Egyptians commonly sacrificed bulls, and their religion is noted for its tolerance of local variation and the assimilation of foreign deities, especially after the beginning of the NK; there is no obvious reason to think that the Egyptians proscribed the use of the double axe on religious grounds. However, there is reason to believe that these other cultures used the double axe for reasons that included the non-practical, whereas Egypt attributed no powers to the form and thus held to the purely secular plain axe.

Are there environmental factors peculiar to Egypt that would negate the usefulness of the double axe? Probably not. If one assumes that, a) Egypt had no major internal timber resources throughout the entire Bronze Age, and b) the double axe was a superior lumbering tool, then one could argue that the double axe was only employed where forests were found, thereby explaining its absence in Egypt. However, since we have already refuted the first assumption and the second cannot be validated, we must conclude that the reasons were mostly utilitarian, religious and environmental considerations notwithstanding. But our explanation is still unsatisfying since it does not explain why the effective double axe is adopted by other cultures as a too, if the single axe was as useful; fetishism is only a guess at this point.

Now if we take a technological perspective, the solution becomes clear for a brief moment before becoming even more elusive. No matter how one considers the double axe—as a weapon, tool, or cult symbol—one must accept that it is a socketed
device. As such, it would have to have been cast in a bivalve, or closed, mold; there is no way to cast such an object in a monovalve, or open, mold. But not only are there no bivalve molds known to have come from Egypt before the Iron Age, there are no socketed tools or weapons either. So we are forced to conclude that the Egyptians did not employ the technique of bivalve casting, and by deduction, that they did not produce the double axe. This conclusion places the current question in a broader context; i.e., we must now ask ourselves why the Egyptians did not use bivalve casting and socketed implements. Unfortunately we are presently in no position to address this question with any rigor, and so must satisfy ourselves with a limited explanation based on utility and technology.

We have spent many words to remain at the fact that the Egyptians did not use double axes in Egypt. However, since the type is known in the Near East, our discussion is not wasted if we accept that they used the double axe on occasion when lumbering in foreign lands.

The axe was the most important tool in the outworker’s basket. Egyptians called the carpenter’s axe mhub throughout the OK, MK and NK. It is less problematic in some ways—but more so in others—than the double axe. To the body of known Bronze Age copper and bronze blades from the Near East have been applied several classification schemes, each with its own definition of what makes an axe an axe; the problem herein lies largely in the difficulty of separating those blades intended for use as axes from blades intended for use as adzes. We could ignore much of the arguments pervading the literature of this debate, since the type of axe used in Egypt in the NK (as well as earlier periods) is peculiar to Egypt; moreover, most of the types commonly used elsewhere in the Near East are altogether absent from Egypt. But one type of blade, the so-called "lugged axe" (Deshayes' Type B) or "lug adze" (sub-type of Petrie’s Type Z) or "lugged axe-or adze" (Maxwell-Hyslop's Type II), occurs in Egypt and is common throughout the Near East, especially the Levant; the question of its use in Egypt and elsewhere for boatbuilding will be addressed after reviewing the less controversial information. A second major problem in classification is deciding what constitutes an axe made for battle as opposed to carpentry or tree-felling; within the realm of Egyptian axes, this problem
recently been put to rest, as we will see in the paragraph below. A third
implication to our study is the fact that it is quite possible--indeed, highly probable--
that the Egyptians gathering timber in foreign lands relied substantially on local
forms of the axe. Thus in order to keep our conceptions accurate, we will have to
learn what forms of the axe were used in Syro-Palestine as well as Egypt during the
NK.

W.V. Davies has recently assembled a practically complete corpus of axes of
known Egyptian provenance from collections around the globe; her catalogue of
these tools plus the objective analyses of those axes held in the British Museum hold
enormous value for the study of Bronze Age technology. For the purposes of this
study, the most relevant contributions of Davies' work are the discernment between
military and carpenter types (figs. 3 and 4) and the metallurgical content of the axes.

Fig. 3 NK carpenter's (symmetrical) axes, from W.V. Davies (London 1987) pl. 22.

According to Davies the axe remained an effective tool and weapon from
predynastic times until sometime in the 18th Dynasty, when the hps (kapesh) sword
became the weapon par excellence. One would thus assume that axes dated to post-
18th Dynasty times were tools. To verify this hypothesis, or to discern the types
Fig. 4 NK carpenter’s (symmetrical) axes featuring the exaggerated lugs and wide butt that became hallmarks of a uniquely Egyptian form in the 18th Dynasty, from W.V. Davies (London 1987) pl. 24.

during and before the 18th Dynasty, we would need an objective means of classification; Davies has provided this. First of all, it happens that all Egyptian axes are flat (plain) axes, cast in one-piece, monovalve molds. Other types, e.g., socketed, flanged, and lugged, are imports or results of foreign influence. Sometime during the Second Intermediate, or Hyksos, Period (ca. 1800-1550 BCE), the rounded forms of the battle and tool axes were replaced by splayed types, with straight or incurved sides, in order to achieve better penetration through metal
armor. So by the start of the NK, two main types of this splayed axe were serving as
the primary weapon and tool of the Egyptian soldier and carpenter: the symmetrical
form was generally more robust and heavier, and served as a tool; the asymmetrical
form was lighter and used in battle. Among the carpenter's axes (symmetrical form)
a uniquely Egyptian form comes about in the 18th Dynasty; exaggerated lugs and a
widened back or butt are its salient characteristics (fig. 4, p. 21).

From Davies' sample, we can calculate average dimensions for the carpenter's
axe in the NK: average mass 645.5 g (range [r] = 231-1272.7, median [m] 607.2); avg.
length 12.2 cm (r = 9.5 - 14.3, m = 12.6); average width of cutting edge 8.1 (r = 6.9
- 9.0, m = 8.2); and average butt width 9.3 cm (r = 9.0 - 12.5, m = 10.9). All
examples are bronze.

The battleaxe (asymmetrical) (fig. 5) of the same period has significantly less
mass and was generally thinner in section throughout the blade. Of the ten
functional examples (functional vs. ornamental or model) analyzed, the average mass
was 443.6 g (r = 312 - 593.6, m values of 418.7 and 439.5), over 200 g less than the
average carpenter's axe. Battleaxes were generally longer, narrower implements (fig.
5), and we obtain the following average dimensions: length 16.1 cm (r = 11.7 - 28.0,
m values = 13.7 and 14.0); width at butt 8.8 cm (r = 6.7 - 10.0, m values 8.7 and 9.2);
width at cutting edge 6.03 cm (r = 5.0 - 7.8, m = 5.6).

It is significant that the simple criteria of mass and shape can be used
efficaciously to delineate these two types; this neat division is supported by
metallurgical, hardness and microscopic analyses discussed below.

Although previous attempts to correlate actual tool weights with weights given in
papyri have failed to provide significant results, it is interesting to note how our
figures compare to those from a MK dockyard record. The heaviest axes in the
Reisner II papyrus should have weighed from about 675 to 550 g; our average and
median mass of actual axes fit nicely into this range. We would expect that the price
of axes would be roughly equivalent to their weight as measured in dbn, which was a
unit of weight (91 g of copper or bronze) and exchange in the NK. Two prices from
the 20th Dynasty, 5 and 7 dbn, theoretically give us 450 and 630 g axes, also fitting
well within the range of Davies' actual sample. The prices will be discussed later.
Davies’ findings on the metallurgy of these axes throw interesting new light on the technology of Bronze Age Egypt. Contrary to earlier opinions, she finds that tin bronze was in limited production as early as the OK, and in the MK, bronze and arsenical copper were replacing copper as the common metal of tools and weaponry; in the NK bronze completely replaced copper. 100

Analyses of the asymmetrical and symmetrical forms of NK axes reveal that the Egyptians were in effective control of the alloy content of these implements. Among the asymmetrical forms of the 18th Dynasty that were analyzed, 15% are arsenical.
copper with an average As content of 1.8%; 85% are bronze with average Sn content of 12.1%.

From the group of NK symmetrical axes, Davies finds that 10% are copper, 10% are arsenical copper with an average As content of 1.5%, and 80% are bronze with an average Sn content of 7.5%. The important distinction to be made here is that the Egyptians were using about 50% less tin in bronze tools than in weapons. Throughout the NK, battleaxes have a consistently higher tin content than carpenter’s axes. The same policy was also true during the First Intermediate Period and the MK: carpenter’s axes contained mostly unalloyed copper or low percentage arsenical copper; battleaxes, on the other hand, are usually high percentage arsenical copper or bronze, sometimes leaded bronze. The gradual replacement of copper by arsenical copper and bronze can be deduced from the chronological analysis in Table I.

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One need not speculate on the reasons for the different alloy content of the two types. It seems reasonable that the carpenter’s axe would require more frequent sharpening than a battleaxe. If this assumption is valid, then the softer metal could be explained as an intentional design to facilitate frequent sharpening. A harder alloy--i.e., one with a higher percent of tin--would be more difficult to sharpen and perhaps more brittle. Hardness tests and examination of hammering marks conducted on 18th and 19th Dynasty axes show that both had undergone forging after being cast to shape the blade. Since these implements were cast in a monovalve
mold, they were always worked with the hammer to some degree to achieve a more or less symmetrical form. Besides achieving the desired shape, the cold-forging and annealing that followed casting hardened the blade. Davies finds that the battleaxes were worked more on the edge and polished more after forging than the symmetrical carpenter's axes. One can safely conclude from Davies' evidence alone that the Egyptians of the NK carefully cast and worked formulated alloys for different purposes: a harder metal for battleaxes in order to penetrate metal armor, and a softer, less-worked metal for blades undergoing continual use in wood and repeated sharpening.

Another important contribution to the typology of metal tools and weapons is Davies' observation that many model tools—evidently cast from leftover scrap—exhibit the same composition as their functional counterparts found in the same deposits. Thus, in the absence of functional types, model tool and weapon finds take on a greater significance, as they probably indicate the metallurgy employed at the site for a particular type of blade.

One type of blade—which some call an axe—found in Egypt is not considered in Davies' work, since it is considered as being the result of foreign influence. The type in question has been termed a "lug adze" in Petrie's Type Z, a "lugged axe" in Deshayes' Type B, and a "lugged axe—or adze" in Maxwell-Hyslop's Type II; the blades of similar form from two Late Bronze Age wrecks off the Turkish coast are identified as adzes or axes based on the sharpening of one or both faces.

In the absence of any hafted examples, three main criteria are used to delineate axes and adzes in the various typologies: dimensions of the blade; beveling or sharpening of the faces; shape of the lugs. Petrie asserts that axes are "equal faced and edged, whereas the adze has one face longer or flatter and is usually ground on one side." Nevertheless he considers all the lugged blades from Egypt and parallel forms from the Near East as "Lug Adzes" or "Adzes with Lugs" under his Type Z, including many examples that others would call lugged axes. This might explain why he has no similarly shaped blades with equal faceting—what others might call lugged axes—in his Type A; thus Petrie actually relied on the presence of lugs as the key criterion for calling these blades adzes instead of axes.
Maxwell-Hyslop uses the relative length of the blade and the position and form of the lugs to isolate three types of blades with side lugs. Type II features unpronounced lugs and a relatively long blade, and is the only type found in Egypt, albeit rarely; one finds its greatest distribution in the Late Bronze Age Levant. The large number of Levantine examples cited, taken with the rarity of Type II blades found in Egypt, suggests to me that this type was not indigenous to Egypt and was an Asian imported form of the adze, which in Egypt had no lugs in earlier periods. Maxwell-Hyslop is not so interested in the function of these blades and makes no commitment to either an adze or axe identification. Her fig. 1 (here fig. 6) of a "lugged axe or another kind of weapon" could easily be interpreted as a socketed axe and thus lends no support to an axe identification for her Type II blades, which of course have no sockets. On grounds very similar to those offered by Deshayes, which will be outlined below, I would identify her Types I and III as shouldered and lugged axes, respectively (fig. 7 [a and c]). Neither of these two types is common in the Egyptian sphere of influence in any period, and we should not consider them as types of axes that the Egyptians might have employed in their timber collection industry.

Deshayes' Type B--lugged or trunnion axes--corresponds to Maxwell-Hyslop's Type II and Petrie's Z92 and Z93 lug adzes (fig. 7 [b]). Deshayes considers Maxwell-Hyslop's typology the most useful of those preceding his but differs from the end classifications so newhat, and although his criteria include Maxwell-Hyslop's, he adds the shape of the sides and the edge, and the section of the blade. He has no problem dismissing two earlier typologies. First, he shows Maryon's theory--that the type was employed in working sheet metal--to be absurd, since the lugs have no function in their hypothesized role; in fact they are inhibitive. Furthermore, Maryon's own examples exhibit both dulled and sharp edges on blades showing signs
of use.\textsuperscript{117} As for Gordon, who considered them as military adzes, Deshayes demonstrates that the only examples of military adzes are shaft-hole weapons—a type known in Mesopotamia, where lugged adzes were virtually unknown.\textsuperscript{118}

It is somewhat ironic that Deshayes himself makes such a convincing case that his Type B lugged axes are really not axes, but adzes. In doing this, he first makes an important distinction between lugs and "shoulders." Shoulders differ by having a flat side, and only appear following the start of the Iron Age.\textsuperscript{119} These shoulders can be seen on most of Maxwell-Hyslop's Type I blades\textsuperscript{120} and some of Petrie's Type Z lug adzes\textsuperscript{121} and Deshayes Type C lugged blades (fig. 7 [a]).\textsuperscript{122} Taken with the decoration that occurs on one side of the lugs on some of Maxwell-Hyslop's Type I blades, it is clear that these are axe blades with shoulders for stopping the blade's movement through a hole in the haft; the decorations would remain exposed by this use.

Deshayes makes the point that the only lugged blades that could make decent axes have the sort of pronounced lugs seen in Maxwell-Hyslop's Types I and III; the slight lugs of Type B (Maxwell-Hyslop's Type II) blades would actually widen the hafting hole with prolonged use, rendering the tool ineffective. In addition, the plano-convex section and the decoration on only one face of Anatolian and Transcaucasian examples also suggest that Type B is a type of adze. The overall thinness and plano-convex section of the type throughout the Near East make it necessary for Deshayes to conclude that "the greater part of the lugged axes were used as adzes."\textsuperscript{123} One wonders why Deshayes did not classify them as such.

Deshayes' geographic analyses are important in understanding that these adzes were not a type widespread in Egypt but in its Levantine neighbors. He shows without doubt that the type originated on the shores of the Caspian Sea and spread throughout Southwestern Asia and Anatolia during the Late Bronze Age. It was never diffused within Egypt and only became dispersed in Syro-Palestine when Egyptian influence in the region was ebbing, sometime in the MBII period (ca. 1950-1600 BCE).\textsuperscript{124} The Egyptians used either plain or necked adzes within their own borders as a rule.\textsuperscript{125}

We have established what were the types of axes used in Egypt and that the type known previously as "lugged axes" were actually adzes and an imported variety.
Fig. 7 Three types of blades variously classified by Deshayes, Petrie and Maxwell-Hyslop, but here classified as shouldered axe (a), lugged adze (b) and lugged axe (c), after Maxwell-Hyslop (1953) pl. VIII.
Although we are concerned mainly with the Egyptian industry of timber collection, it is necessary to point out the types of axes that were common in Syro-Palestine during the Late Bronze Age, since it is reasonable to suggest that these forms were used in the procurement of timber for ships being built by or for the Egyptians. Thus one must include the socketed axes of the Near East. Some examples of the common types are depicted in fig. 8. Note that the socketed axe does not appear in tomb paintings of the NK, unless we accept there being one in fig. 1, p.11.

![Diagram of socketed axes](image)

**Fig. 8** Socketed axes of the types common in the Levant during the New Kingdom in Egypt, from Petrie (London 1917) pls. IX-XI and Deshayes (Paris 1960) pls. XVIII-XXIX.

For the hafting of axes it appears that mostly native woods were used. Davies' examinations reveal acacia, sidder and tamarix serving this role in the NK.

As we have seen in fig. 1, rope could be an important tool in timber collection. Rather than simply allowing the tree to crash to the earth, and thereby to suffer cracking or other damage, the Egyptians were careful to ease the timber to the ground, at least in some cases. Hauling the cut logs to the boat or to the workshop was also facilitated by rope, as an OK representation illustrates well: the log is suspended with ropes to a long pole which is shouldered by several men. As can be imagined, rope was a handy item to have for many related tasks as well, e.g., towing barges of wood, tying logs to posts for sawing, etc.
We have an excellent understanding of how rope was produced in pharaonic Egypt due to the number and consistency of scenes from tombs and elsewhere that depict men making rope. For the current topic we can rely on the two scenes known from the NK. Actual rope from Deir el-Bahari has survived to corroborate the reliefs. Four steps can be clearly delineated: initially fibers were gathered of either dom palm, halfa or papyrus (or sometimes hair, wool or leather); the fibers are then neatly sorted and stacked; usually two people twist the fibers, one man holding his end fixed and the other imparting a spin to the fiber with a tool "composed of a handle with a short lanyard, to which a round weight is attached"; the yarns are then twisted around each other to make rope (fig. 9).

Fig. 9 Painting of rope-makers, from the NK tomb of Khaemwaset, from Mackay (1916) pl. 15.

The common term for rope in the NK was nwh and terms for both palm leaf (wd) and papyrus (w3d) are known. It seems that palm was the sturdier component since it was used for ship cables. One price list from the reign of Ramesses IX (1138-1119 BCE) suggests that ship cable cost about 1.2 dbn per meter, compared to an uncertain length of rope which cost 1 dbn in the 19th Dynasty (1305-1200 BCE).

Oil was used in timber collection for sharpening the axes just as today one applies oil to a whetstone for the same purpose. It was also used in the dockyard workshop to lubricate a saw blade when heat and friction caused it to stick. A flask, fashioned from a hollowed-out horn and wooden plugs (fig. 10), provided the best way to carry one's oil into the field. Since the lower plug was carved into a spout, the flask was effective as a container and convenient dispenser. A leather strap or cord
could be attached to facilitate transport as we might carry a canteen or leather bota today. Powder horns employed with musket-loading firearms of recent centuries bear a striking similarity.

Due to the difficulties involved in identifying oils left from antiquity, we can only say which oils are likely to have served the pny. Similarly, many hieroglyphic names of certain indigenous oils remain untranslated.\textsuperscript{134} We rely upon the classical authors for their observations of oils used in Egypt; the common varieties that were not used mainly in foods included castor oil, linseed oil, and possibly olive oil.\textsuperscript{135} Several Egyptian terms for a generic oil exist, but we attempt here no certain identification with types used in sharpening.\textsuperscript{136}

These are the tools and accessories which we conclude the timber collector and/or wandering shipwright must have minimally employed in his work. Other tools of the larger business of shipbuilding will be looked at in the following chapter as we...
deal with the dockyard workshop and the men who made the boats. In summary, the timber collector bore a basket containing minimally a whetstone (with loop or some means of portage), one or more plain bronze axes of symmetrical proportions and relatively high mass and low tin content (if he was in Canaan, the type might be Near Eastern, probably socketed), some rope and an oil flask. We do not know what his lunch basket looked like, but more will be said about that in Chapter V. The *pry* was an extended member of the dockyard workshop crew; his knowledge of boat construction was needed in the field to make decisions regarding the procurement and preparation of timber. Certainly less skilled men—or boys—were employed as well for large orders of timber, but we have no specific information about them. A *pry* would probably serve as an unofficial (i.e., illiterate) supervisor in that case.
CHAPTER III
THE DOCKYARD WORKSHOP

Surely, some fascinating tales were born out of journeys from the field back to the dockyard workshops in boats overloaded with timber and weary men. Unfortunately not one is known to us and the routes of the timber trade that existed with the northeast can only be imagined: one or two stops along the Levantine coast—or perhaps not, if one adopts Nibbi’s thesis—and up the Nile under oars, or if the northwesterlies were blowing, under sail.

Memphis would certainly have been the usual home port of these voyages during the NK and earlier periods as well. The dockyard workshop (wḥtfr) south of Memphis is referred to several times in NK sources as Prw-nfr, whereas there are no other principal dockyards during this period save that of Akhenaten at Akhetaten, during the brief Amarna phase. Memphis was a logical choice for the naval headquarters of the empire, since it was close to the northeastern borders where much of the business of empire-building was being conducted in the earlier 18th Dynasty under Tuthmosis III and Amenhotep II (ca. 1465-1406 BCE). Moreover, the hauling of timber from the mouth of the delta upstream practically necessitated a northern shipbuilding center if imported timber was to be involved; the empire’s capital, Thebes, was over 500 miles upstream! Naturally one must consider the commercial importance of a port such as this for the nation’s economy. In order to participate effectively in international commerce, which was especially active during the NK, it behooved the Egyptians to maintain a center that was more accessible to foreign merchants. Finally Memphis was, since earliest times, the center of worship to Ptah, who was the patron god of craftsmen and certainly that of shipwrights. In sum, Memphis makes perfect sense to us as the Egyptian shipbuilding center.

Unfortunately, archaeology has not uncovered the remains of this shipyard nor any other in Egypt from the pharaonic period, although the timbers found at Lisht, a town just south of Memphis, suggest that boatbuilding was active in the environs during the MK. Where exactly the dockyard workshop was is a matter for speculation, but there are some clues. Boatbuilding scenes from the earlier periods, particularly a scene from an OK tomb at Deir el-Gebrawi, suggest that the
dockyard workshop was an extension of the temple, in this case that of Ptah. This would agree well with the many NK scenes we know that depict other industries being conducted on the grounds of a temple, and it would certainly be convenient to have other workshops (those making tools, sails, rope, etc.) close at hand when trying to build a boat. However, in the NK there is no evidence that the connection between the dockyard workshop and the temple was anything more than administrative—an important connection, of course. There is some evidence that at least part of the dockyard workshop was separate from the main site and was on, or bordering, a lake or the Nile: in Ptolemaic times the dockyard was called "the island of Ptah." Likewise the dockyard records of Pap. BM 10056 frequently refer to timber being brought from "the lake." An administrative link also existed between the dockyard and the capital Thebes, at least during Amenhotep II's reign: Kenamun, a steward of Thebes whom we know well through the famous Syrian ships scene on his tomb wall, also held at Prw-nfr the office of a mr pr wr or "Grand Steward," no less.

The dockyard workshop was highly organized. Responsibilities were distributed over a considerable number of officials, and exacting daily records were kept of literally anything coming in or going out of the workshop. We are fortunate to have the NK records that we do for the dockyard workshop, but they are probably a mere fraction of the paperwork that was produced in the same period at that location.

Timber arrived at the dockyard in one of two forms, either unprocessed or ready for use. Imported timber, usually sf or mr, arrived ready for use, implying that it was processed (split and/or sawn) in the field or at some foreign processing station. How logs were processed at this time is an enigma due to lack of evidence. It is even more difficult to say when they were processed (if it was before or after seasoning), but it probably depended on the specific form that was intended for the wood. One OK scene has been interpreted as a splitting operation, but not everyone agrees on this. On the other hand, sawing planks is a well-documented process, albeit one that seems unnecessarily tedious when compared to splitting. Of course, if boatbuilding—and therefore straight planks—are the issue, then sawing would be the more governable method, slow as it was with bronze hand saws. The fact that sawing
logs was so arduous could explain the relative thickness and shortness of planks in existing ancient Egyptian hulls\textsuperscript{150} and Herodotus' observations of Egyptian boatbuilding.\textsuperscript{151} But one must remember that in the existing boatbuilding scenes of earlier periods the outer hull is finished by adzing,\textsuperscript{152} as in later Greek times,\textsuperscript{153} and any plank that was not as straight and smooth as a sawn plank could be sculpted so. Thus the question of splitting vs. sawing remains for the present, although we can safely conclude that only the axe was used for cutting across the grain, since the saw is only depicted ripping lengthwise through logs.\textsuperscript{154}

Locally obtained timber was processed in the dockyard workshop; the manpower and tools available would made it easier to do there than in the field, and it was probably easier to retrieve single logs than multiple planks. Shade and refreshment were also readily available in the workshop. No texts or depictions from the NK can support these assertions, but there is an OK relief that shows the defoliating and processing of a tree at a workshop where furniture and boats were made (fig. 11a).\textsuperscript{155} There is also at least one NK scene of carpenters sawing planks for furniture inside the workshop (fig. 11b).

Prices of imported and local timber should reflect the differences we have just pointed out. One would naturally expect imported planks to cost more than imported logs, which would cost more than local planks, etc., since the labor involved in cutting longer planks and the seasoning involved for any ready-to-use wood would certainly be figured into the prices. In fact during the NK, indigenous timber such as tamarisk is inexpensive whereas imported timber, such as s\textsuperscript{8}, is very expensive according to Jansen's comparison of commodity prices. More importantly, he finds that ship timber is especially costly: e.g., at the high end of the scale, a keel could cost 3 to 4 times as much as a prize bull; at the low end, a certain plank cost more than a fancy garment.\textsuperscript{156}

Purchasing timber for the dockyard workshop was handled by an officer, or steward. The NK sources do not provide a title for this office, but at the MK dockyard workshop the officer in charge of timber supplies was an \textit{bny-\textsuperscript{r} t\textsuperscript{hwny}, or chamberlain.\textsuperscript{157} This official was one of about eight scribes who had special responsibilities within the on-site administration (Appendix A). The only on-site
Fig. 11a. Boatbuilding and log trimming in the Old Kingdom, from Moussa and Altenmüller (Mainz 1971) pls. 20 and 21; b. Furniture construction in the 18th Dynasty, from Davies (New York 1973) pl. 55.

official at *Prw-nfr* that we have record of was Amenemhet, a "scribe of the dockyard," *ss i3 wht* in Egyptian. Judging from this title Wall-Gordon\(^{158}\) supposes that he probably had no special duties beyond providing clerical assistance to the other officers, whose titles we lack in the NK. The timber officer (like the other officers) was probably answerable to the "Grand Steward," *mr pr wr* in Egyptian, who had some authority at Thebes; Kenamun was such a steward.\(^{159}\)

Inside the dockyard workshop the most important individuals bore the title *hmw wr*. This title has been translated variously as "Master Shipwright," "Foreman over a Gang of Shipwrights," etc.,\(^ {160}\) but the meanings hardly differ. Pap. BM 10056 records six different men with this title at *Prw-nfr*: Heny, Mont, Pa-nem, Tuny, Tyty and Yena, each of whom was responsible for the construction of a particular vessel.\(^ {161}\) These men, by virtue of their expertise and judgement, made decisions and executed
orders that controlled exactly how boats would be put together, once a contract was given to them by the "Grand Steward" of Prw-nfr, or, as can be imagined, the client himself.

The *hmw-wr*’s first order to his gang was probably to fetch the keel from storage. As to how this was done, there is no direct representational or textual evidence from earlier periods and no representations from the NK; this is certainly due to the fact that the keel did not exist in Egypt before the NK. We can surmise that Egyptian keels came about during or immediately after the Second Intermediate (Hyksos) Period (ca. 1800-1550 BCE) for reasons discussed below in Chapter IV. Initially, the *hmw-wr* must have sent several men, *prys* and/or shipwrights (*hmw*),162 to the proper timber storage facility. Timber was stacked carefully (*w3h*)163 by *prys* or ship’s hands (*hwty*)164 in different locations depending on its origin and, perhaps, intended use: for example, Syrian wood was stacked in the *smwrt*, which was apparently a section of a larger storage magazine, the *msyt*, where Nubian wood and ivory were also kept.165 Glanville calls this larger facility a chancellery,166 and it was probably here where the most precious woods were kept for security. Most ship timber was kept in the *hr-s3*, a storage magazine on an island in the Nile or on a lake;167 the location of this facility could just as easily be taken as a promontory, an interpretation that would simplify the task of hauling the timber to the construction site by alleviating the need for a boat. Now at this point the keel was merely a long log, or *5*- (logs with lengths of 21 and 15.75 m are known),168 of imported *5* that was defoliated and de-barked. It could be hauled to the construction area from "the Lake" by the same method known to be used on logs in the OK—that is, suspended with a rope beneath a carrying-pole (*m3wd* in NK Egypt),170 which was shouldered by groaning *hwty* and *prys*.

Laying the keel would be the next step. At this moment boatbuilding in its proper sense began. In fact the word for boatbuilding in Pap. BM 10056, *w3h*, literally means "to lay down."171 The big log we can now refer to as a keel, *pipit* or *p3yp*, in Egyptian, literally meaning "mud-kneader."172 Although the NK leaves us no direct evidence for laying the keel, it is reasonable to assume that the keel was supported by wooden blocks and stanchions; such devices can be seen in OK boatbuilding scenes (fig. 12). Achieving the papyriform hull shape that pervades the
Fig. 12 Boats being constructed with the support of blocks in the Old Kingdom, from Steindorff (Leipzig 1913) pl. 119.

pictorial corpus required considerable bending and carving. We have no way of knowing how many pieces made up the keel if there were more than one; more will be known about keel construction in this period when the hull remains at Ulu Burun have been fully excavated and studied. What is almost certainly the keel of that hull has been identified as fir.173 It is quite possible that the Egyptians used fir (probably *abies cilicia*) as well, since it was obtainable from Syria and is a probable identification for the fir.174 Theophrastus’ comments on the suitability of fir for merchantmen keels lend support to this hypothesis.175 Since fir is not rigid but is easy to work,176 it is conceivable that with stanchions, weights and carving, the desired shapes could be achieved without scarfing, i.e., with a one-piece keel. The keel of the shipwrecked hull at Ulu Burun appears to be about 21 cm sided (bird’s eye width) and perhaps as long as 15 m, but it is too early to tell if the keel is continuous, or scarved.177

The keel was carved with adzes under the watchful eye of the *hmw-wr*. Adzes (and other metal tools) were probably obtained by the *hmw-wr* from the steward, mr pr wr, who was the actual owner of the tools. Each *hmw* was in turn issued an adze by the *hmw-wr,178* who kept a record of the mass of the tool loaned out, perhaps with a marked stone or ceramic object that balanced the tool on a balance-pan scale.179 This
was done because of the high value placed on bronze implements in general.\textsuperscript{180} Always having enough tools was one of the \textit{hm-nw-\textit{wr}}'s more serious responsibilities; the adze, in particular, was a very important tool, used in every phase of construction.\textsuperscript{181}

The adze (\textit{\textit{nt}})\textsuperscript{182} was discussed in the first chapter because of the controversy over a Near Eastern type of blade that occurs in Egypt and has been called an axe by some scholars. We resolved that matter in Chapter II and can clearly show which adzes were used in the NK and how they were used in boatbuilding. Although the adze is not shown as a boatbuilding tool in NK scenes, we have enough evidence from texts, artifacts, carpentry scenes, and earlier boatbuilding scenes to allow a generalization.

Three types of adze blades that date to the NK have been excavated: the plain adze (fig. 13a), the necked adze (fig. 13b), and the lugged adze (fig. 13c).\textsuperscript{183} Necked adzes are the most ubiquitous in the NK and are found on two LBA shipwrecks, as are lugged adzes.\textsuperscript{184} Lugged and plain adzes (without a distinguishable "head") debut in the NK,\textsuperscript{185} the lugged adzes apparently intended for heavier use since they are thicker and capable of being more securely fastened to the haft. Unfortunately, it is practically impossible to distinguish between these forms in the reliefs and paintings, since they are always shown in profile. Adze blades were undoubtedly made by the same process that created carpenter axe blades, and made in the same workshops. Therefore, the metallic content of these tools would presumably be a relatively soft bronze that would lend itself to frequent sharpening.\textsuperscript{186} A broad analysis of adzes has not been published, but NK adzes are generally identified as being of bronze, not copper.\textsuperscript{187}

There is some ambiguity in the difference between a narrow, plain or necked adze and a wide chisel.\textsuperscript{188} Given that these tools are either adzes intended for finer work or mortising chisels, one has to consider the shape and width of the butt, the overall thickness of the blade, and the form of the edge in order to make a classification. What is proposed here is that a chisel must have a bifacial edge, a suitable striking surface, and enough thickness to be used effectively without breaking; on the other hand, an adze can have either a bifacial or monofacial edge.
Thus I would change a few identifications of "chisels" that feature bifacial edges but have relatively narrow necks, thin blades and/or rounded butts; these I will here consider to be adzes. Hafted examples of adzes come in many widths, apparently for finer or rougher work; narrower blades with thin section and unsuitable hammering surfaces need not be classified as chisels in order for us to understand their purpose.

Before the NK there is one basic shape of the adze haft, but it comes in different sizes: where one gripped the handle, it could be curved or straight, but the distinguishing feature is at the business end, which is curved--more or less angularly--
back against the haft (fig. 14a). With this design the carpenter could grip the handle as high or low as he pleased without touching the blade or the leather thongs that fastened the blade to the haft. This type of adze is shown in various sizes in carpentry and boatbuilding scenes of the OK and MK. A distinction can be made between the smaller and larger forms: the smaller "hand-adzes" tend to have a blade-to-handle angle closer to 45 degrees; on the other hand, some of the adzes wielded in the boatbuilding scenes are long enough to be effectively swung with two
hands,\textsuperscript{190} moreover the angle of the blade in relation to the haft—approaching 90 degrees usually—enabled the shipwright to remove layers quickly. After the MK, the type appears only in hieroglyphs and ceremonial scenes, but we should not be surprised if, in the future, one turns up in a NK boatbuilding scene, since one adze of this form has been excavated from a NK context (fig. 14c, p. 41).\textsuperscript{191} This larger adze used a characteristically OK or MK mode of hafting that one does not see in NK art. This absence, except in hieroglyphs and where it is used in the "opening of the mouth" ritual,\textsuperscript{192} might suggest that the unique NK adze is ceremonial, but since that adze was found with other carpenter’s tools in a basket we must accept that this form continued to be used for heavy work, despite its absence in the art.

In the NK representations, a new haft shape appears that is simpler to carve and more elegant to work with. There is no recurve of the haft where the blade is attached, but the piece is curved and carved so that the blade descends at about a 45 degree angle to the haft (fig. 14b, p. 41).\textsuperscript{193} The adze is much smaller now, i.e., a tool that was not swung as one swings an axe, but like a hammer or small pickaxe, to chip away the wood. It could also be gripped with two hands so that the top hand held the haft, blade and thongs; this may have been an advantage insofar as it brought the craftsman "closer" in a sense to his work. A better planing action was certainly obtained with this two-hand grip than could have been possible with the older shape of haft; a pushing and pulling action could be generated at the same time, thereby maintaining greater control over the working of the material. The new haft was an innovation that was widely and rapidly adopted in the NK, as the pictorial corpus shows, but was this a native or foreign invention?

There is an interesting chronological coincidence between the appearance of the new adze haft in Egypt and the appearance of the lugged adze— a seemingly superior blade for heavier work—in Egypt and Canaan. It is conceivable that as the Egyptians expanded north in the NK they brought the robust lugged adze with them for boatbuilding. But the few examples of the type in northern Egypt\textsuperscript{194} would be better explained by the blade being a Hyksos introduction, especially since it appears widespread in LBA Canaan,\textsuperscript{195} and is found on two LBA shipwrecks of the southern Turkish coast (supra, p. 6). The fact that this diffusion occurs during and after
Hyksos rule in Egypt suggests that the lugged adze was invented by the Hyksos during their occupation of Egypt.\textsuperscript{196} Why the form did not attain wide use in Egypt during or after the Hyksos occupation is difficult to explain. This peculiarity suggests that the lugged adze originated outside of Egypt. Given the presence of the lugged adze on the shipwrecks mentioned, it is tempting to conclude from that this particular adze may have been the boatbuilder's preferred type. However, it is too early to tell if all these tools were simply scrap metal or shipboard utensils.\textsuperscript{197} This issue could remain speculative until a boatbuilding site is excavated.

Returning to the keel, one can now picture a group of carpenters taking off thin layers of wood, what we today call planing, and what the Egyptians called 3\textsuperscript{4} in the MK.\textsuperscript{198} If level siding and moulding were desired, and we cannot say if they were, then the work could be objectively checked with levels and right angles. Right angles from the NK look just like modern examples and were made of wood. Right angles also appear in NK carpentry scenes (fig. 15). Two kinds of levels--actually plumb bobs attached to reference sticks--were used for either horizontal or vertical sighting (fig. 15). Levels are not depicted in carpentry scenes, but were used in masonry;\textsuperscript{199} they may have been used in boatbuilding but were probably not necessary for most projects.

Probably the most important measuring devices were strings ($h3d$)\textsuperscript{200} and wooden rulers ($mh$).\textsuperscript{201} The lengths of most timbers in Pap. BM 10056 were recorded, and there is no reason to think that the $hmw$-$wr$ did not use measured dimensions in his work; otherwise a lot of time would have been wasted correcting inprecise guesses, manifested as mismatched joins, etc. Measuring strings are not shown in the boatbuilding scenes we have. From the large measurements taken in Pap. BM 10056, we presume that some measuring strings were marked so as to indicate cubits. The Memphite cubit was ca. 52.3 cm, as known from existing rulers, which had markings for subdivisions.\textsuperscript{202} Strings could also be used for relative measurements without reference to the cubit standard, but since the Egyptians seem to be so precise in all their woodcraft, we must assume that they preferred absolute measurements wherever possible.

Shipwrights and carpenters of OK-MK times had to sit in the dust when carving
objects such as keels that were low to the ground, as illustrated in tomb reliefs and a rare model of a MK woodshop. But again innovation seems to have benefitted the NK carpenter, this time in the form of the wooden stool. In virtually every handicraft scene that dates to the NK, we see the workers happily perched on their stools. Two basic types are seen: the first has three legs and must have been very handy to grasp and move; the second was more of a finished stump. Several preserved examples of the former are known, some from the workmen’s village at Deir el-Medina (fig. 16a). There is great variation in quality but all share the three-legged design. The seats are either solid wood or woven from reeds; the latter were the more comfortable. Most examples would have seated the worker about 30-35 cm off the ground. The second type of stool was a block with a depression in the top. There are no surviving examples of this type, but many instances of it in tomb art exist (fig. 16b).

The advent of stools in the workshop will concern us more when we look at the social position of the shipwright. For now it is important because the initial work on
the keel could not be performed standing up for long without backstrain, since the keel was not very high off the ground. There are no records that can tell us how long the shaping took, but it certainly involved some hard labor. What could really help our understanding here and elsewhere would be to know how many men were in the 'hmw-wr's service: the records are silent on this matter. There is some reason to believe that some keels were quite long—as much as 40 or perhaps 50 cubits (ca. 21 or 25 m). The amount of planing would have been considerable and more men
would obviously have made a faster, easier job of it.

Rabbeting has not yet been found on the keel of the shipwreck at Ulu Burun. If none is found when the keel is finally raised, it should not surprise us since the keel was still in its infancy as a constructional feature. We will assume, tentatively, that the next step in construction was carving mortises out of the flat sides of the keel for the garboard strake. Mortise-and-tenon joinery is present in OK and MK hulls and depictions of boatbuilding including a scene in which two men are chiseling out mortises in a plank (fig. 12, p. 38). The NK leaves us only with pictures of finished hulls that resemble earlier forms in their basic shape. The pegged mortise-and-tenon joint found in the Ulu Burun hull and similar joinery in a later classical Greek shipwreck convince us that this was the method of fastening the first strake to the keel and joining the planks edge to edge.206

Fig. 17 Disassembled chair of NK date showing mortise-and-tenon joinery and holes for dowels or pegs, from Killen (Warminster 1980) pl. 90.

Mortises were cut with heavy bronze chisels under the striking force of large wooden mallets. The archaeological and pictorial record is rich with regard to these tools. There is some controversy in the distinction between some broader chisels and narrower adzes which we have just discussed above. As for the use or capabilities of these tools, despite our lack of a NK hull, the Egyptians left us enormous samples of
their woodworking skill in preserved furniture, chariots and ornamental objects. The mortise and tenon joinery in preserved furniture and chariot wheels$^{207}$ is incredibly precise, probably more so than required in boatbuilding (fig. 17, p. 46). One does not have to be a woodcarver to be impressed with the ingenuity and skill shown by these complex and beautiful works. If one conducts a survey of the types of joinery employed in the existing objects,$^{208}$ it becomes reasonable to say that the NK Egyptians could produce any of the forms we see in subsequent techniques of carpentry, including shipbuilding, even up to modern times. Their skill was admirable; they manually produced forms that must be closely examined in order to deny that they were turned on a lathe.$^{209}$ This is all a long way of saying that we cannot impose any limits on the capabilities of NK boatbuilders based on technological arguments. But if there were limits, they were certainly not in technique, but perhaps only in the more rapid dulling of bronze tools. The NK Egyptians even had a word for dull tools ($\text{sftâ}$)$^{210}$ that had become so blunt that they needed to be recast.

Two types of deep-bar or mortising chisels ($\text{mnhip}$)$^{211}$ were used in boatbuilding to create mortises. The square-bar mortising chisel consisted of a long (e.g., ca. 20 cm) bronze blade about .5 cm square in section set in a long (e.g., ca. 20 cm) wooden handle (fig. 18a).$^{212}$ The length of the blade was needed to chip wood out of deep mortises used in boatbuilding. The levering action used to free the chips from these narrow mortises would put much stress on the tool, and so it has a thicker section than many smaller or flatter chisels. Square-bar mortising chisels are found throughout the Near East$^{213}$ and on the LBA shipwreck at Ulu Burun.$^{214}$ A slightly more robust form of chisel could be used for mortising also. Its section is rectangular, being narrower in the plane of the cutting edge (fig. 18b). It is called a "deep-bar chisel" by Petrie.$^{215}$ Its distribution generally matches that of the mortising chisel and has been found on two LBA shipwrecks.$^{216}$ Examples of both types of blades are found with and without their handles, but no bare examples show signs of being struck as a round-section mason's chisel, which has a broad platform on its butt end.$^{217}$ The square-bar and rectangular-bar mortising chisels were always set into a handle so as not to damage the mallet. Strain on the blade was minimized by not
Fig. 18a. Square-bar mortising chisel BM 6053, from Killen (Warminster 1980) pl. 11; b. Rectangular-bar chisel, from Petrie (London 1917) pl. XXII.

Setting the blade very deep into the wooden handle, thereby increasing the distance between the blade itself and the impact of the mallet. Occurrence of the two types side by side on shipwrecks and on land sites suggests that they were used more or less simultaneously. The shape of the two forms and the way in which they were generally handled suggest that the square-bar mortising chisel was used initially with a mallet for digging out the hole, followed by scraping and prying with the heavier rectangular-bar chisel to clean the mortise out and finish it. In general these chisels are similar to modern examples, except for the metal and the edge, which is
monofacial on a genuine modern chisel, while both bifacial and monofacial edges were used in the NK.\textsuperscript{219}

Wooden mallets (\textit{hrpw})\textsuperscript{220} were perhaps the simplest tools in the workshop and yet were very versatile. Two forms are preserved from the NK and are seen in workshop representations and OK-MK boatbuilding depictions. The type that bulges out to a greater mass after the handle is seen in OK-MK boatbuilding scenes and many NK woodworking scenes. The smaller form is shaped like a rod or baton, obviously intended for finer work, as NK sculpting scenes show (fig. 19). Mallets were carved from single pieces of locally available hardwood, viz. acacia, often from the center of the log where the wood is hardest (fig. 20).\textsuperscript{221} I discuss mallets here since they were used in pounding chisels, but they were used in other stages of construction as well: pounding pegs into tenons and driving planks into place are two uses seen in OK-MK boatbuilding, and similar uses are revealed by NK woodworking scenes. Besides using one mallet to strike the intended object directly, two mallets could be used in combination to spread the impact over a broader surface or soften the blow; this is done by holding one mallet on the object and striking its raised handle with a second mallet. Since mallets did not have an even, flat striking surface, as does our modern hammer, this combined method could be used for better control when necessary.

Mortises were cut along the sides of the keel; we do not know the height at which they were cut (which would determine the extent of the keel's protrusion from the hull) or what the size and spacing of the mortises were. Comparisons should not be made too closely with the funerary barges of the OK-MK period since we are concerned with only sailed vessels that were capable of carrying personnel and/or cargoes up and down the Nile and beyond. The shipwrecked hull at Ulu Burun is a superior analogue since we know that it was a seaworthy merchant craft. Mortises found joining the garboard strake to the keel of the Ulu Burun hull are spaced ca. 21
cm apart (center to center); a mortise joining the garboard to the second strake may be 7 cm wide and 17 cm deep; pegs of about 2.2 cm dia. were used to lock the tenons in place by being pounded into a hole drilled through the strake and the tenon; the other side of the tenon was locked similarly by a peg driven into the top of the keel. A comparison of these fastenings to those found on the MK timbers from Lisht would appear to be valid; the latter timbers may be the only hull remains from pharaonic Egypt that represent a working vessel. These timbers were fastened with mortise-and-tenon joinery and lashing: mortises were about 9-10 cm wide, 12 cm
deep and 1.5 cm thick, fitted with tenons that were wedged with pegs to fit closely; woven webs that passed through mortises cut into the inner face of adjoining planks secured the hull further.223 No lashing has been found in the Ulu Burun hull. The presence of a keel and the larger, locked tenons suggest that the Ulu Burun hull was more substantial.

Tenons and pegs were probably cut in the workshop with axes from locally available or imported hardwoods, viz. acacia, dom palm, sidder, tamarisk, yew or oak (see Appendix D). Tenons in the Ulu Burun hull have been identified as a Quercus species, that is, a species of oak; the pegs have been tentatively identified as oak also.224 Quercus ithaburensis, Tabor oak, was the most available imported hardwood, growing in southern Canaan (Appendix D). I have found only one word for "joinery" (dm3m)225 in NK sources, and there is no word for "peg" or "tenon" in the earlier boatbuilding sources. There are many unidentified and tentatively-identified terms related to timber; it is likely that the terms for "tenon" and "peg" will be found once someone looks for them. Likewise, the cutting or placing of tenons is not depicted in the tomb art. But to say that tenons and pegs were not used in Egyptian boatbuilding during the NK because there is no pictorial evidence for their use would be ridiculous in view of the ubiquity of this joint in furniture of the time (fig. 17, above), earlier funerary hulls and the Lisht timbers. Because tenons and pegs were so hard and relatively small, a bronze ripping saw would not have been a good tool for producing them; it is more likely they were cut with axes and trimmed with adzes.

After the tenons were placed in the mortises, the garboard strake was added to either side of the keel, mortises already having been cut in its bottom edge. During the NK, much of the wood used in boatbuilding at Ptw-nfr was imported and came to the dockyard either as planks or ready to use. Pap. Bm 10056 and Pap. Anastasi IV both record a great use of "planks of ready-to-use deal" (ksw n 8f), which has been identified as fir or pine, or both. Another highly-used imported wood, unidentified, seems to produce the very best pieces; mr-wood is mentioned always with hst.t-planks, meaning "choicest planks of mr." Pre-cut planks alleviated the tiresome task of sawing, though we have seen above that imported timber was an expensive luxury. Smaller working vessels not financed by the palace or temple were probably built
Table II. Timber Measurements from Pap. BM 10056, after Glanville (1932) 41.

<table>
<thead>
<tr>
<th>Egypt.</th>
<th>Piece</th>
<th>Wood</th>
<th>Max Cubits</th>
<th>Min.</th>
<th>Nearest Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>hst.t</td>
<td>plank</td>
<td>₣</td>
<td>28</td>
<td>13</td>
<td>15-7</td>
</tr>
<tr>
<td>ʃswt</td>
<td>plank</td>
<td>₣</td>
<td>21</td>
<td>1</td>
<td>11-6</td>
</tr>
<tr>
<td>tp</td>
<td>endposts</td>
<td>₣</td>
<td>18.5</td>
<td>10 or 11</td>
<td>10-5</td>
</tr>
<tr>
<td>wnh</td>
<td>plank</td>
<td>₣</td>
<td>18</td>
<td>4</td>
<td>9-2</td>
</tr>
<tr>
<td>rwd.t</td>
<td>plank</td>
<td>₣</td>
<td>17.5</td>
<td>4</td>
<td>9-2</td>
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<tr>
<td>bnbnt</td>
<td>?</td>
<td>?</td>
<td>17</td>
<td>4.5</td>
<td>9-2</td>
</tr>
<tr>
<td>ph3</td>
<td>plank</td>
<td>₣</td>
<td>15.5</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>hfrt</td>
<td>gunnel</td>
<td>₣</td>
<td>30</td>
<td>---</td>
<td>16</td>
</tr>
<tr>
<td>ʃt-r3w(?) mast</td>
<td>?</td>
<td>?</td>
<td>13</td>
<td>---</td>
<td>7</td>
</tr>
<tr>
<td>nhb</td>
<td>upper yard</td>
<td>?</td>
<td>6 (16?)</td>
<td>---</td>
<td>3 (8)</td>
</tr>
</tbody>
</table>

with a lot of native wood by virtue of its economy. Lengths of the longer pieces in Pap. BM 10056 are given above in Table II.

Planks were cut lengthwise from logs or ready to use timbers with two devices: the bronze saw (f3 or d3sw)\(^{26}\) and the carpenter's vice (dbt ?).\(^{27}\) These two tools appear widely in NK art (fig. 11b, p. 36). The vice was always used when planks were cut with the saw. The vice was a simple but ingenious device, seen earliest in OK tomb depictions (fig. 21), consisting of a large pole, some rope, a smaller pole or stick, and a heavy stone. To saw planks from a log, the sawyer wrapped some rope around the intended piece and the pole, which was vertically imbedded in the ground; a stick weighted by a stone was wedged between the pole and the rope where it acted as a lever and tightened the rope around the piece. By lifting the stone, the rope binding could be quickly loosened and moved to allow the movement of the blade through the sawn object. The same

Fig. 21 Fifth Dynasty sawing, from Hodges (Norwich 1970) fig. 98.
sort of vice is used during the MK, as one can deduce from the wooden model of a carpenter's shop, though the weighted stick is not shown. The same system was used in the NK, although the weighted stick does not appear in the art. The stance of many sawyers, their grip, and the attitude of the saw show clearly that most saws cut only on the backstroke, or pull, hence the name, "pull-saw," advanced by Lane. The shape of the handle—a piece of wood fitting onto a tang on the blade—was such that it was not particularly efficient for pulling or pushing; most are aligned, more or less, with the blade and would slip through the palm on the forward and backward stroke (fig. 22). Modern saws have the grip about perpendicular to the blade.

A saw introduced in the NK far exceeded the capability of earlier types. Before the NK, saws had irregular and regular shape and spacing of teeth. When the spacing and shape was regular, the cutting edge was usually pointing towards the handle, another reason for calling them "pull-saws." A major disadvantage of these saws was their unset teeth, which cut a kerf only as wide as the saw blade, thus binding the saw. Wedges were inserted into the kerf to widen it and allow the saw freer movement. Saws with set teeth, that is, with teeth bent out of the plane of the blade slightly to either side, were introduced in the NK. This relieved, to a degree, the dependance on wedges. Sliwa observes a change in the stance of some sawyers following this NK innovation in which they are less bound to the vice by the need to keep the kerf open. Perhaps now we can explain why the weighted stone of the OK vice does not appear in NK art. Saws with set teeth were less apt to bind. This alleviated the need for the weighted stick, the role of which was to widen the kerf. Saws with unset and set teeth from NK context suggest that the replacement was gradual. The blade shape also changes in the NK: it takes on a longer, less round shape, more like our modern saws, which are narrower at the distal end than at the handle. NK saws have been found with teeth that point down and could presumably cut on the push stroke, so we must admit the existence of "push-saws" as well (fig. 22).

Mortised planks were fit onto the row of tenons that emerged from the keel. Measurements must have been quite precise in order for the joins to meet. Notches or other devices were probably made on the plank to mark the proper location of
mortises. Once the plank was pounded down on the tenons and the fit was acceptable to the *hwj-wr*, the tenons could be locked with pegs. Pap. Reisner II mentions the bow-drill (*huqit*)\textsuperscript{25} among the MK dockyard tools, so there is no doubt that this was the device used to bore holes for pegs that passed through the keel, planks and tenons in the NK, when there is less mention of tools in the dockyard records. Tomb art from the NK documents the use of the bow-drill (fig. 23). Three basic components manifest themselves in the scenes and preserved examples: a wooden cylinder with a bronze drill bit set in it, a drill-cap of stone or dense wood
(e.g., *dom palm*) that allowed the cylinder to rotate while holding the tool in place, and the wooden bow (*pdt*, usually with *wn*), which was spanned by a string that wrapped once around the cylinder and imparted the critical spin by being moved back and forth. Bits were round or square (preferable since it would not turn in the cylinder) in section with a flat, sharp edge which Killen likens to a screwdriver blade. Bronze drill-bits were also found aboard LBA ships, as two from Ulu Burun demonstrate; these bits exhibit square sections of ca. 1 cm, flared, v-shaped edges, and lengths between ca. 13-15 cm; the v-shaped edge would probably start more easily than a flat one.

Pegs of a suitable hardwood, e.g., acacia, *dom palm*, oak, sidder, or yew (see Appendix D), were driven in with mallets which locked the plank firmly in place. Consecutive planks were fastened in this manner and scarved as lengths of timber and hull shape determined. Several types of scarved joints were used by the craftsmen who built earlier funerary craft. The OK Cheops barge, for example, used several types of scarves, including diagonal, s-shaped, and several variations of the locking scarf (fig. 24a). In the MK Dashur hulls we see, almost exclusively, strakes comprised of "butt joints" where one plank meets another on a straight edge perpendicular to its length; there is one true scarf in the Cairo 4925 hull (fig. 24b).

So far we have relied on knowledge of later boatbuilding techniques and common sense to reconstruct the NK boatbuilder’s craft. This has been necessary because the NK dockyard records do not provide solid grounds for stating the order of assembly of boat parts. Because of its lists of actual boat parts, Pap. BM 10056 is the most explicit ancient text that relates to NK boatbuilding. However, it has been argued that Pap. BM 10056 may only record the repair or refurbishing of boats and not complete hull construction, which is what we are most concerned with. Beyond what has been described above, little can be said with confidence as to when certain members were installed. The order in which the remaining hull members are presented reflects a speculative notion of how the boat was finished.
Endposts, i.e., stem and stern-posts, are mentioned in Pap. BM 10056 as *tp-ht*. They are not common on depicted boats in the NK; we see them on funerary barks as a rule. But it is the exceptional cases that are the most instructive in this matter. Substantial posts are seen at Deir el-Bahari on Hatshepsut’s expeditionary vessels (fig. 25a), at Medinet Habu on Ramses III’s war craft (fig. 25b), on Syrian ships in the Theban tombs of Kenamun (fig. 25c) and Nebamun (fig. 25d), and at Karnak and Abydos (fig. 25e). These craft have at least one thing in common besides endposts: they were all intended for sea voyages. Endposts served as devices for preventing submersion of the decks in high seas, so it is no surprise to find a reference to endposts in Wenamun’s report of his adventures at the close of the NK.²⁹⁶ The placid
waters of the Nile posed no such threat, and thus we see that the cargo boats and travelling boats that belonged to dignitaries have no endposts. It would be convenient if we could link the occurrence of "endpost" or even decorative "finial" (drdt)[237] pieces for endposts with a particular ship or type of ship in Pap. BM 10056, but the term occurs where there is no clue to which ship or shipwright the pieces were given. That seagoing craft were definitely produced at Prw-nfr is suggested further by the types of boats being built by at least three of the ħmw-wr: Mont, Yena and Tity were each involved with building Kefī ships, which Glanville proposes are Cretan-influenced, seagoing merchantmen.238 The significance of Cretan-influenced ships being built in Egypt is of special importance for this thesis, since it proves that boatbuilding techniques of the NK may reflect those of other powers in the Eastern Mediterranean during the LBA.

Scaffolding may have been used to support the hull—and give workers access to it—as it grew up from the keel. Examples of scaffolding for other purposes are seen in the artwork of several tombs (e.g., fig. 26). It would appear from these scenes that relatively narrow logs are lashed with leather or papyrus thongs to erect what looks much like modern scaffolding.

Frames and/or floors were probably installed after a given number of strakes
were erected. Floors are present in the funerary barge of Cheops and are among the timbers found at Lisht.\textsuperscript{239} The well-known Dashur hulls from the MK have no frames or floors. However, the mortise-and-tenon joinery incorporated in the Dashur hulls does lend some rigidity to the planking shell. The absence of frames in the Dashur boats might suggest that perhaps frames or floors were not as necessary in a mortise-and-tenon fastened hull if other stiffening elements (such as through-beams) were used. However, since the Dashur hulls were not designed to sail or carry cargo, I would hesitate to extend that conclusion to the type of craft we are concerned with in this thesis. On the other hand, the timbers found at Lisht exhibit mortise-and-tenon joinery and framing simultaneously.\textsuperscript{240} Thus we can say that framing and strong internal joinery were probably necessary components of merchant hulls as early as the MK.

In the MK dockyard records, a tentative definition of "frames" or "trestles" is offered for \textit{s3hw}.\textsuperscript{241} A very similar (if not identical) term--\textit{s3w}, in Pap. BM 10056--is translated as "beams" by Glanville.\textsuperscript{242} Gardiner, on the other hand, translates \textit{sw3} as "planks."\textsuperscript{243} Also in Pap. BM 10056, frames ("ribs" to Glanville) are called \textit{wg3}, and are always of \textit{s'-wood}.\textsuperscript{244} Although there is an amount of play in translation with regard to these terms, Glanville points out that \textit{wg3} is one of the better understood technical terms.\textsuperscript{245} For myself, it seems difficult to identify with any certainty the
Egyptian word for "frame" based on these varying definitions. One could reasonably conclude, however, that it was either s3w or wg3.

Fig. 27 Ramesside cargo vessel with removable mast, as seen in the Theban tomb of Apy, from Davies (London 1927) pl. XXX.

A mast step (ḥṣ. 247 or hptw 248) in the keel has never been found on an ancient Egyptian hull, and the models and reliefs offer little evidence for how masts were stepped in the NK. The step could be carved at any time after the laying of the keel, since we know that at least some boats carried removable masts. Fig. 27 shows an example of a removable mast that has a chamfered foot for insertion in a mast step. Pap. BM 10056 records a mast of 3 for the Kefit-ship (a Cretan-influenced merchantman) built by Yena as being 30 cubits (ca. 15.7 m) in length. 249 This bit of information may actually help us estimate the overall length of the vessel: if one takes the average ratio of the length of the hull to height of the mast from the Syrian ships of Kenamun and Nebamun, and Hatshepsut's fleet (i.e., seagoing merchantmen of which we have detailed depictions), then a hypothetical length could be calculated for the Kefit-ship as a function of the height of its mast. Of course, for this formula to be valid, one must grant the assumption that Cretan influence would help produce a hull with proportions falling within the range of Syrian and Egyptian ship proportions. That assumption is not demonstrable at this time, but may still be valid.
for approximation. Other sources of error include possible compression of
dimensions to fit the registers and the fact that we cannot see the bottom of the hull
(where the mast is supposedly stepped), which gives us a low figure for the length of
the mast. Despite these limitations, I offer the following ratios for the ships of which
the top of the mast and entire length of hull is visible: Kenamun A = 1:1.2;
A range of 36 to 51 cubits, or 18.8 to 26.7 m, is obtained with these ratios. However,
the average mast length-to-hull length ratio is 1:1.5, so we can hypothesize that the
length of Yena’s Kefit-ship was ca. 45 cubits, or ca. 23.5 m long. This figure is still in
the high end of the range of possibilities; I favor the lower values (ca. 19-22 m) since
the mast length is shortened in the scenes by compression of the registers and the
waterline. We will compare these figures to other hull dimensions arrived at in
Chapter IV below.

Deckbeams or through-beams must have been added after most or all of the
sides were planked. Reliefs and models from the NK show how high the through-
beams were located in the hull (fig. 28); by virtue of their position, they also
supported the deck planking, which is why they are sometimes called deckbeams.
However, the main function of through-beams was to transfer stress to the planking
shell, where it was distributed evenly through the joinery and strakes due to the
shell’s cross-sectional shape of an inverted arch.249 Pap. BM 10056 contains several
words (sw3, wnh, lbs.t)250 that may mean "through-beam." oS is the wood used in each
case.

The lengths of some beams may suggest the width of the ship being built; the
longest beams of 10 to 11.5 cubits suggest a ship with a maximum breadth of ca. 5.2
to 5.75 m. Taken with the hypothetical length of 19 to 27 m, we can calculate
hypothetical beam-to-length ratios of 1:3.3 up to 1:5.2.

Deckbeams seen in the Cheops barge and the Dashur hulls do not protrude from
the hull. Many NK representations and models demonstrate protuding through-
beams,251 but there is an equal number of models and depictions without that feature.
It is difficult for us to ascertain if there was a significance to this difference, if it was
anything more than cosmetic. The absence of frames in the Dashur hulls has led
Haldane to propose an important role of deckbeams in the overall structural integrity of those vessels. Through-beams in the boats found at Dashur were fastened to the upper strake with treenails driven from the outside; for additional strength many were fit into carved notches as well.\textsuperscript{252}

Once the deckbeams were in, planking could be laid over them. To what extent different types of boats were decked is a question that can hardly be addressed, but NK models suggest that the travelling boats that carried officials upon the Nile were fully decked.\textsuperscript{253} Tomb art also shows objects and people supported by something throughout the length of the boats. It is impossible to know, for the various type of merchantmen (\textit{imw})\textsuperscript{254} built at \textit{Prw-nfr}, what sort of decking was used because there are no ships of the period preserved up to that level, and the depictions are in profile. Glanville translates \textit{yms} and possibly \textit{ph3} as deck planking, both of \textit{\&}-wood.\textsuperscript{255} If he is right, then the assignment of these pieces to shipwrights in charge of building ships at \textit{Prw-nfr} shows that at least some decking was used in merchantmen. The
extent of decking is discussed in Chapter III.

At this point in the construction, the hull is solid and has reached its final shape. The planks would now probably be finished on the outside with adzes to fine-tune that shape. If necessary rubbing stones could be used to achieve even a finer finish. Rubbing stones ($\text{n.t.}^2$)\textsuperscript{257} were the Egyptian equivalent of sand-paper and can be seen in an MK model of a workshop—unless these are whetstones\textsuperscript{258}—and a few NK carpentry scenes (fig. 29). Oil and sand were used with them to control abrasion.\textsuperscript{259}

Of course a hull needs to be more than solid to begin its service on the water. In order to make the hull waterproof—not absolutely, of course—caulking (pounding papyrus, bark, or softwoods into crevices with wooden mallets) the seams of the hull may have been necessary, since even the most precisely built hull would probably develop leaks through shrinkage and expansion. But what evidence is there for caulking? The funerary craft of Egypt, as we know them, were not caulked, but again we must admit to their unsuitability as models of Egyptian hull construction, since they were never in the water. Caulking is not illustrated in Egyptian art, and we lack the words for materials they may have used, unless they have been overlooked or mistranslated. However, one would not expect to find a lot of evidence for caulking even in boatbuilding sources, as it was a procedure that was probably done after the boat was finished (we may hypothesize that the finished boat was put in the water for a period that allowed the wood to expand, and was then dry-docked again for caulking). The shipwreck at Ulu Burun may yet yield contemporaneous evidence on this subject, but no caulking was found in the small section of hull heretofore examined.

Herodotus' observations of Egyptian boatbuilding in the 5th century BCE include a controversial passage that may mention caulking (from \textit{\text{nkrto\textbackslash o\textbackslash r},} lit., "they caulked" or "they fastened") with papyrus (Herodotus II.96).\textsuperscript{260} The problem with this passage is that it allows one to interpret the fastening technique as either papyrus

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{image}
\caption{Workers finishing a wooden column with stone rubbers, from Davies (New York 1973) pl. 53.}
\end{figure}
lashing or mortise-and-tenon joinery. I see no way to resolve this question with
current information, so we are left in doubt as to how the Egyptians caulked their
hulls, if in fact they did.

A final preparation of the hull would be coating the timbers with some sort of
sealant. Terebinth resin was imported by the Egyptians for various purposes, one of
which may have been boatbuilding.260 Theophrastus describes in detail the processing
and utility of pitch or resin, which can be used in coating hulls inside and out for
sealing and discouraging teredo attack.261 Ballard proposed that Hatshepsut’s ships
pictured at Deir el-Bahari were given a coat of resin for sealing.262 Resin could be
heated to a liquid, then applied with brushes.

Here ends discussion of the hull proper as far as its constructional features are
concerned. Attributes of the superstructure, including the rigging, will be discussed
to some extent in the next chapter. One can see in NK representational art how a lot
of the superstructure was built and we need not discuss it any more than Vandier263
already has. Construction of the highly ornate cabins seen on NK boat models and
many represented boats of the NK was an art all its own (fig. 30). Specific words
and offices that pertain only to the construction of the cabin are mentioned in Pap.
BM 10056 (see Appendix A). It was, however, a task not involving shipbuilding
techniques as we are discussing them in this thesis, so we will move on in the next
chapter to the problems of rigging and how the ships were sailed, given the available
depictions and models.

Hopefully the reader can now attempt to visualize the dockyard workshop and
the activities therein. A brief summary: a large enclosure, perhaps attached to a
palace or close to a palace’s large timber storage facility, is occupied with the
construction of several large boats, some as much as 27 meters long and perhaps
encased in intricate webs of wooden scaffolding; many men are employed therein,
and each boat has its own crew and supervisor; the environment is busy but
extremely well organized; scribes walk here and there checking to see how much
wood is needed where and how many tools are being used by a gang of workers;
perhaps one would see a special room set aside for sawyers who pull their oily rip-
saws through logs gripped in vertical vices; another room containing stones and oil
might be set aside for the sharpening of dull tools, perhaps their recasting; lastly, somewhere there would be one or more huge tool bins (fig. 31) for securing the precious bronze tools. Our picture is incomplete and unclear in some areas because of the limited nature of the evidence, but in reality the scene must have been quite lively.
Fig. 31 Model tool bin from a MK carpenters' workshop model, from Winlock (New York 1955) pl. 28.
CHAPTER IV
CONSTRUCTIONAL EVIDENCE OF SEAFARING CAPABILITY

Fig. 32 Egyptian ships on the sea: Hatshepsut’s expedition to Punt (left), from Naville (London 1898) pl. LXXIV; Ramesses III’s naval fleet (right), from Nelson et al. (Chicago 1930) pl. 39.

Introduction

Did NK boats possess the structural stability and handling characteristics necessary for navigating the high seas? The answer to this question has important implications for the study of Egyptian commercial and naval affairs, as well as the broader issue of Late Bronze Age trade. Towards answering this question, we are again compelled to consult indirect forms of evidence, since no Egyptian seagoing hulls have ever been found. Two problems immediately confront us: first, there are only two depictions of Egyptian ships on the sea (fig. 32); secondly, the textual references to sea and seafaring are not well-defined on the crucial issues, e.g., the Egyptian words for "Great Green," which most take to mean the sea, whereas Nibbi is adamantly opposed to any such definition. Both of these difficulties lend credence to the skeptics’ argument that the Egyptians were not seafarers. However, the skeptical theories are generally founded on a fallacious argument—viz., lack of evidence. On the other hand, it will be shown below that the structural properties of the most feasibly and conservatively projected NK hull are entirely seaworthy.

Hull properties germane to this discussion are lateral stability and rigidity, and
longitudinal stability and rigidity. Maneuverability of the sail must also be considered as it determined how the hull could be used. Structures related to these properties in NK boats would have been through-beams, frames, the keel and/or hogging truss, the mast and rigging of the sail.

Hull shape is also pertinent to the concept of seaworthiness. Based on the shapes of models and the Dashur hulls—and the hull lines taken off of them—most scholars agree that the shapes of Egyptian craft in the pharaonic period were quite seaworthy, even analogous to modern racing yachts.267

**Lateral Stability and Rigidity**

By NK times the Egyptians were well acquainted with wooden hull stability and its attendant problems. OK tombs show the sailing of wooden hull vessels,268 so the ability to stabilize hollow hulls must go back at least a thousand years prior to the NK.

Through-beams first appear in the First Intermediate Period (ca. 2200-2050 BCE).269 In the MK there are through-beams in the Dashur hulls, where they play an essential part in stiffening the boat laterally. These boats have no frames and, without through-beams, could support very little weight.270 Bell first discussed the strength of the Dashur hulls in terms of an inverted arch.271 To understand this theory, one conceptualizes the outer planking of the craft as an arch turned upside-down. As such, the water pressure exerted on the planking forces the strakes against each other and imparts greater rigidity. Within this model, one could picture the through-beam as a lintel or the floor beneath the door that holds the sides in place. According to the arch theory, it was necessary to load cargo onto the deck vs. down in the hold, since the latter loading would weaken the arch by concentrating stress at critical joins or weak points. But while there are several pictures of cargo on deck in the NK (fig. 33), there are many more in which it could be loaded below.272 As will be discussed below, this could be allowed by the presence of frames, or even more simply, by planks laid inside the hold.

Other visible functions of the through-beams in the MK hulls and models are to support deck panels and serve as rowing benches. The through-beams of the Dashur
hulls feature chamfered edges on the top surface that enable the deck panels to sit flush with the beams.\textsuperscript{273} The advantages in this refinement are safety and convenience for passengers and cargo alike. Models from the MK either have actual through-beams or simulations painted on the deck.\textsuperscript{274} Passengers and rowers are placed on these beams. The ability to remove any number of deck panels allowed the cargo space on deck to be maximized while accommodating the required number of rowers. The number of rowers changed with the prevailing winds and/or current, so the advantage of such a versatile deck design is obvious.

In the NK, the words for through-beam were ś3y, plural ś3w, and Ļyn.\textsuperscript{275} In the late MK a similar word, ś3hw (plural), probably meant through-beams, although
Simpson could not identify that term.\textsuperscript{276} Several boat models from the period have through-beams protruding from their sides at deck level. Likewise, most of the artistic renditions show through-beams as rectangles just below the top strake (see fig. 28a, 61). In very large vessels, more than one level of beams may have been necessary, as one sees in the depictions of Hatshepsut’s obelisk barge (fig. 34).

We are not fortunate enough to have a complete hull dating to the NK,\textsuperscript{277} but other evidence shows little change in the role played by through-beams in lateral rigidity. Dr. Dilwyn Jones has studied the NK boat models and reliefs and observes that “cargo continues to be shown stacked on deck presumably so that the cross-thwarts could transmit its weight to the entire hull surface and not at any one concentrated spot as would be the case if it were loaded below deck.”\textsuperscript{278} This is a reiteration of the arch theory. Of course, the fact that we see cargo on deck has no bearing on the possibility of there being goods below, since the profile perspective denies us a view into the hold.

Dr. Jones’ concern for stressing the inner hull is valid, but he obscures the main function of through-beams. First of all, cargo could be stored below safely if boards were laid beneath it to spread out the pressure. With frames beneath the boards, this would be even more effective. Secondly, the holds in these vessels were not very large, due to their narrow, papyriform shape, so one would expect to see cargo on deck in any case. Finally, if the bulk of the cargo was stored on deck, while the through-beams may have dispersed the forces evenly throughout the hull, lateral stability would be sacrificed by a center of gravity much too high for these shallow hulls. In other words, at least some of the cargo was stored below deck; otherwise the boat would likely tip over. The modern canoe provides a good analogy; you do not see people strapping their gear across the gunwales or standing up for very long without hazardous results. Likewise native American canoes were more stable than
their modern counterparts since the paddlers kneeled inside the hull, as opposed to the modern method of sitting on seats that are about even with the gunwale.

Through-beams are needed less for providing on-deck storage than for sustaining stress. Why then in the reliefs do we see cargo—even obelisks—on deck? Obviously, Hatshepsut’s obelisks were on deck because a flat space was required and it would be easier to load and unload them. The extra rows of through-beams attest to the need for lateral rigidity in this immense craft. Moreover, the through-beams are so intrusive as to make it impossible to put the obelisks anywhere but on the deck. Other deck cargoes might be dry goods (not to be placed in a damp place) or they could be simply what would not fit in the hold.

The stress placed on hull members was much greater if there was a broad square sail and a strong wind. It is impossible to imagine a wooden, seaworthy vessel sailing without strong through-beams that transferred the massive forces of the wind evenly throughout the hull. Thus one notices through-beams on the Syrian ships depicted on the NK tomb wall of Kenamun (fig. 35). Even the river craft shown sailing up and down the Nile had through-beams in most cases.

Fig. 35 Syrian ship depiction in Kenamun’s tomb, from Davies (New York 1930) pl. 15.
Did through-beams also serve as rowing benches and deck panel supports as in the MK? We do not know, but common sense dictates that they probably did. The uncertainty is due to the exclusively profile views handed down to us by the Egyptian artists and the lack of detail on the decks of NK boat models. Regarding the models, Dr. Dilwyn Jones said: "Although the typically compartmented deck painted on MK models is absent on NK models, it is probable that it was laid out in the same way as before, that is, with removable hatches laid over the cross-thwarts [through-beams]." Furthermore, the rowers in many of the reliefs are undoubtedly seated or standing on the through-beams that appear below them on the sides of the hull (e.g., see fig. 36). And just as in the MK, the deck panels, in the NK called ḫmḥ, were probably removed to accommodate a variable number of rowers.

The other structural component to be considered in a discussion of lateral rigidity is the framing. Frames would contribute not only to the strength of a seagoing hull, but would help spread out the weight of cargo placed in the hull. Despite these technical advantages, the existence of frames in Egyptian hulls is controversial. In 1923 W.F. Edgerton asserted that the wooden ships of Egypt "never had ribs." This was a reasonable conclusion to draw before the discovery of the Cheops vessel. In 1940 R.O. Faulkner argued, on the basis of one of the Dashur hulls which had recently been displayed at the Field Museum, that "Egyptian ships had no keel, but consisted of a shell of planking with light ribs at comparatively wide intervals." How he got the idea for frames from this hull is a complete mystery, since the Dashur hull in Chicago has no frame-like components. Three years later J. Hornell stated that ribs were only used in seafaring craft, such as Sahure's OK ships or Hatshepsut's Punt ships. To substantiate this claim, he cited the Egyptian words for "frame" discovered separately by two French scholars, Boreux and Jequier. Jequier found the term ḫwaw used eight times for "ribs" in the NK, while Boreux—fourteen years after—found it in the Book of the Dead. The same term occurs in
the dockyard records of Pkw-nfr (Pap. BM 10056) and in 1933 was defined by Glanville as "ribs." Finally, in 1970, Landström reasoned that ships showing keels--and which were similar to Tutankhamun's and Amenophis II's boat models--probably had frames, but he was at a loss to describe them because of the limited nature of the evidence.

In general, the arguments against the use of frames are based on their absence in existing funerary barges and an observation in Herodotus (II.96), in which frames are not used in constructing a boat that does have a keel. On the other hand, timbers found at Lisht dating to the MK provide solid evidence for frames in Egyptian hull construction. The shipwrecked hull at Ulu Burun--which has a keel--is still covered and thus cannot help us settle this matter. However, we must still be careful not to expect that what is uncovered at Ulu Burun will tell us everything (or necessarily anything) we want to know about NK shipbuilding.

First let us consider the negative position, i.e., that frames were not used. What need is there in a barge with no sail, bearing little cargo, and navigating a smooth river for great lateral rigidity? Very little. The Cheops and Dashur hulls were funerary barges. One should not expect to find structures associated with seafaring in those hulls. The Dashur hulls have mortise-and-tenon joinery and through-beams, and thus were more than stable enough for the relatively placid Nile waters. But the Cheops barge was fastened with lashings and could not be so rigid without other components. In fact, frames are used to provide the lateral rigidity necessary. Why, then, doubt the existence of frames in Egyptian boatbuilding when even a river bark used them? Perhaps it is philhellenism that clouds the objectivity of those who read Herodotus. It must be emphasized what little information about general boatbuilding is contained in Herodotus' account. He only described the construction of one type of vessel, a baris, hundreds of years after the NK. The boat in Herodotus is built on a keel, but beyond that we do not even know whether lashing or mortise-and-tenon joinery was used. We do know is that it was strictly a river craft, so whether or not it had frames is irrelevant to an argument concerning seafaring craft. The absence of frames simply supports what the Dashur hulls demonstrate: that sufficient rigidity for riverine navigation can be achieved without frames. In sum, the case
against frames in Egyptian seafaring or cargo vessels is baseless.

Fig. 37 Timbers from Lisht, from Haldane, *Boatbuilding in Ancient Egypt* (presented to the Maritime Egypt Conference, Alexandria 1987).

The case for frames is relatively strong for cargo or seagoing vessels. Haldane describes the frame found at an early MK site at Lisht: "The 1914 excavators discovered a frame with a group of other timbers beyond the outer court on the west side of the pyramid complex. The following description [our fig. 37] is based on drawings and photographs kindly provided by Dieter Arnold from the Metropolitan Museum of Art Archives. The frame is built of three timbers: two upper timbers about 1 m long fastened to a 2.4 meter-long curved floor timber by mortise-and-tenon joints and webbed lashing."

Haldane continues, "The top timbers are about 15 cm sided (wide) and 20 cm molded (high) near the inboard ends. The outboard ends are notched and continue the curve shown by the floor timber for 40 cm on one side and about 25 cm on the other. The inboard ends of the timbers are separated by about 50 cm; this opening corresponds to a 1 cm deep notch on the inner face of the floor timber."

"An illustrated section of the floor timber suggests that it is about 12 cm molded and 22 cm sided. It has 12 slightly triangular notches on its outer face that measure, on average, 5 cm wide at the base and 10 cm deep. There are also three circular
holes 8 cm deep and 6 cm in diameter in the outer face. One is located directly in the center of the frame; the other two are about 80 cm distant on either side of the central hole.291

In her analysis, Haldane points out the important distinction between funerary hulls and the timbers from Lisht, viz., that the Lisht timbers represent "the remains of what were probably working boats."292 There is no reason to think that NK "working boats"—as opposed to funerary craft—did not employ frames in their construction, since frames have been used in wooden hulls throughout the world from OK times to the present. We should not overlook Homer, who describes the building of Odysseus' ship as including frames, or οξύμετροι in ancient Greek.293

To summarize this discussion of lateral rigidity and stability, one can be sure that through-beams were an important part of seagoing and Nilotic sailing craft at this time. It is highly probable, yet inconclusive, that some river craft and all ships used frames, the timbers from Lisht currently being the best evidence. It is important to realize that while the technical details may not be in perfect order, the evidence does permit us to say that the Egyptians knew the value of lateral rigidity and stability.

**Longitudinal Stability and Rigidity**

A ship must be able to hold a straight course on the open sea. If a ship drifts laterally when the wind pushes against its hull or its sail, the force of the wind is wasted and the ship is not propelled in the direction in it is pointed. Here, we shall call this ability to hold a course longitudinal stability. The structures that impart longitudinal stability also contribute to what will be called longitudinal rigidity. The swelling of the sea causes various amounts of the hull to be partially—or completely—unsupported by the buoyancy of the water. This places strain on the entire hull, but the greatest stress is on the ship's spine, or longitudinal axis. To keep the hull from "breaking its back," structures must be incorporated that maintain the proper longitudinal rigidity. "Rigidity" should not be taken here so literally as to imply that there was no flexibility in the hull. Flexibility is crucial. Longitudinal rigidity was imparted by certain structures to prevent excess flexing of the hull's extremities.

In order to discuss longitudinal stability, it would help to know the approximate
length/beam ratios of seafaring hulls. It would also help to know how much of the hull was actually underwater when loaded. From several depictions we could calculate the proportion of the hull that sits in the water, but most of these are of Nilotic vessels. Length/beam ratios can be taken from models, but all of these are of nilotic craft. Although some seafaring depictions can be relied upon for a certain amount of accuracy (some scenes are exact in detail, and some even drawn to scale), the beam cannot possibly be calculated from the profile view. Thus there can be no purely quantitative method of determining accurate length/beam ratios for the seafaring craft. One could judge by their appearance that the ratios were somewhat close to those of the Nilotic sailing (travelling) craft. Ratios for the models of travelling craft are calculated below. In Chapter III, I estimated the length/beam ratio of a Kefii ship in Pap. BM 10056 to be somewhere between 5.2 and 3.3. This seems to be a reasonable figure, but it is based on averages and assumptions that are not necessarily valid for attaining any degree of accuracy. The sailboat models (unfortunately, the entire rig has been removed from them) of Amenhotep II, since they possess through-beams and a keel (characteristic features of NK seafaring hulls), may be helpful in corroborating this ratio.

Cairo 4944 (fig. 38) from the reign of Amenhotep II (ca. 1450 BCE) is 2.34 m long and .38 m wide at midships, giving a 6.16 length/beam ratio. Cairo 4945 (fig. 38) is 2.1 m long and .36 m wide, a length/beam ratio of 5.83. Cairo 4946 (fig. 38) is 2.72 m long and .39 m wide, a length/beam ratio of 6.97. These are very long vessels for sailing compared to the usual 3 to 4 length/beam ratios common among ancient sailing ships. However, most ancient ships did not have so much hull out of the water at the extremities. This peculiarity erroneously inflates our ratios. If we could somehow estimate what length of the hull was actually in the water (i.e., waterline length), then we might correct the ratios. By using the length of the deck (instead of overall length), the ratios change considerably. Cairo 4944, with a deck length of 1.2 m, has a modified length/beam ratio of 3.75. Cairo 4945, with a deck length of .95 m, has a modified length/beam ratio of 2.64. Cairo 4946 has a modified length/beam ratio of 3.38. These figures are much more reasonable--slightly beamy, perhaps--for sailing craft. Since we do not know the actual waterline length of the boats
Fig. 38 Models from the tomb of Amenhotep II, from Daressy (Cairo 1902) pl. XLVIII. Note protruding through-beams and keel. A horizontal line drawn across each model represents the highest possible waterline (just below the through-beams).

represented by these models, I would estimate that the true length/beam ratios fell somewhere between the modified and unmodified ratios. Since the deck length is certainly a closer approximation of the waterline length (see fig. 38), the modified ratios reflect a truer length/beam ratio. Our figures fall generally in the 3 to 4 range, which are expected ratios for sailing ships. The ironic conclusion to be drawn from these estimates is that although the models appear too narrow for sailing the open sea, their actual proportions in the water may have been quite wieldy.

The same principle can be applied to the rigged model boats from Tutankhamun's tomb. Model nos. 336, 321 and 276 (fig. 39) are all of similar dimensions that for no. 276 are: overall length 1.18 m, max. beam .22 m, length of
main deck .615 m. From these figures comes a length/beam ratio of 5.36 and a modified length/beam ratio of 2.80. Again one sees that these ratios are about what one would expect of an ancient seagoing vessel. It is important, however, to remember that these models represent Nilotic travelling boats, which we can use only in a general way for interpreting aspects of NK ship design.

One good reason to say that the Egyptians were exploring the sea in the NK is the undeniable appearance of the keel. A keel protruding from the hull provides resistance to the water on an axis perpendicular to the longitudinal axis of the boat and thus reduces lateral drift and contributes to longitudinal stability. However, while the prevention of lateral drift is an asset on the sea or the river, a keel can be a hindrance on the river due to the frequency of sandbars. Egyptian literature abounds
with nautical tales and metaphors where hardship is often portrayed by the sandbar.\textsuperscript{294} To avoid snagging these obstacles, a smooth-bottomed hull with low draft is better than a deep hull with a keel protrusion. The Egyptians realized this and consequently the literal meaning of keel (\textit{pipit}) in their tongue is "mud-kneader."\textsuperscript{297} Thus nilotic sailing craft in depictions and as models are usually without a keel. It is possible, however, that the keel is actually there, but not protruding, in which case it would serve mainly as a stiffening component (this aspect will be discussed shortly).

Amenhotep II’s boat models (and the nearly identical no. 306 from Tutankhamun’s tomb) must again occupy our attention because they clearly possess keels. This feature seems peculiar on Nilotic travelling craft. In 1898 Daressy called them "sacred boats,"\textsuperscript{298} but that title should be replaced with "travelling craft" or "official’s boat" (\textit{b3w}),\textsuperscript{299} since the models are identical in appearance to the functional craft used by the pharaoh and his staff (e.g., see fig. 30, p. 64)\textsuperscript{300} in conducting governmental business, or "travelling," along the Nile. But the keels on these craft have a unique characteristic: they do not protrude from the central fifth of the bottom of the hull. Landström’s explanation for this peculiarity is that the keel was removed on the bottom so the model would not tip over when set on a flat surface.\textsuperscript{301} The problem with that answer is that the models are not balanced. They require external support in order to stand on display. I propose that the unusual keels in these models represent an invention that provided longitudinal rigidity and stability, but did not snag on the Nile bottom. How much of the keel was hidden must have been arrived at by experimentation.

The importance of maintaining longitudinal rigidity in Egyptian hulls is seen most clearly in the depictions of cargo-bearing vessels on the sea and the Nile. From as early as the OK, the hogging truss was used to prevent excess flexing and a resultant breaking of the hull.\textsuperscript{302} Huge cables of twisted fiber ropes were attached to the inside of the stem and stern (the method of attachment is

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{fig40.png}
\caption{Fig. 40 Punt expedition depicted at Deir el-Bahari, from Nibbi (Park Ridge 1981) pl. 4. Note rope around stem and stern.}
\end{figure}
unknown) and stretched over stanchions on deck which elevated the cable for greater leverage (the same leverage effect is felt when drawing a bowstring; less effort is required as the string is drawn farther away from the starting point). At some point along the cable’s length, some sort of device for twisting the cable was inserted. By twisting the cable, its tension was increased and the stem and stern were drawn upwards. Depending on the amount of cargo, this tension could be adjusted to prevent “hoggling,” or the longitudinal sagging of the hull, hence the term “hoggling truss.” The amount of tension in these cables was very great in some cases. For examples, note the binding ropes around the ends of the Punt expedition ships of Hatshepsut (fig. 40, p.78); these “girt-rope”s transferred the pull of the cables to the entire section of the hull so the cables would not tear out parts of the hull.

Before the advent of the keel, the hoggling truss or the central shelf, whichever was used, was the main component for sustaining longitudinal stress. The strongest longitudinal hull member was only a relatively thick central plank, which later was replaced by the keel. Even after the keel appears in the NK, however, we still see hoggling trusses in a few scenes (fig. 40, p. 78, and fig. 41). To understand the role of the early keel, these scenes should be explained.

From the funerary complex of Hatshepsut, we see evidence for boats with a hoggling truss, boats with a keel, and boats with both a hoggling truss and a keel. The obelisk barge of Hatshepsut naturally had a superb hoggling truss (fig. 34, p. 69). One could safely guess that the largest tree available would not have produced a keel thick enough to support the weight of two granite obelisks in this extraordinary vessel. C.V. Solver estimated the dimensions of the barge to be about 63 m long, 21 m wide and 6.5 m deep. The displacement of the ship and the obelisks together came to about 1500 tons! Even if a sufficient keel could have been built, would not a hoggling truss have been added just for caution? As Solver has

![Fig. 41 Cargo boats with hoggling trusses during Tutankhamun’s reign, from Davies (London 1926) pl. XVIII.](image)
demonstrated, this was no ordinary hogging truss, but was actually composed of many
cables in a complex system of supports and tourniquets.\textsuperscript{305}

In Hatshepsut's time (ca. 1486-68 BCE), we witness the earliest evidence of keels and probably the earliest experimentation with keels used in Egyptian boats. If there was a transition from the hogging truss to the keel, one would expect it to be gradual, which would go towards explaining the keel and hogging truss seen together in the Punt ships (fig. 40, p. 78). One can see that these were very long, large ships. The fact that they sailed the Red Sea and carried a large amount of cargo testifies to their need for the added support of a hogging truss. One needs to remember that these were unusual ships built for one purpose, and their construction probably does not reflect that of normal-size ships. The fact that smaller seagoing ships did not require both a hogging truss and a keel is demonstrated by the absence of hogging trusses in the scenes of Syrian merchant ships and the Sea Peoples battle. It is interesting to note that the towing vessels alongside Hatshepsut's obelisk barge have keels but not hogging trusses (fig. 42). So even at this early stage, the Egyptians apparently trusted in the keel enough for it to be the only longitudinal stiffening component, at least in some types of boats.

Another reason for hogging trusses still being used in the NK has to do with economics. Keels were very expensive to produce because they were cut from long, thick timbers, a rare commodity along the Nile. Small cargo boats (\textit{skty})\textsuperscript{306} built with locally available short acacia timbers would lack keels, but a hogging truss could be substituted at relatively low cost. The cargo boats pictured in the tomb of Huy are the sole examples in the NK of this (fig. 41, p. 79).

Besides the obelisk barge and Punt ships of Hatshepsut and the isolated example from Huy's tomb, the hogging truss has been replaced by the keel in the NK. It is used in cargo ships on the sea and in official boats on the Nile. Given the length and shape of the ships (19-27 m long, and 5-6 m wide, as
estimated in Chapter III), the keels must have been made of several pieces scarved together, and as stated above in Chapter III, the size of these timbers can only be guessed at unless we take the 21 cm wide keel at Ulu Burun as analogous. Thus the statement by Landström that the keel probably appeared in the NK is strongly supported here, although there is disagreement on the special keel of Amenhotep II’s model boats.307

The idea that foreigners brought the keel into Egypt is an attractive hypothesis, since the NK marks a boom in intercultural contact between the Aegean, Syro-Palestine and Egypt. To Landström,308 the Canaanite names that appear in the dockyard workshop documents (cf. Appendix C) suggest that the keel came from Egypt’s eastern neighbors. There is no conclusive evidence to support this theory, but the circumstantial evidence is enough to make one think that if the keel did come from outside influence, it most likely would have been from Canaan. Besides Canaanite names being in the dockyards, most of the military activity of the NK was taking place in Syro-Palestine. Timber was imported from this region also. The Canaanites certainly had the tools, timber and geography to pursue whatever nautical technologies they could imagine, and no foreign people had as much contact with the Egyptians in the NK as did the Canaanites.

Sailing

The other major consideration in this discussion of seafaring capability is the degree to which the sail could be maneuvered to capture the force of the wind.

Sails (ḥt3w cr ḫētalḥtw)309 were probably manufactured by men and women in weaving shops similar to those depicted in NK art and models. We have good reason to believe that sails were cloth—probably a tough linen—rather than papyrus since, in the reliefs, we see large pieces of cloth being made.310 Other considerations include the weight and strength of the available materials. In the case of large sails, leather was far too heavy and would have reacted adversely to repeated exposure to the salt and sun, while papyrus was light, but too weak, especially when exposed to water. No actual sails exist to settle this question, but the boat models from the MK and NK (all with linen sails) permit us to say that sails were made of a woven material. In the
tomb art of the MK and NK, one sees two basic types of looms upon
which these sails must have been made: the horizontal loom, supported just
above the ground (fig. 43a), and the vertical loom, which had an erect frame (fig.
43b). Both looms work on the same principles and it seems as if the vertical loom
was a NK invention that made the job of weaving less taxing on one’s back (note that
the NK weaver also uses a stool, as does his/her comrades in the dockyard
workshop).

Herodotus attributes papyrus sails to the cargo boats he saw in the 5th century in
Egypt.311 This statement should, however, only be applied to light craft such as
Herodotus described. Sails of travelling boats and ships would certainly have been
made of strong linen, as the models show us.

We have seen that ships were expensive to build due to the large amount of
precious timber that went into each hull. The cost of sails must be considered also,
as some were obviously very large and required a great deal of labor and fine
materials. Egypt was producing pieces of cloth large enough to be sails at least as
early as ca. 2000 BCE. The price of bulk linen is not among the prices known for the Ramesside era of the NK. However, we do know that some linen garments were expensive. The magnitude of the weaving industry needed to support the quotas of the shipyards would have been great; many men and women undoubtedly earned their living in the weaving trade. The economic importance of weaving—even as it was only related to shipbuilding—should be noted. In fact, Egypt enjoyed a wide reputation for its linen industry and capitalized on it in its trade relations with other powers.

The sail of the NK sailing vessel, ships and boats alike, was attached to an upper yard that hung from a single-pole mast. There were two basic arrangements: that with an upper and lower yard, and that with loose-footed sails, like one sees on the warships of Ramesses III (ca. 1195 BCE) (fig. 44). The size of the spars varied from boat to boat, some masts being as long as 30 - 40 cubits (ca. 14 - 18 m). Economic texts confirm timbers of this magnitude being sold for great prices. Yards were also apparently quite large and usually made out of two pieces lashed together. One suspects that the mast was stepped in the keel, since it would make sense and the depictions suggest this arrangement. Certainly, the evidence is not explicit in regard to this, but the shape of the mast’s foot in one instance (see fig. 27, p. 59) and the lack of any apparent means to support the mast on the deck suggest that it is secured in a mast-step. We can only hope that continued excavation at Ulu Burun will reveal some clues as to how keels were stepped in the LBA. Thus, some light may be shed on how masts in NK Egypt were stepped.

In every depiction of sailing in the NK, the mast is fitted with a cap for handling the lifts and lines that support the yards. There are several varieties of this device in the art and models, but they all function in the same manner. Fig. 45 depicts a typical mast cap used during the NK. The material was most likely bronze, although these shapes could be carved out of wood (fig. 45), and one could hope that the
archaeological record has preserved an example, as yet undiscovered. The rings on
the side of the cap guided the "false lifts," which were fixed lines holding up the lower
yard. The framework on the top, which was multiterriered in some cases, acted as a
guide for the lifts that raised and lowered the upper yard. It also guided back-stays
and/or fore-stays where these were used. On the warships of Ramesses III and
Syrian ships, the mast carries a crows nest which appears to be lashed to it; these
scenes testify to the strength of the masts.

The rigging is almost the same in every case, with only minor differences in the
varieties. A diagram of the rigging found on the models from Tutankhamun’s tomb is
equally valid for the rigging depicted in the reliefs (fig. 46). As we have said, the
lower yard is usually in two pieces, joined by lashings and sometimes featuring
specially "barbed" ends that prevent the lashing from working its way off. The lower
yard is further lashed as a whole to the mast at some height that is not so low that the
ends would become submerged when the ship was rolling. The lower yard is
supported throughout its length by ropes that run up through the mast-cap’s side
rings and back down to the yard. In this way the lower yard can be adjusted--or bent-
-into a smooth slight curve that gives the bottom of the sail its shape.

The upper yard (typ) is built the same way as the lower. It is controlled and
supported by three sets of lines in most cases. First, lifts run from the stern up through the top framework of the mast-cap and down to the middle of the upper yard. Other lifts run from the bow up through the mast cap and out to the ends of the yard, which would allow a mariner in the bow to adjust the attitude of the sail according to wind direction. He could also assist in the hoisting of the yard. When the sail is up, ropes that hold the upper yard in its lowered position are slack and appear as graceful curved lines over the sails in the reliefs. These ropes are a fixed length—one end connected to the mast cap, the other to the yard—so that when the sail is down, the weight is taken off the lifts.

In order to raise the sail (to "make sail" was ḫr ḫ3w),318 there must have been a concerted effort. Four lines were available for hoisting the upper yard: two lines in the bow that ran up through the mast-cap framework and out to the yard’s ends, and the two halyards that ran to the stern. To assist them in this task, there was of course
the pulley action obtained from the mast cap, always above the upper yard. Less obvious, though, is the bracing action they got from structures attached to the deck that are analogous to cleats. These are hidden in the tomb art (because they are low on the deck), but pieces from the decks of Amenhotep II’s boat models show the ingenuity involved (fig. 47). By pulling the ropes through the holes in these "cleats" at different angles, a belaying technique could be applied to the yard. Thus the yard probably went up in succeeding heaves—not one smooth pull—as the sailors pulled, belayed to rest themselves, and then pulled again. Obviously, at least one man would have to be between the "cleat" and the mast cap to break the belaying effect during the hoisting phase of the operation (fig. 48). The cleats may also have helped the lifts to act as fore and back-stays during sailing.

Fig. 47 "Cleats" from Amenhotep II’s boat models, from Daressy (Cairo 1902) pl. LII.

Fig. 48 Illustration of halyards and "cleat" as they were probably used (drawing by author).
In all of the artistic renditions of which I am aware—save that of Kenamun’s tomb, which is highly stylized—the upper yard is lowered to furl the sail. As the upper yard was lowered, sailors untied the sail from the lower yard and furled it to the upper yard. One tomb painting from Herihor’s reign (ca. 1090 BCE) clearly shows the sailors standing on the yard as they furl the huge sail (fig. 49). Other depictions show the sail already furled to the upper yard. The technique of loosing the sail first appears in the NK, and it came as a major improvement in navigation. When coming to dock or land, the speed of the ship could be reduced quickly by this method.

Fig. 49 Sailors furl the sail of an NK travelling boat, from OIP 100 (1979) pl. 19.

The warships of Ramesses III (fig. 32, p. 66) possess a different sort of rig. The sail is loose-footed, without a lower yard, probably so that warriors would not be obstructed by it as they moved about the decks, throwing spears, shooting arrows, etc. They also had crow’s nests so that approaching ships could be detected from as far off as possible. The sails of these ships required some sort of brailing so that, without the lower yard, they would hold the wind. No models of this type of vessel are known to exist.

Looking at all of the seagoing ships, it is interesting to recall Faulkner’s observation that Egyptian seagoing ships had no deck houses.\textsuperscript{319} I have found no exceptions to this rule and think that some explanation should be hypothesized. In
the context of our discussion, one has to ask "what disadvantage is posed by the deck house at sea?" Or in another way, "what advantage is gained from having a deck house at sea?" The first suggestion that comes to mind is that it would blow off, or be ruined, by the wind. Shelter would be taken below instead, and at night, a camp would be made on land. But if wind was the main objection to erecting a deck house, the Egyptian cabin craftsmen simply would have built a better one that could take the punishment.

A better reason for the missing deck house may lie in the fact that seafaring was more demanding than river navigation. For this reason, the sailors would have to perform their tasks with more efficiency than they would if they were on the Nile. Now, if one assumes that the deck house would represent something of an obstruction to the sailor, then a viable explanation for the absence of the deck house is at hand. The deck house posed only a minor obstruction to the sailor when he had to adjust the lower yard. On the Nile, the direction of the sail, and thus the yards, would probably remain in more or less the same orientation. Boats drifted downriver with their sails down, since the prevailing wind is out of the North. Upstream, the sail would be up and the boat would run with a following wind. On the other hand, the lines that control the sail's movement are located in the bow and stern (away from the deck house), and if the sailor had to get up the mast to tend lines, the deck house may actually have facilitated this.

Of course, the elevation of the deck house would force the lower yard to be elevated above it, hence the sail would have to be at least as high. A higher sail would increase the leverage of the wind on the hull, thereby increasing the stress on the hull and the chances of capsizing. A lower sail would be more stable, all other things being equal. Of course, they could always build a lower deck house.

The last explanation for the absence of deck houses that I will offer is based on the need for storage space in a cargo ship. There is no evidence to suggest whether or not cargo ships were fully decked. If they were decked in the bow and stern to allow the sailors their necessary footholds, but open throughout the middle, there would be no floor for the deck house, and therefore no deck house. Why would the deck be open in the middle? Because a deck puts a ceiling—i.e., a limit—on the
storage capacity of the hull. Without a full deck, the cargo could theoretically be piled as high as the lower yard, although this would be dangerous. So as a best explanation for the lack of deck houses on seagoing ships in the NK, I offer this suggestion: the exigencies of seaborne commerce effected an open hold, which in turn precluded the deck house. This explanation does not contribute directly towards our discussion of structure as determined by seaworthiness, but rather as structure that is determined by commercial gain, a closely related concept.

Although Faulkner gives the Egyptian sailors more credit than some authors, he underestimates the capabilities of a "ship rigged with a single square sail," which he claims "can only run with the wind fairly well aft; she cannot reach or tack, so that with a beam or head wind it is necessary for such a ship to lower her sail and to be propelled by oars."³²⁰ We know now that square sailed ships can do quite well on a tack, as the sea trials of Kyrenia II have demonstrated. Although this ship has a more malleable loose-footed rig, the yards of the NK rig had enough maneuverability to catch a side wind. To tack, the sailor in charge of the ropes connected to the ends of the upper yard—i.e., the braces—let one side out and pulled the other to turn the upper yard in the desired direction. Meanwhile a couple of sailors would be pushing the lower yard around the mast to best catch the wind. Perhaps future sea trials of a NK replica will demonstrate this theory of how the Egyptian square rig was handled.

To close this discussion of seaworthiness, one should be fair to Nibbi, who claims that Egyptians did not go to sea in Egyptian ships.³²¹ She makes many interesting arguments for her position in many works, but her arguments concerning "Egyptian anchors" are especially relevant here since they deal specifically with navigation. Basically she claims that pharaonic Egyptians were not seafarers since no anchors have ever been found.

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Fig. 50 Cargo vessels at Amarna docked with mooring posts, from Davies (London 1908) pl. XXIX.
in pharaonic Egypt. What Ms. Nibbi has failed to realize—at least as late as 1975—was that stone anchors of the type we generally associate with the Bronze Age had no purpose in Nilotic navigation! No anchors appear in NK scenes. The mooring post appears in enough depictions (e.g., fig. 50) to tell us that they moored with ropes attached to stakes that were driven into the river bank. Naturally, the mooring post has names in the ancient texts—mnh and wjyt. I do not know why Nibbi should be surprised that no name appears for anchors if they were never seen along the Nile. She is arguing strictly from lack of evidence; that is, that so far the word for anchor has not appeared in the very limited body of seafaring tales. The other pillar of her argument was the absence of anchors in Egypt. However, since her article was published L. Basch has reminded her that a stone anchor was found at Karnak. Furthermore, it may be that "Egyptian anchors" discovered in the Levant show just how incorrect she was in regards to Egyptian seafaring. More importantly, though, one should note the difficulties inherent in the term "Egyptian anchor." Every anchor thought to be Egyptian has been found outside of Egypt, while the only anchor (the one from Karnak) found in Egypt is actually of Cypriot origin. Thus one can see the danger in basing such a broad theory as Nibbi’s on such tentative evidence. In contrast to her statements, the logical conclusion to draw from the limited evidence of "Egyptian anchors" is McCaslin’s; viz., that "...such anchors were specifically meant for sailing voyages outside Egypt, given that no indisputably Egyptian stone anchor has yet been found in Egypt itself." 

As Faulkner has summarized, seafaring by the Egyptians was common by the time of the NK: "Queen Hatshepsut seems to have gotten the ball rolling with her famous expedition to Punt; Tuthmosis III establishes military bases at the principal Syrian harbors to which troops were transported by sea, and by virtue of his sea-power exercises a kind of loose authority over some at least of the islands of the Eastern Mediterranean; Egyptian merchant ships trade to Syrian harbors, and Syrians bring rich cargoes to Egypt; Amenophis III organizes a naval police force to protect the coast from piratical raids; Ramesses III fights a victorious naval battle, and even in the period of decline Wenamun sails to Syria to buy timber for the sacred bark of Amun. In view of this long history of seafaring the gibe that the
Egyptians were no sailors is devoid of justification."  
I would agree also with Basch, in light of the seafaring capability demonstrated in 
this chapter—and the constructional skill demonstrated in the last—that the Egyptians 
knew how to build and sail several kinds of seagoing ships."
CHAPTER V
SOCIO-ECONOMIC POSITION OF THE BOATBUILDING CLASS

Introduction

The discussion that we are embarking on below is a very problematic one. First of all, since the body of data is so limited, necessity dictates that we consult evidence regarding the larger class of woodworkers and other artisans. Fortunately, we can be confident that boatbuilders did fall into the category of woodworkers for economic and social purposes. But Egyptologists have not agreed on the social position of those falling into the more general category of craftsmen. There is a small body of evidence concerning two "shipwrights" who were quite famous in their time. The stelae left by Inena and Nakht-Thuty will be discussed towards the end of the chapter, but for now, it may be useful to know that they were not boatbuilders in the pure sense; they were artists who built sacred barks for the high officials and pharaohs of Egypt. Their story has little bearing on the social or economic position of true boatbuilders, as we would identify them.

Looking at the economic and social conditions of the NK, one has only written records for evidence. From Deir el-Medina and Medinet Habu we have information regarding workmen and their communities. These are not groups of boatbuilders, but since they fall into the category of artisans or craftsmen, a generalization is valid, particularly in view of a close similarity in the underlying organization of all these artisans. Cerny's description of the work gangs, with its hierarchy of officials, is reminiscent of the dockyard workshop organization in many ways. After detailed study of the Deir el-Medina texts, Janssen has concluded that, in general, the "economic outlook" in this community was representative of the rest of society and can be characterized by what he calls "village economics." Without restating Janssen's entire thesis, one can capture the essence of "village economics" in the statement that "the Egyptians did not use any money at all—not valuables in so far as they represented money, but it was the objects themselves which they tried to obtain." It is important to keep this assumption in mind if we are to understand the NK boatbuilder's motivation.

It was stated above in the second chapter that the dockyard workshop was closely
connected to the palace. Actually, the economic relationship between the temple, palace, and craftsmen is contested by egyptologists who cannot agree on the roles of the temples and palaces in the economic structure of Egypt. We can bypass this obstacle if we adopt the more recent theory that the temple and state of NK Egypt were not separated as church and state have been in modern times.\textsuperscript{338} In other words, I do not wish to address the issue of who actually paid the workmen, whether it was the palace or the temple. Workmen were paid by the state, which could have been either the palace, the temple, or both. Palace and temples were both capable, since every temple had its own treasury, from which craftsmen were paid.\textsuperscript{339}

Not everyone in the dockyard workshop received the same amount of payment. It is certain that those holding offices received more, since the same is true for work gangs.\textsuperscript{340} Women received less than men.\textsuperscript{341} Men received more than boys.\textsuperscript{342}

Despite the claim that Ramesses II took good care of his workmen, it is widely held that the artisan or craftsman was near the bottom of the socio-economic ladder. We must assume this was true for the boatbuilder as well. According to Sliwa, "The NK professional rank of the craftsmen engaged in woodworking had not been too high, especially in case of workers performing subsidiary activities (sawing, a work with an adze or with an axe)."\textsuperscript{343}

Subsistence Needs

At Deir el-Medina, workers were not paid with money, but with goods they needed in order to survive. An officer was in charge of supplies, i.e., bread loaves, fish, beer, oil, and grain. It seems that workers ate well, at least on the job. Payment was on a "need" basis; that is, a man with a large family would get more grain than a young, unmarried boy.\textsuperscript{344} In the middens of the workmen's villages at Deir el-Medina and Amarna, pig and fish bones were quite common, suggesting that these were the essential dietary meats of workmen in the NK.\textsuperscript{345} But Janssen states that the meats were raised by those in the workers' villages,\textsuperscript{346} so it would seem that grain was the only form of payment the worker actually took home. The rest he had to produce for himself or barter for in the village.

Housing and land were also obtained through the grace of the state, and for the
boatbuilder, there was not much of it. Most, if not all, employees of the dockyard workshop lived in a workman’s village, such as Deir el-Medina. According to the Wilbour Papyrus of Ramesses V (ca. 1157-1153 BCE), craftsmen owned land only in the rarest cases. Those who owned land were either distinguished officials, warriors, or those who used the land to produce goods for the state, e.g., bee-keepers and herdsmen. These few craftsmen who were land-owners were probably, like Inena and Nakht-Thuty, ones who distinguished themselves by serving royalty.

One can see the parallels between the above situation and the feudal system of the Middle Ages. So it would be fair to suggest that the boatbuilder worked on a corveé system, obtaining grain for his family that otherwise made a living in the workman’s village by tending pigs, catching fish, weaving, etc.

The system was not as rigid as it may sound at first. People did advance, but usually in a linear fashion. What that means is that sons of craftsmen, such as boatbuilders, usually followed in their father’s footsteps.348 Advancement was based on merit and recommendation to a higher officer, and eventually to the vizier. Being noticed by the right official often required a little bakshish, or bribery.349 But anyone who accomplished official status ultimately had to know how to write, so in this way, education determined one’s ability to advance. Many of the better posts were inherited, but virtuous men could still be recommended for coveted positions. And available positions were highly coveted, since there were more young men than jobs.350 However, even if one was an official in the area of crafts, the outlook was not much better than that of the average worker. They were still low on the ladder, living near their fellow workmen and being buried in the same necropolis.351

Religious Preference

We have already mentioned in a previous chapter that Ptah was the patron god of craftsmen, and certainly that of shipwrights, since the great dockyards at Memphis were directly associated with Ptah.352 Janssen also finds that an estate working for the temple of Ptah handled shipping in the NK, though building ships may not have been part of the operation.353 The title of the high priest of Ptah at Memphis was "Greatest of Craftsmen."354
Egypt was always tolerant of religious variance among its subjects, so it is no surprise to see other deities receiving homage as well. At Prw-nfr, the dockyard from which we get so much information about boatbuilding, Amon-Ra, Seth, and Astarte were worshiped also. However, it is very curious that Ptah is not mentioned in the extant dockyard records of Prw-nfr, and likewise not mentioned on the stela of Inena, a renowned bark-builder. Is it possible that Ptah was supplanted at Prw-nfr by these other deities? Indeed, was Ptah necessarily the patron god of all shipwrights? It is highly probable that the discrepancy arises from lack of evidence. Nevertheless, one should be judicious in applying the title "Patron God of Shipwrights" to Ptah. As a general rule, Ptah would have been preferred at Memphis, and Amon-Ra at Thebes, their respective centers of worship.

Social Position

It might strike one as somewhat unfair that a class of people so vital to Egypt's greatness was not duly recognized in its time. Such is undoubtedly the case with many great artists and craftsmen of the Preclassical Age. Anonymity seems to be the norm rather than the exception. The architect Imhotep, designer of the magnificent funerary complex of Djoser, is one exception from pharaonic Egypt. In the realm of boatbuilders, we have no great ones. Inena has to be discounted on the grounds that all we know is that he built sacred funerary barks for his clientele. Of course it is very possible that he worked his way up from being a worker in the dockyard workshop, but we have no basis for that fanciful interpretation. Likewise Nakht-Thuty can be dealt with in the same way. The evidence overwhelmingly points in the other way; boatbuilders were a motley crew.

Craftsmen/artisans are always characterized in the middle of the lower classes. In a list of the lower-ranking jobs in NK Deir el-Medina, the woodcutter rates just above the door-keeper and gardener. We saw in the first chapter how some positions of the dockyard could be even worse. The outworker's job was characterized as the worst of all. And it was just mentioned that artisans were not among the landowning class. Similarly, sailors in the employ of a shipping estate at Memphis are referred to as "free peoples of the lower classes." That reference
suggests that they were barely better than slaves! Along that line of thought, consider the Asiatics at work in the dockyard at *Prw-nfr*. They were certainly not among Egypt’s upstanding citizenry, at least not in the eyes of the landed society. The only respectable individual known to be connected to boatbuilding was a "scribe of the dockyard," whose position was still described as "a modest one."³⁶¹

Finally, if one looks at the NK tomb decoration for any evidence of boatbuilding in its proper sense, nothing will be found. If future research uncovers something to the contrary, I will modify my thesis accordingly, but the present lack of any recognition for those of the boatbuilding profession—in this life or the hereafter—is a strong, albeit silent, testimony to their arduous days along the Nile.
CHAPTER VI
SUMMARY

Some general conclusions about the boatbuilding industry of the New Kingdom can be taken from the preceding chapters. These will now be reviewed.

First, it is unfortunate that there is little clear, or direct, evidence that one can apply to this problem. As a result, I have relied on the combined input of history, archaeology, linguistics, art, analogous information and a lot of well-guided (one hopes) inferences.

Secondly, the men and women employed in the timber gathering industry and dockyard workshops worked in a highly organized and sophisticated system typical of most industries operating in pharaonic Egypt. Several technological innovations, including new forms of tools and looms, and the increased availability of imported timber via expanding trade put the New Kingdom boat builder at an advantage over his predecessors.

Thirdly, the seafaring capability of New Kingdom ships cannot be disputed, as they had the hull characteristics necessary for sea navigation. Recognizing the advent of the keel in the New Kingdom is especially important to understanding and accepting the idea that the Egyptians were seafarers and conducted their seaborne commerce aggressively. There is likewise enough evidence to determine how the sails were rigged and operated. This information also supports arguments for the seafaring capability of Egyptian ships in the New Kingdom.

Finally, it is somewhat ironic that an industry so vital to Egypt’s indigenous and intercultural ways of life is so poorly represented in the archaeological, historical and artistic records. This fact, plus the few allusions made in ancient texts, suggest that the New Kingdom boat builders did not enjoy a high social position; indeed, they seemed to have wielded almost no prestige at all.

2. Following the chronology set down in J.A. Wilson, *The Culture of Ancient Egypt* (Chicago & London 1951) 319 and 320, although slight changes for many dates are continually proposed.

3. Lipke (supra n. 1) passim.


9. There is one Eighteenth Dynasty tomb painting that depicts some workmen putting the final touches on a solar barque shrine, but it contributes nothing to the study of hull construction (N. Davies, *Two Ramesside Tombs* [New York 1927] pl. 36).


14. For example, the following volumes feature depictions of travelling and/or sailing craft and/or woodworking tools and industry related to boatbuilding: Nina de G. Davies, The Tomb of Amenemhet (London 1915), The Tomb of Huy (London 1926), The Tombs of Two Officials (London 1923); Norman de G. Davies, Seven Private Tombs at Kurnah (London 1948), The Rock Tombs of El-Amarna I-V (London 1908), The Tomb of Kenamun at Thebes (New York 1930), The Tomb of Nahkt at Thebes (New York 1917), The Tomb of Nefertete (New York 1933), The Tomb of Puymere at Thebes (New York 1922), The Tomb of Rekh-Mi-Re at Thebes I-II (New York 1943), Two Ramesside Tombs at Thebes (London 1927); E. Naville, The Temple of Deir el-Bahari I-VI (London 1894-1908); J. Quibell, The Tomb of Yuya and Thuya (Cairo 1908); T. Sâve-Söderbergh, Four Eighteenth Dynasty Tombs (Oxford 1957).


16. Vandier (supra n. 10) presents a thorough description of the various wooden boats, but does not discuss construction in any detail.


18. The contributions of archaeology, performed on land and underwater, relevant to this study are discussed in G.F. Bass, A History of Seafaring Based on Underwater Archaeology (London 1971) and more recently in P. Throckmorton, The Sea Remembers. From Homer's Greece to the Rediscovery of the Titanic. Shipwrecks and Archaeology (New York 1987).

20. H. Murray & M. Nuttall, A Handlist to Howard Carter's Catalogue of Objects in Tut'ankhamun's Tomb (Oxford 1963), contains references to dozens of wooden boat models that exist at the Cairo museum published only in the most summary fashion. The models are soon to be published by Dilwyn Jones of the Griffith Institute. The Ashmolean Museum has kindly sent me photocopies of catalog cards and photographs with permission to use them in this study.


22. Sources of the most important ancient texts used in this study include: J.H. Breasted, "Papyrus Harris," Ancient Records of Egypt II (New York 1962) 87 ff.; J. Cerny, A Community of Workmen at Thebes in the Ramessid Period (Cairo 1973); B. Cummings, Egyptian Historical Records of the Later Eighteenth Dynasty (Warminster 1982-84) Fascicles I-III, is an English translation of W. Helck's Urkunden der 18. Dynastie IV (Leipzig 1906-09); A.H. Gardiner, The Wilbour Papyrus (Oxford 1948); S.R.K. Glanville, "Records of a Royal Dockyard of the Time of Tuthmosis III," ZAes 66 (1936) 105-121 and ZAes 68 (1937) 7-41; H. Goedicke, The Report of Wenamun (Baltimore & London 1975); J.J. Janssen, Commodity Prices from the Ramessid Period (Leiden 1975); J.B. Pritchard, Ancient Near Eastern Texts Relating to the Old Testament (hereafter ANET) (Princeton 1950); W.K. Simpson, Papyrus Reisner II: Accounts of the Dockyard Workshop in the Reign of Sesostris I (Boston 1956), serves as an important analogue to Glanville. The many primary references, mostly papyri, need not be listed here, since I have not mastered hieroglyphs and generally follow the interpretations given by the above authors and others.

23. Glanville (supra n. 22).

24. J. Sliwa, Studies in Ancient Egyptian Handicraft, Woodworking (Krakow 1975) passim, summarizes evidence for woodworking in all the pharaonic periods through the use of models, depictions, and artifacts.

25. The Late Bronze Age shipwrecks found at Ulu Burun (supra n. 6) and Cape Gelidonya (G.F. Bass, "Cape Gelidonya: A Bronze Age Shipwreck," Transactions of the American Philosophical Society 57, part 8 [Philadelphia 1967] 84-121) have yielded tools that may have been employed for shipboard repairs.


32. Many scenes of boats and tools of which I am aware are not illustrated in this thesis. Particular parts of scenes that can illustrate my arguments are included wherever this is necessary.


34. Of course, there is a scene showing the felling of cedars in Lebanon which illustrates clearly how some tools were probably used, but it fails to show how the timber was prepared or transported. We will come back to this below.

35. Sliwa (supra n. 24) 45.

36. Glanville (supra n. 22) 9; Janssen (supra n. 22) 373, cites the word, sw3, as meaning "to fell trees."

37. Simpson (supra n. 22) 40.

38. Cumming (supra n. 22) 4 (originally translated into German by Helck [supra n. 22] lines 1237-1238).

39. R.A. Caminos, *Late-Egyptian Miscellanies* (London 1954) 384 and 385; published earlier by A.M. Blackman and T.E. Peet "Papyrus Lansing: A Translation with Notes" *JEA* 11 (1925) 284-298. I prefer Caminos’ translation on the whole; the content is basically the same but his is less haughty sounding. The only noteworthy
difference is the translation of ḫry as "journeyman," which may be a more familiar term than "outworker."

40. Caminos (supra n. 39) 388.

41. Glanville (supra n. 22) passim.

42. Simpson (supra n. 22) 42.

43. Ibid.

44. E.g., it could just as easily be explained by the ḫry having been supervised by the owner of the preceding official title.

45. Glanville (supra n. 22) 37.

46. Janssen (supra n. 22) 374 ff. More will be said specifically regarding the sale of wood to the workshops below.


48. Goedicke (supra n. 22) 19 and 20. Wenamun was surely an official with higher status than a ḫry, and was sent to buy or receive as tribute timber, as opposed to cutting it down himself. His mission is mentioned here to illustrate a sense of what "in the field" may mean. It is very probable that several ḫrys accompanied officials such as Wenamun, while here it seems that Wenamun relied on local labor at Byblos for the task of timber collection.

49. One could interpret these tools as either socketed or double axes, although it is difficult to discern the exact mode of hafting. Both types would be at home in the Levant. Deshayes (supra n. 26) pls. III-VIII, XIII-XV, XXXIV-V.

50. Goedicke (supra n. 22) 64, translates ʿ as "fir," while Glanville (supra n. 22) 8, translates it as "fir" (abies liciia) or "another conifer" throughout the papyrus.

51. For imported timber, it was probably often the case that Egypt received it as tribute from subject cities, or obtained it via trade. Since Egypt controlled the Levantine forests for most of the New Kingdom, there is little hope for finding an international market price for it.

52. Goedicke (supra n. 22) 80-82.

53. Cf. a passage in F.L. Griffith, "The Teaching of Amenophis the Son of Kanakht. Papyrus BM 10474," JE 12 (1926) 202, where an analogy is made with a tree whose "end is reached in the dock-yard; or it is floated far from its place, the flame is its winding-sheet." The passage does not imply that logs were floated to a boatbuilding site, but it does seem to imply that timber as a charcoal source was floated to the furnaces, possibly for metalworking.
54. Goedicke (supra n. 22) 98 and 103, where they stack the fir for drying for the pr(t) season (winter).

55. Ibid., 141, does not believe that a cut conifer could be dried during cool and/or wet conditions.


57. Ibid.

58. Goedicke (supra n. 22) 69 ff.

59. Ibid., 98.


61. Meiggs (supra n. 31) 54.

62. A. Nibbi, Wenamun and Alashiya Reconsidered (Oxford 1985) 25. This title is omitted from Goedicke's (supra n. 22) translation and appears to be Nibbi's own rendering.

63. Caminos (supra n. 39) 388.

64. J.K. McDonald, Egypt's Golden Age (Boston 1982) 133-138, specifically mentions the use of baskets for carrying tools and notes the preponderance of basketry finds dating to the Eighteenth Dynasty.

65. S.K. Doll, Egypt's Golden Age (Boston 1982) 53, describes a carpenter's tool kit found in a basket at Thebes that dates to the NK. The kit included a large carpenter's adze and other functional--as opposed to model--tools.

66. McDonald (supra n. 64) 133-134.

67. Caminos (supra n. 22) interprets this as the principal duty of the outworker.

68. Odyssey V (supra n. 30) line 234 ff.: "She gave to him a great double axe (ἀνάγῳς), fitted to the palms, of bronze, sharpened on both sides." ἀνάγῳς by itself can mean either simple or double axe, but with the qualifier, underlined, it must be a double axe.

69. A.T. Hodge, "The Labrys: Why Was The Double Axe Double?," AJA 89 (1985) 307 and 308, observes this modern application and suggests Minoan woodsmen may have used the double axe similarly.

71. Simpson (supra n. 22) 25.

72. Papyrus Anastasi IV contains a reference to blunt tools (nykh) and does not mention any specific types (Caminos [supra n. 39] 160).

73. Glanville (supra n. 22) passim.

74. Petrie (supra n. 26) 13-15 and pl. XII, his Type T; Bass (supra n. 25) 95 and 96; Bass (supra n. 6) 90; Deshayes (supra n. 26) 253 ff. and pls. XXIV and XXXV; Catling (supra n. 27) 88 and 89.

75. Killen (supra n. 28) 18 and pl. 14, shows a small "sharpening hone" (19.3-cm length, 4.2-cm width) of slate pierced at one end, apparently for a tether. The "hone" has a NK provenance and is now in the British Museum (BM 36728). Cf. Bass (supra n. 6) 276 and Ill. 6, which describes a whetstone small enough to be carried, and provided with a recess for a loop.

76. Bass (supra n. 25) 95 and 96, for tools on the shipwreck at Cape Gelidonya, and Pulak (supra n. 6) 75-90 for those on the shipwreck at Ulu Burun; for Cretan tool hoards, A. Cotterell, *The Minoan World* (New York 1979) 166 and 167.

77. Petrie (supra n. 26) 13 and 14.

78. Catling (supra n. 27) 88 and 89.


81. Depicted in countless scenes from tomb walls and mentioned frequently throughout ancient texts.

82. Petrie (supra n. 26) 11; W.V. Davies (supra n. 70) 22.

83. W.V. Davies (supra n. 70) 9, implies that Egyptians were restricted to monovalve casting because they were not using bronze, but copper or copper alloys that would not cast well. Even if this were true, this explanation would not suffice.

84. Ibid., 16, comments that the adze is second in importance only to the axe as a primitive tool.

85. W.V. Davies (supra n. 70) 64-70, gives a full explanation of the variations.
86. Deshayes (supra n. 26) 113-115 and pls. XIII-XV.

87. Petrie (supra n. 26) 17-18 and pls. XVII and XVIII, nos. 92 - 122; nos. 92-93 are Egyptian examples.

88. Maxwell-Hyslop (supra n. 27) 69-87.

89. W.V. Davies (supra n. 70) passim.

90. W.V. Davies (supra n. 70) 23.

91. Cf. Deshayes (supra n. 26) 51-54, who says that "most" plain axes from the Near East (not including Egypt) were cast in monovalve stone molds.

92. W.V. Davies (supra n. 70) 23.

93. Ibid., 22-24; cf. Petrie (supra n. 26) 8-9, where he describes the battleaxe as a lighter variety of his Type A with broad lugs.

94. Cf. Petrie (supra n. 26) 8-9, where he states the still-accepted view that the purpose of this development was to prevent the handle from splitting. Nos. A122-130 of his catalogue exhibit this feature.

95. W.V. Davies (supra n. 70) 44-46.

96. Simpson (supra n. 22) 26; see APPENDIX B.

97. Janssen (supra n. 22) 101 and 102.

98. Ibid., 322 and 323.

99. E.g., Petrie (supra n. 26) 8, implies that Egyptian metallurgy—which consisted of copper working—was behind European technology, which was casting forms such as the socketed axe. On pg. 7 Petrie states that the making of bronze "cannot be traced farther back than the Hyksos period in Egypt."

100. W.V. Davies (supra n. 70) 24.

101. Ibid., 96 and 100, considers 4% Sn the minimal concentration at which bronze can be alloyed to obtain the desired results.

102. Ibid., 24 and 96, states that 1% As is the minimal concentration of arsenic in arsenical copper.

103. Ibid., 24 and 25.

104. Ibid., 119-124, used a Vickers microhardness tester and alcoholic ferric chloride to determine hardness. Microscopic examination of axes and samples of axes was employed to assist in the study of metallurgical properties.
105. Ibid., 121.

106. Ibid., 100.

107. Cf. supra pg. 15; although this type is catalogued among Deshayes' Type B "lames à moignons," he himself, on pg. 128, admits that most of these tools were probably used as adzes.

108. C. Pulak, "The Bronze Age Shipwreck at Ulu Burun, Turkey: 1985 Campaign," *AJA* 92 (1988) 14 and 15, follows the "commonly accepted view, without passing judgement on its validity that if a non-socketed blade, regardless of its thickness and length, has beveling or chamfering on both of its faces, it is called an ax; and, if this beveling is confined to only one face, it is identified as an adze." Based on my personal communication with Pulak in 1989, we agree that these blades were probably used as adzes, and that we must try to determine how an adze with beveling on both faces was used.

109. Maxwell-Hyslop (supra n. 27) 69, states that no examples of her Type II have been found in the Near East still bound to a handle, which would unequivocally confirm the use of the blade.

110. Petrie (supra n. 26) 5.

111. Ibid., 17 and 18 and pls. XVII and XVIII; his Z92 and Z93 are the Egyptian examples.

112. Maxwell-Hyslop (supra n. 27) 80-83, cites one Egyptian example of Type II, Petrie's (supra n. 26) Z92 from Gerzeh.

113. Maxwell-Hyslop (supra n. 27) 80-83, cites one Syrian example of Type I and 1 example of Type III from Gezer; the rest occur outside the region where Egypt ever exerted any political control in antiquity.

114. Deshayes (supra n. 26) 113-115.

115. Ibid., 51.


118. Ibid., 126.

119. Maxwell-Hyslop (supra n. 27) pl. VIII (no. 2) and fig. 4.

120. Petrie (supra n. 26) pl. XVIII.

121. Deshayes (supra n. 26) pls. XIII and XIV.
122. Ibid., 126-131; he states on page 128 that "il est probable donc que la plupart des lames à moignons étaient utilisées comme herminettes."

123. Ibid.

124. Petrie (supra n. 26) 16 and 17 and pls. XV-XVII. Adzes will be dealt with in more detail below.

125. Petrie (supra n. 26) 11-13 and pls. IX-XI (his Type O); Deshayes (supra n. 26) map 10 and pls. XVIII-XXIX, mostly his Types E and F of "haches à collet" (socketed axes).

126. W.V. Davies (supra n. 70) 128.


129. Oriental Institute #2101 is a three-ply rope of twisted palm fiber from the foundation of Hatshepsut's temple. I thank the Oriental Institute of Chicago for their permission to use this information.


132. Killen (supra n. 28) 18 and pl.15, shows a NK oil flask now in the British Museum, #6037.

133. Lucas (supra n. 27) 378-380.

134. Ibid., 381-390; Singer et. al. (supra n. 27) 287-289.

135. E.A.W. Budge, An Egyptian Hieroglyphic Dictionary I and II (New York 1978); the terms include merh-t, neh-t, haken, and heh.

136. Nibbi (supra n. 62) passim; A. Nibbi, The Sea Peoples and Egypt (Park Ridge, New Jersey 1978) 124 ff., and Nibbi (supra n. 29) 1 ff., makes the case that Egyptians were not a seafaring people, per se, and that their timber needs were fulfilled by forests in the Delta and in southern Palestine. She asserts that previous notions of a timber connection with Byblos are founded on incorrect translations of ancient texts.

137. H. Wall-Gordon, "A New Kingdom Libation Basin Dedicated to Ptah," MDIK 16 (1958) 174, points out that shipyards existed in the Memphis area since the Old Kingdom, as shown by the titles of certain tomb owners at Giza and Saqqara.
138. See Appendix A; the word ḫrировать meant "dockyard workshop" throughout the MK and NK and even in Ptolemaic times (Wall-Gordon [supra n. 137] 175).

139. Ibid., mentions a dockyard called "the dock of the charioteer ḫnfr" south of Memphis during Seti I's reign (1302-1290 BCE). See Glanville (supra n. 22) passim for the dockyard of Tuthmose III (1490-1436 BCE) near Memphis; Caminos (supra n. 39) 140 ff., for the Memphis dockyard mentioned in Pap. Anastasi IV, dated to Seti II's (ca. 1200 BCE) reign (also discussed in Glanville [supra n. 22] 37 ff.); Caminos (supra n. 39) 384-388, for the Pap. Lansing account of work at a Memphis dockyard. Finally, there are a total of six references to Prw-nfr from 3 stelae, a temple block, Pap. Petersburg 1116 A and an ostracon, all dating to the Eighteenth Dynasty, in M.W. Spielberg, "La ville de PRW-NFR dans le Delta," Revue de l'Égypte ancienne 1 (Paris 1927) 215-217.

140. T. Säve-Söderbergh, The Navy of the Eighteenth Egyptian Dynasty (Uppsala 1946) 39; Glanville (supra n. 22) 109, states that the dockyard workshop at Memphis was "...nothing less than the chief port of the Egyptian kingdom...."

141. Wall-Gordon (supra n. 137) 175.

142. Haldane (supra n. 5) 10-16.

143. Davies (supra n. 128) pl. X, shows scenes of boatbuilding alongside furniture construction, metallurgy, and ornamental sculpture.

144. Wall-Gordon (supra n. 137) 175.

145. Glanville (supra n. 22) 110, 113 (twice), 115, 117, 118 (twice), 119, 120, 121 (twice).

146. Spielberg (supra n. 139) 215-217.

147. Glanville (supra n. 22) 8 and 9.


149. Cf. planking dimension of MK funerary craft in Haldane (supra n. 4) 20-21 and 69-74; the average plank is ca. 3 m long and ca. 9 cm thick.

150. Herodotus II.96, "The boats in which they carry cargo are made of the acacia, which is in form most like to the lotus of Cyrene, and its sap is gum. Of this tree they cut logs of two cubits length and lay them like courses of bricks...."

151. Steindorff (supra n. 7) pl. 119.

153. Sliwa (supra n. 24) 46.

154. Moussa and H. Altenmüller (supra n. 33) pl. 21.

155. Janssen (supra n. 22) 374 and 381-882.

156. Simpson (supra n. 22) 40 and 41.

157. Wall-Gordon (supra n. 138) 172.

158. Spielberg (supra n. 139) 215-217.

159. Various translations of hnw-wr in the New Kingdom include: Caminos (supra n. 39) 160 and 387, "shipwright" and "shipyard carpenter overseer" in Pap. Anastasi IV and Pap. Lansing; Glanville (supra n. 22) 7 and 39, "foreman over gang of shipwrights" and "chief craftsman" in Pap. BM 10056 and Stele BM 1332; Cumming (supra n. 22) 315, "Master Shipwright" on Stele BM 1332.

160. Glanville (supra n. 22) 110-113, 116 and 117.

161. This word translates variously as "craftsman," "carpenter," and "shipwright" through the entire Pharaonic period: Caminos (supra n. 22) 388, "dockyard worker" in Pap. Lansing; Simpson (supra n. 22) 23 and 42, "craftsmen," "shipwright," "carpenter"; Glanville (supra n. 22) 18, "shipwright," "wood-worker."

162. Caminos (supra n. 39) 387, of Pap. Lansing.

163. Ibid., 388.

164. Glanville (supra n. 22) 17.

165. Ibid.

166. Ibid., 20.

167. Janssen (supra n. 22) 370, meaning a log of no particular wood, i.e. generic.

168. Ibid., 379 and 80.

169. Ibid., 385 ar.d 386.

170. Glanville (supra n. 22) 27.

171. Goedicke (supra n 22) 95; variantly in Janssen (supra n. 22) 379, although he is not sure. Janssen also identifies some large timbers of δ, brkt, as "trunks" that could be identified as "keels" with as much conviction as pipit is.

172. Pulak (supra n. 6) 131.

173. See Appendix D. As mentioned in the previous chapter, the identification of
wood species in Egyptian texts is always somewhat tentative, but I adopt the view of what seems to be the majority of Egyptologists, that 𓊕 was fir, or at least a similar conifer, e.g., pine.

174. Theophrastus (supra n. 30) V.VII.1-2.


176. Pulak (supra n. 6) 129 and 130.

177. Cerny (supra n. 22) 129-131. Many useful analogies can be made between the dockyard workshop and the necropolis workmen at Thebes who were similarly situated in a village economy and employed by the palace. It is interesting that the "gang" is organized into groups with nautically derived words (100 ff.).

178. Simpson (supra n. 22) 17-18. Tool dispersions preponderate in the MK records, which show that a coppersmith was worked in connection with the workshop. This was probably the case in NK times as well, but the NK records contain little information regarding tools.

179. Janssen (supra n. 22) 321 and 542, finds that an adze might have cost as much as a pig or two goats.

180. Petrie (supra n. 26) 16, states "the adze is only second to the axe in importance as a primitive tool;" Sliwa (supra n. 24) 24, states "the significance of the adze in Egyptian craft was enormous, as, by comparison with the axe, it was a much more delicate instrument, serving the craftsmen--who did not know the plane--in all kinds of finishing-off processes."

181. Sliwa (supra n. 24) 24; Janssen (supra n. 22) 321; Simpson (supra n. 22) 25.


183. Bass (supra n. 25) 95-98, figs. 109 and 110, shows 4 lugged adzes and 2 plain adzes from the Cape Gelidonya shipwreck; Pulak (supra n. 108) 14-17, describes some of the necked and lugged adzes found on the Ulu Burun shipwreck so far.

184. Petrie (supra n. 26) 16 and 17.

185. Cf. W.V. Davies (supra n. 70) regarding axe metallurgy above in Chapter II.

186. E.g., Killen (supra n. 28) 15.

187. E.g., Pulak (supra n. 109) 16 and 17. I thank Mr. Pulak for pointing out this problem to me.
188. E.g., Simpson (supra n. 22) 55, shows some illustrated examples from MK tombs.

189. There are several Egyptian words for the attachment thongs in the MK dockyard records; see Appendix A.

190. Steindorff (supra n. 7) pl. 119.

191. Doll (supra n. 65) 53 and 54, reports that this adze was found in a basket with other carpenter’s tools (chisels, saw and oil horn) at Thebes, where the find dates to the NK; Killen (supra n. 28) 15 and pl. 8, describes the same tool as a functional adze used for “heavy timber roughing and shaping” with a necked blade. It is kept in the British Museum. #22834.


193. Cf. Sliwa (supra n. 22) fig. 3.

194. Petrie (supra n. 26) 17 and pl. XVII, cites two from Gerzeh and Gebelyn; both are sites in the Delta region.

195. Maxwell-Hyslop (supra n. 27) 75, cites the distribution of her Type II blade which is found mainly in Canaan.

196. Deshayes (supra n. 26) 113 ff., asserts that the lugged adze became widely dispersed in Palestine as a result of decreased Egyptian influence between the MK and NK periods, i.e., the Hyksos period. Catling (supra n. 27) 87, notes the relative absence of adzes, in general, on Cyprus before Egyptian or Near Eastern influence, but sees an appearance of “trunnion axes”—what we are calling lugged adzes—in the Late Cypriot period (roughly LBA).

197. I thank G.F. Bass for making this important point. Bass believes that the tools aboard the shipwreck at Cape Gelidonya were scrap, and that the nature of the tools aboard the shipwreck at Ulu Burun cannot yet be determined with certainty.

198. Simpson (supra n. 22) 26.

199. Petrie (supra n. 26) 42.

200. Sliwa (supra n. 22) 38 and 39.

201. Ibid., 38 and 39.

202. Doll (supra n. 65) 59, describes a cubit rod (Louvre n. 1538) from the 18th Dynasty that is divided into 7 “palms,” which are further divided into digits and subdivisions of those; also, Sliwa (supra n. 22) 39, describes the Memphite cubit.

204. Sliwa (supra n. 24) 40, and Killen (supra n. 28) 44, among others, have taken note of this innovation and the great number of scenes showing stools in the New Kingdom.

205. Janssen (supra n. 22) 378 cites the existence of an "o shipbuilding part, the *īrīt*, which he thinks may mean "trunk," but which I have tentatively identified as "keel," since the examples could only be either keels, unprocessed logs, or the longest known masts.

206. Pulak (supra n. 6) 130, found on the Ulu Burun wreck; Throckmorton (supra n. 18) 56 ff., compares the construction of the shipwreck from Kyrenia with that of the Ulu Burun wreck.

207. Killen (supra n. 28) passim; Littauer and J.H. Crouvel (supra n. 28) passim.

208. Killen (supra n. 28) 8-11, lists these carpentry techniques among those used in Egypt in the NK inlays, veneer, marquetry ("a highly complicated pattern made of different timbers on a panel"), plywood, dowels, scarf joint with butterfly cramp (a locking joint also found in the Dashur hils), nails and tacks, hinges, and locks. Lucas (supra n. 27) 512-514, similarly lists the types of wood joints with which the Egyptians were familiar, including: mortise and tenon joints, dove-tailing, mitred joints, lashing, and pegging.

209. Sliwa (supra n. 24) 34 and 35, also states that the earliest wooden object produced by lathe in Egypt dates to the 4th century BCE.


211. Simpson (supra n. 22) 25.

212. Killen (supra n. 28) 17 and pl. 11.

213. Petrie (supra n. 26) 19-22 and pls. XXI and XXII, nos. 44-48, 55-66, uses the "square bar" terminology to subdivide his 3 broader types, which are not followed here; Deshayes (supra n. 26) 85-111 and pls. IX-XII, bases his typology of chisels largely on section, but his deep-bar chisels (bedanes) are in a separate category. Egyptian square-bar chisels and rectangular-bar chisels resemble examples from several of Deshayes types, mostly his A and E *ciseaux* and A and B bedanes; these types appear mostly on Canaanite and Syrian sites.

214. Pulak (supra n. 108) 19 and fig. 16, KW 566 is a firmer square-bar chisel in my typology.

215. Petrie (supra n. 26) 21 and pl. XXII, nos. 68-73 and 82-85.

216. Bass (supra n. 25) 100, B131 from Cape Gelidonya, resembles the common
Egyptian type that Petrie calls a "deep-bar chisel" and what is called a "rectangular-bar" chisel in the current typology; Pulak (supra n. 108) 17-18 and fig. 15, identifies KW 276 as a bronze deep-bar chisel, after Petrie's typology.

217. Petrie (supra n. 26) 20 and pl. XXII, nos. 76-81.

218. Killen (supra n. 28) 17.

219. Sliwa (supra n. 24) 30, following Petrie (supra n. 26), states that the bifacial edge is the earlier development, followed by a gradual increase in use of the monofacial type. However, all the chisels we have mentioned above from the LBA shipwrecks, and most of the excavated NK chisels known to myself, have bifacial edges.


221. Acacia mallets are mentioned specifically in the MK dockyard records (Simpson [supra n. 22] 38-39), while excavated mallets are rarely analyzed for wood type. Cf. Petrie (supra n. 26) 40 and pl. XLVI. Killen (supra n. 28) 18 and pl. 16, shows a NK heavy mallet (950 kg) that was carved from the center of a tree trunk.

222. Pulak (supra n. 6) 129 and 130.

223. Haldane (supra n. 4) 10-14 and fig. 3.

224. Pulak (supra n. 6) 131 and 132.


226. Simpson (supra n. 22) 36; Sliwa (supra n. 24) 26.

227. Sliwa (supra n. 24) 35-37.

228. Winlock (supra n. 203) pl. 68.


230. Sliwa (supra n. 24) 28.

231. Ibid., 31-33.

232. Simpson (supra n. 22) 36.

233. Killen (supra n. 28) 21.

234. Pulak (supra n. 108) 19, figs. 18 and 19.

236. Goedicke (supra n. 22) 95.

237. Simpson (supra n. 22) 118.

238. Glanville (supra n. 22) passim.

239. Haldane (supra n. 5) 14-16.

240. Ibid., states that "for the first time, we have the remains of what were probably working boats..."

241. Simpson (supra n. 22) 38 and 39.


244. Glanville (supra n. 22) 26.

245. Ibid., note 77.

246. Ibid., 15.


248. Glanville (supra n. 22) 115.


250. Glanville (supra n. 22) passim.

251. Seven models of the type shown in figure 27 are in the Cairo museum. There at least 15 distinct scenes of NK ships and boats with protruding deckbeams.

252. Haldane (supra n. 4) 18.

253. I thank Dilwyn Jones for his observations of the models from Tutankhamun’s tomb and his generosity in sharing his ideas with me.

254. The generic term for seagoing merchantmen, or boats, from Pap. BM 10056, Glanville (supra n. 22) 8.

255. Ibid., 12 and 13.

256. Sliwa (supra n. 24) 37 and 38.

257. Winlock (supra n. 203) pls. 28-29 and 68.
258. Sliwa (supra n. 24) 37.

259. Haldane (supra n. 5) 6 and 7, prefers "to tie inside" as a definition, as it applies well to the sewn joinery of the Cheops barge and Lisht timbers.

260. V. Loret, "La résin de térébinth (sonter) chez les anciens égyptiens," Recherches d'archéologie de philologie et d'histoire 19 (L'Institut Français d'Archéologie Orientale, Cairo 1949) passim.

261. Theophrastus, Enquiry into Plants IX.II.


263. Vandier (supra n. 10) 926-1014.

264. Winlock (supra n. 203) pls. 28-29 and 68.

265. Landström (supra n. 17) 122, believes the Punt ships were for seafaring; J. Oderwald, "Were the Egyptians Builders of Sea-going Ships," JIEL 6 (1955) 5, says they were river craft only.

266. Basch (supra n. 13) 99, makes the observation that Nibbi (supra n. 136) and Säve-Söderberg (supra n. 140) are at opposite extremes in this matter.

267. See hull lines in Landström (supra n. 17) 100, 102-103, 108-109, 126-127, and 136-37. Faulkner (supra n. 11) 9, notes that "...the body-lines of the ships which sailed to Pwenet [Punt] in Queen Hatshepsut's reign will bear comparison with those of a racing cutter of the present day."

268. Bass (supra n. 18) 16.

269. Landström (supra n. 17) 71, describes the protruding through-beams on EM 4918, a First Intermediate Period boat model.

270. Haldane (supra n. 4).

271. Bell (supra n. 249) 102.

272. Faulkner (supra n. 11) 8, agrees that much of the cargo was stored below in NK seagoing hulls.

273. Haldane (supra n. 4) 18 and fig. 6.

274. Winlock (supra n. 203) pls. 80, 81, 84 and 85.
275. Glanville (supra n. 22) 26; Janssen (supra n. 22) 374.

276. Simpson (supra n. 22) 38 and 39, thought this term might mean “frames” or “trustees,” but I think it reasonable to define as “through-beam” for two reasons: first, Simpson offers no other word for through-beam and we know that most—if not all—boats had them; secondly, the similarity between the stems of the plural forms s3w and s3hw suggests the identification.

277. The shipwreck at Ulu Burun, although not fully excavated, betrays no evidence of through-beams. The chance that any shipwreck of the LBA being preserved up to the deck level is slim at best.

278. I am deeply indebted to Dr. Dilwyn Jones and Diana Magee of the Griffith Institute for information on the boat models from Tutankhamun’s tomb (letter 16 January, 1988). Dr. Jones’ observations will be published in the Griffith Institute’s Tut’nkhamun series.

279. E. Naville, The Temple of Deir el-Bahari VI (London 1908) pls. CLIII and CLIV.

280. I thank Dr. Jones and the Griffith Institute again for providing me with this information.

281. In the opinion of C.V. Sölver, “Egyptian Shipping of About 1500 B.C.,” MM 23 (1937) 499, rowers stood between the through-beams on deck panels. Although this is a subjective judgement, due to the obstruction of the rowers’ feet by the hull, the rowers’ inclination suggests that the rowers were standing on the through-beams in almost every scene. Of course, one must observe and make a personal decision. Since the deck was probably flush with the through-beams, the rowers could, of course, stand on either the deck, the through-beams, or both. However, I believe that the rowers would be more efficient pushing against the side or edge of a solid beam than the flat surface of the deck. This would give the rower superior leverage on the oar towards the end of the attack stroke, just as modern rowing crews use a horizontal leg thrust for most of their power. For this reason, I believe panels were removed, allowing rowers to either sit or use the side of the through-beam for leverage while performing standing strokes.

282. Glanville (supra n. 22) 13.


284. Faulkner (supra n. 11) 4.


286. G. Jequier, Éssai sur la nomenclature des parti de bateaux,” Bulletin de l’Institut Français d’Archeologie Orientale IX (Cairo 1911) 37-92; C. Boreux, Études de
nautique égyptienne (Cairo 1925), found the word in chapter XCIX of the Book of the Dead, according to Hornell (supra n. 285) 36.

287. Glanville (supra n. 22) 26.

288. Landström (supra n. 17) 106 and 107.

289. Herodotus II.95-96.

290. Herodotus II.96 states that this type of boat is taken downstream by a tug and kept straight with an anchor let out the stern. Obviously, such a vessel could not be a ship.

291. Haldane (supra n. 5) 10-15 and fig. 4.

292. Ibid., 15.

293. Homer V, line 252 ff.

294. Bell (supra n. 249) 102 and 110.

295. Measurements for the models are taken from Daressy (supra n. 19) 239-243 and nos. 24001-2499(c).

296. E.g., Allen (supra n. 220) 171.

297. Goedicke (supra n. 22) 95; Janssen (supra n. 22) 379.

298. Daressy (supra n. 19) 239.

299. Simpson (supra n. 22) 38 and 39.

300. There are at least 24 other NK scenes of this type of craft of which I am aware.

301. Landström (supra n. 17) 106 and 107.

302. Bass (supra n. 18) 16.

303. The central shelf of the Cheops barge is an exception, but may only have been used in sewn hulls. Central shelves may also have been used in the Middle Kingdom, as models from Mechet-Re’s tomb suggest by the stripe painted down the longitudinal axis of their decks (Winlock [supra n. 203] pls. 70, 80 and 81).

304. C.V. Solver, "The Egyptian Obelisk-Ships," MM 26 (1940) 244 ff. His estimations were facilitated by the existence of one of the pictured obelisks at Karnak. Landström (supra n. 17) 32, believes the barge was even larger.

305. Ibid., figs. 2 and 3.

306. Glanville (supra n. 22) 15; Caminos (supra n. 39) 160.

308. Ibid.

309. Goedicke (supra n. 22) 82; Allen (supra n. 220) 171-174.

310. H.L. Roth, *Ancient Egyptian and Greek Looms* (Halifax 1951) 1-32; Singer, Holmyard & Hall (supra n. 27) 425-439; E. Riefstahl, *Patterned Textiles in Pharaonic Egypt* (Brooklyn 1944) 42 and 43, thinks that some sails may have been leather, since she cannot explain some patchwork patterns as a woven product; G. Crowfoot, *Methods of Hand Spinning in Egypt and the Sudan* (Halifax 1931) 7 ff., provides a detailed study of how the fibers and threads that went into the textiles were made; Winlock (supra n. 203) 29-33 and pls. 26-27 and 66-67, explains and illustrates a model of a MK weaving shop.

311. Herodotus II.96, refers to the material as "byblus," a material made from papyrus normally used as a recording surface.

312. Riefstahl (supra n. 310) 1. It is highly probable that the techniques of weaving sails were known long before this since we see sailed boats and ships in the OK.

313. Janssen (supra n. 22) cites 5 *dbn* for a fancy garment; however this high price could merely reflect the luxurious nature of this particular garment.

314. Riefstahl (supra n. 310) 1.

315. Glanville (supra n. 22) 20 and note 48.

316. Janssen (supra n. 22) 377-378 and 381-382: "a mast may cost twice as much as the most expensive bull...."

317. Goedicke (supra n. 22) 82, calls it the "main yard."

318. Ibid., 82.

319. Faulkner (supra n. 11) 5 and footnote 4.

320. Ibid., 6.


323. See also N. Davies, *The Tomb of Huy* (London 1926) pls. 31 and 32, for mooring posts.

325. Griffith (supra n. 53) 199.

326. Basch (supra n. 13) 118-121 and figs. 32 and 33.

327. D. McCaslin, "Stone Anchors in Antiquity: Coastal Settlements and Maritime Trade-routes in the Eastern Mediterranean ca. 1600-1050 B.C.," Studies in Mediterranean Archaeology LXI (Göteborg 1980) 34, cites the existence of four anchors of Egyptian origin (identified by shape and markings), all of which were found outside of Egypt.

328. Ibid.

329. Ibid., 39.

330. Faulkner (supra n. 11) 4.

331. Basch (supra n. 13) 100.

332. Sliwa (supra n. 24) 66, states "the professional category of woodworkers included not only carpenters, joiners, shipwrights, chariot-makers, wheelwrights and coopers, but also sculptors (making both statues and reliefs) and carvers--in other words, in the language of today, not only craftsmen, but also artists."

333. Ibid., 67.


335. Sliwa (supra n. 24) 66.

336. Cerny (supra n. 22) passim.

337. Janssen (supra n. 22) 539-541. Montet (supra n. 10) 168, also holds this view.


339. Montet (supra n. 10) 148.

340. Cerny (supra n. 22) 112 ff.

341. Ibid.

342. Ibid., 113 ff.
343. Sliwa (supra n. 24) 71.

344. Cerny (supra n. 22) 112 ff.


346. Janssen (supra n. 338) 507 and 508.


348. Sliwa (supra n. 24) 69.

349. Cerny (supra n. 22) 114-116.

350. Ibid., 116.

351. Ibid., 228 ff.

352. Wall-Gordon (supra n. 137) 175.


354. Aldred (supra n. 345) 196.

355. Glanville (supra n. 22) passim.

356. Ibid., 39.

357. Kitchen (supra n. 334) passim.

358. Cerny (supra n. 22) 170.

359. Caminos (supra n. 39) 384 ff.


361. Wall-Gordon (supra n. 137) 172.
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## EGYPTIAN BOATBUILDING TERMS

### Papyrus Anastasi IV
- acacia (160)
- bark of acacia (160)
- bark of acacia (160)
- binder or fastener (162)
- blunt (tools) (160)
- brace (some sort) (162)
- deteriorated (boat) (160)
- fastener or binder (162)
- gunnel (161)
- gunwale or tholeboard (161)
- many-oared boat (173)
- Nilotic craft or pleasure boat (140)
- panelling or lining wood (163-4)
- plank of deal (fir or pine) (163)
- pleasure boat or Nilotic craft (140)
- shipwright (160)
- shipyard (163)
- tholeboard or gunwale (161)

### Papyrus Lansing
- dockyard worker (388)
- outworker or timber collector (388)
- ship's hand (388)
- shipyard carpenter overseer (387)
- stacking of timber (387)
- timber in generic shipbuilding (388)
- tool-box for outworker (388)

### Papyrus Reisner II
- ?
- ? title (42)
- adze (25)
- axe (25)
- binding-goat leather (27)

---

2. Ibid., 384-385 for description of shipbuilder's toil, especially with reference to "outworker."
bit/borer of drill (36)
boat for cargo (39)
boat (20)
bow of drill (36)
branding iron (?) (36)
break (to make scrap metal) (29)
chisel (25)
coppersmith (29)
craftsmen
dockyard workshop (17)
graver (36)
melt down (Cu tools) (31)

Officers (40-42)
bearers of orders
clerk, scribe
commander of crew
disputes
foreman
judicial officer
overseer of crew belonging to N
overseer of crew
timber supplies
treasury clerk, received ration
accounts

plane (v.) (26)
saw, carpenter’s (36)

Shipbuilding, parts (38-39)
?, possibly “endpiece”?
? part
? part
? part of ship
part
? title (42)
bailer, scoop
boat, ship, merchantman, cargo boat
boat for officials
build y.
cargo boat
frames (?), trestles (?)
mallets (of acacia)
mooring block, stake, cleat
oar, paddle, rudder
planks, timber
pole, support
pole
port side
post or prop or mast (?)
rudder part
sounding rod or pole
starboard
tow-rope (?)
what's in deck house  
shipwright (23)  
shipwright or carpenter (42)  

<table>
<thead>
<tr>
<th>Thongs for Hafting (37-38)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>? hide</td>
<td>ḫkꜰ</td>
</tr>
<tr>
<td>? piece of hide</td>
<td>ṭs</td>
</tr>
<tr>
<td>binding, thonging (n. and v.)</td>
<td>ḏrww</td>
</tr>
<tr>
<td>certain pc. of hide</td>
<td>ṣḥd</td>
</tr>
<tr>
<td>cut out of hide (v.)</td>
<td>ṣmk3 n ḫḥ</td>
</tr>
<tr>
<td>goat hide, leather</td>
<td>ḫst</td>
</tr>
<tr>
<td>shank leather</td>
<td>ṭnh</td>
</tr>
<tr>
<td>thongs</td>
<td>ṭnh(ʿ)</td>
</tr>
<tr>
<td>woodworking, re. handles</td>
<td>ṭnh</td>
</tr>
<tr>
<td>thongs-goat leather (27)</td>
<td>ṭnh</td>
</tr>
<tr>
<td>weight of 91 g (25) in NK</td>
<td>ḫbn</td>
</tr>
<tr>
<td>weight of 14 g (25) in MK</td>
<td>ḫbn</td>
</tr>
</tbody>
</table>

---

Cerny 1973⁴  

<table>
<thead>
<tr>
<th>Port side of boat</th>
<th>Transliterated Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>prow</td>
<td>ḫmy-wrt</td>
</tr>
<tr>
<td>starboard side of boat</td>
<td>(ḥmyt) ṭndt</td>
</tr>
<tr>
<td>stern</td>
<td>ṭ3-wrt</td>
</tr>
<tr>
<td></td>
<td>ṭ3dt</td>
</tr>
</tbody>
</table>

---

Papyrus BM 10056⁵

<table>
<thead>
<tr>
<th>? part of chariot</th>
<th>Transliterated Form (p.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>?</td>
<td>ṭrḥ (30)</td>
</tr>
<tr>
<td>-piece</td>
<td>ṣnfr (11)</td>
</tr>
<tr>
<td>-plank</td>
<td>ṣbnbt (118)</td>
</tr>
<tr>
<td>beams</td>
<td>ṣrdt (118)</td>
</tr>
<tr>
<td>boat, prob. heavily cared</td>
<td>ṣ3w (26)</td>
</tr>
<tr>
<td>boats of acacia</td>
<td>ḥstq (16)</td>
</tr>
<tr>
<td>build, lay down</td>
<td>ṣkyw (15)</td>
</tr>
<tr>
<td>cabin</td>
<td>ṣmḥ (27)</td>
</tr>
<tr>
<td>cabin craftsman</td>
<td>ṣ3r.t (21-22)</td>
</tr>
<tr>
<td>cut or fell timber</td>
<td>ḫmyw-n-3r.t (21-22)</td>
</tr>
<tr>
<td>deal, cut timber, imported</td>
<td>ṣd (9)</td>
</tr>
<tr>
<td>deck planking</td>
<td>Ph3 (12)</td>
</tr>
<tr>
<td>deck or cabin planks</td>
<td>ṣḥb (26)</td>
</tr>
<tr>
<td>deck-covering</td>
<td>Phw nfr (27)</td>
</tr>
<tr>
<td>dockyard of Thuth III—Amenhetp III</td>
<td>whrt (27)</td>
</tr>
<tr>
<td>dockyard or wharf</td>
<td>whrt (27)</td>
</tr>
</tbody>
</table>

---

⁴ J. Cerny, A Community of Workmen at Thebes in the Ramesside Period (Cairo 1973) 101; this is not from a boatbuilding context, but the terms should still be valid for our purposes.

⁵ S.R.K. Glanville, "Records of a Royal Dockyard of the Time of Tuthmosis III," *ZÄS* 66 (1931) 105-121 and *ZÄS* 68 (1932) 7-41.
end posts
final stage of boat refitting
finales (?)
firm or pine, imported
 fir, abies ciliaca
foreman over gang of shipwrights
largest planks, of "s
long pc.-13 cubits, upper yard (?)
mast step, carrying pole, thwarts,
or ox-skin
Mersumennefer (ship's name)
oar, paddle or rudder
outer planking timber, special cut
outer timbers or cross beams
ox-skin fit over rudder post
papyrus finials
part of boat
parts of sky boat
Payeh (ship name), lit. "the stable"
ribs
rolling logs
rudder
sculptor (?)
sculptor's name
seagoing merchantman, or boat
seagoing merchantman, Cretan
Semitic shipbuilder's name
shipwrights, wood-workers
short timber-2 cubits
solar bark or sun boat
storage for Syrian wood
storage for Nubian wood & ivory
Syrian shipwright's name
Ta'ahe (ship's name), lit. "the Cow"
timber of choiceness
timber storage outside in the lake
wood, unidentified, import
wooden object

*These pieces are placed symmetrically and longitudinally in the ship and hold a key position in construction. Their length is 15 and 15.5 m. Perhaps they are gunnels or upper strakes.

*From Papyrus BM 10016, within mwy, the chancellery.

*Always of m, wood, which produces the longest pieces save for one 30-cubit mast of 8.
<table>
<thead>
<tr>
<th><strong>Book of the Dead</strong></th>
<th><strong>Transliterated Form</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>bow or tow rope</td>
<td>pehuit</td>
</tr>
<tr>
<td>halyard-bags</td>
<td>3du</td>
</tr>
<tr>
<td>joinery &lt;TGA says dovetails&gt;</td>
<td>ḏm3m &lt; ḏm3y_t (derived)</td>
</tr>
<tr>
<td>lower halyard</td>
<td>'(t)n(t)gr</td>
</tr>
<tr>
<td>mallet</td>
<td>sems/qenqenit/qenqenju</td>
</tr>
<tr>
<td>mast head</td>
<td>?</td>
</tr>
<tr>
<td>mast w/sails</td>
<td>ḫptw</td>
</tr>
<tr>
<td>mast socket</td>
<td>mnit</td>
</tr>
<tr>
<td>mooring post</td>
<td>tepu/hept/mahu/m3h/</td>
</tr>
<tr>
<td>oars</td>
<td>user/sp</td>
</tr>
<tr>
<td>oars (cont)</td>
<td>s3w</td>
</tr>
<tr>
<td>planks</td>
<td>ḫtw/ ḫeta</td>
</tr>
<tr>
<td>sails</td>
<td>m3w</td>
</tr>
<tr>
<td>steering oar</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Wenamun</strong>&lt;sup&gt;11&lt;/sup&gt; (pg. #)</th>
<th><strong>Transliterated Form</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>boat or vessel or generic type (70)</td>
<td>br</td>
</tr>
<tr>
<td>bow line (128)</td>
<td>h3t4</td>
</tr>
<tr>
<td>finials of bow and stern posts (95)</td>
<td>p3 tp</td>
</tr>
<tr>
<td>heavy transport (98)</td>
<td>lth</td>
</tr>
<tr>
<td>keel &lt;lit. mud-kneader&gt; (95)</td>
<td>pipit</td>
</tr>
<tr>
<td>main yard (82)</td>
<td>tpy</td>
</tr>
<tr>
<td>make sail (82)</td>
<td>ḫr ḫt3w</td>
</tr>
<tr>
<td>master of a royal ship (25)</td>
<td>hry-mrš</td>
</tr>
<tr>
<td>sails (82)</td>
<td>ḫt3w</td>
</tr>
<tr>
<td>ship for transport of fir (64)</td>
<td>P3 w3 n ܿ</td>
</tr>
<tr>
<td>stack up (116)</td>
<td>w3h</td>
</tr>
<tr>
<td>tackle &lt;v&gt; (81)</td>
<td>t3l</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Janssen</strong>&lt;sup&gt;12&lt;/sup&gt; (pg. #)</th>
<th><strong>Transliterated Form</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>? priced as beam or plank (380)</td>
<td>ḡph</td>
</tr>
<tr>
<td>? priced and sized as keel</td>
<td>ḡrt</td>
</tr>
</tbody>
</table>

<sup>11</sup>T.G. Allen, *The Egyptian Book of the Dead. Documents in the Oriental Institute at the University of Chicago.* (OIP 82) (Chicago 1960) 171-174. These terms are part of a list, in which the parts of a boat are named in a magic spell; they are not from a boat-building context *per se* but can be included here since the terms themselves are certainly relevant.

beam in a ship (374)
beam (372)
carrying pole (385-6)
fall trees (373)
keel <?> (379) cf. Wenamun, pipit
log of generic wood (370)
mast (377)
plank <ship's outer> (375)
stake <mooring> (376)
sycamore (370)
trunk <?> (378) CMM-keel

BM 10474a (pg. #)
dockyard, harbour (202)
mooring post (199)
wreck, upset, strike rock (222)

Transliterated Form

mbhmr
wyyt
gy

12F.L. Griffith, "The Teaching of Amenophis the Son of Kanakht," JEA 12 (1926) 191-231. This papyrus dates to sometime after 20th Dynasty.
APPENDIX B
STANDARD WEIGHTS AMONG TOOLS

<table>
<thead>
<tr>
<th>Tool</th>
<th>Egyptian</th>
<th>Weight(s) in dbn</th>
</tr>
</thead>
<tbody>
<tr>
<td>axe</td>
<td>mlnb</td>
<td>50, 40, 30, 22, 20, 19, 10(?)</td>
</tr>
<tr>
<td>adze</td>
<td>'nt</td>
<td>15</td>
</tr>
<tr>
<td>chisel</td>
<td>mnh</td>
<td>20, 14</td>
</tr>
<tr>
<td>graver</td>
<td>md3t</td>
<td>20</td>
</tr>
<tr>
<td>saw bow</td>
<td>pdt nt tf3</td>
<td>25, 26.5, 32, 33</td>
</tr>
</tbody>
</table>

\[1\] W.K. Simpson, *Papyrus Reisner II* (Boston 1965) 26; he admits to the fruitlessness of trying to pair actual tool weights to these standards; J. Janssen, *Commodity Prices from the Ramessid Period* (Leiden 1975) 322 and 323, shows the MK *deben* = 14 g and the NK *deben* = 91 g.
APPENDIX C
PERSONAL NAMES FROM BOAT-BUILDING CONTEXT

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amenemope (118)</td>
<td>official</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Amenhotep (115)</td>
<td>prince</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Amenhotep II (106)</td>
<td>official</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Amenmose (121)</td>
<td>official</td>
<td>Egyptian</td>
</tr>
<tr>
<td>'An-hor (118)</td>
<td>hmw wr</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Arzaw (120)</td>
<td>scribe</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Heny (110)</td>
<td>hmw wr²</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Huy (118)</td>
<td>lieutenant of the prince</td>
<td>Egyptian (24)</td>
</tr>
<tr>
<td>Menkheper (117)</td>
<td>craftsman of the prince²</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Mont (111)</td>
<td>hmw wr</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Nebmertef (111)</td>
<td>nf³</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Nebwahyeb (118)</td>
<td>sculptor</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Pa-nem (111)</td>
<td>hmw wr</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Pameri (121)</td>
<td>scribe</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Penta'usekh (121)</td>
<td>official</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Sankh (117)</td>
<td>hmw³</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Se (112)</td>
<td>nf</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Senere (118)</td>
<td>official</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Shebya'al (118)</td>
<td>official</td>
<td>Semitic (25-26)</td>
</tr>
<tr>
<td>Simut (?) (121)</td>
<td>scribe</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Tsy (118)</td>
<td>official</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Tuna (118)</td>
<td>hmw wr</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Tyty (117)</td>
<td>hmw wr ? (23)</td>
<td>Egyptian</td>
</tr>
<tr>
<td>Yena (112)</td>
<td>hmw wr</td>
<td>Egyptian</td>
</tr>
</tbody>
</table>

1S.R.K. Glanville, "Records of a Royal Dockyard of the Time of Tuthmosis III," ZAeS 66 (1936) 105-121, and ZAeS 68 (1937) 7-41; page numbers are cited in parentheses in appendix.

²A foreman in charge of a gang of shipwrights, according to Glanville (supra n. 1) 7.


⁴"Ship's captain," Glanville (supra n. 1) 35.

⁵Workman, wood carver or shipwright, as opposed to chief of workmen, or chief of shipwrights (cf. Glanville [supra n. 1] 23).
## APPENDIX D

### POTENTIAL WOODS OF EGYPTIAN BOATBUILDING INDUSTRY

<table>
<thead>
<tr>
<th>Timber</th>
<th>Properties/uses¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia (ṣnd)²</td>
<td>strong, durable/boats, widely used, Indigenous</td>
</tr>
<tr>
<td>Ash³</td>
<td>hard, elastic/Tut's compound bow, Foreign</td>
</tr>
<tr>
<td>Blackwood (ḥbny)⁴</td>
<td>dense, difficult to work, strong/ornaments, F</td>
</tr>
<tr>
<td>Boxwood⁴</td>
<td>bushy/linlays, ornaments, F</td>
</tr>
<tr>
<td>Cedar⁴</td>
<td>soft, resists rot, tall, shrinks/boats, i.a., F</td>
</tr>
<tr>
<td>Carobwood⁷</td>
<td>furniture, ornaments, F</td>
</tr>
<tr>
<td>Cypress⁴</td>
<td>strong, soft, knotty, tall/ornaments, F</td>
</tr>
<tr>
<td>Date Palm (bnr.t)⁹</td>
<td>fibrous/unsuitable for joinery, roofing, I</td>
</tr>
<tr>
<td>Dom Palm (m3m3)⁸</td>
<td>dense, harddoors, joinery, I</td>
</tr>
<tr>
<td>Ebony¹¹</td>
<td>not a wood used in antiquity; see Blackwood.</td>
</tr>
</tbody>
</table>


²*Acacia nilotica* and various other species, mentioned in Herodotus II.96 for boatbuilding, and in Theophrastus, *Enquiry into Plants* IV.II.8. Produced planks up to 18' long.

³*Buxus sempervirens* (European) and *B. longifolia* (oriental), grew to 10 m in heights in Nubia: Killen, (supra n. 1) 3 and 4; Lucas (supra n. 1) 494-496.

⁴*Cedrus libani, C. atlantica* (N. Africa), *C. deodara* (Afghanistan), of which *C. libani* is best known on account of the expeditions to Lebanon to retrieve cargoes of it and Theophrastus' (supra n. 2) V.VII.1) praise of it for ship material. *C. libani* grew to lengths of over 30 m: Killen (supra n. 1) 2; Lucas (supra n. 1) 491-494.

⁵*Ceratonia siliqua*, from western Asia and southern Red Sea regions: Killen (supra n. 1) 2; Lucas (supra n. 1) 502-3.

⁶*Cupressus sempervirens*, from western Asia, grew to over 30 m. A strong wood that does not bend well due to knots: Killen (supra n. 1) 3; Lincoln (supra n. 1)

⁷*Phoenix dactylifera*: Lucas (supra n. 1) 503 and 504.

⁸*Hyphene thebaica*, common to Upper Egypt, difficult to work or fell: Killen (supra n. 1) 3; Theophrastus (supra n. 2) IV.II.7.

¹¹*Diospyros ebenum*, probably not used in ancient Egypt since it would have been imported from India or Ceylon: Lucas (supra n. 1) 495.
Elm, tall, tough, strong chariot wheels, F
Fig, bushy, not a timber source, I
Fir (Scots), strong, tall, easy working boats, F
Hornbeam, hard, dense, heavy, bends well/chariots, F
Juniper (wet), tall incense, ornaments, F
Lime, hard, tall, works easy ornaments, F
Maple (Sycamore), tall, dense, turnery, musical instruments, F
Oak (burn), tall, dense, hard, brittle/dowels, models, F
Persian (swe), evergreen, strong ornaments, implements, I
Pine (Scots), fairly tall, soft, boats, F

12 U. procera, imported from Canaan, grew up to 40 m, and was used in chariot construction by virtue of its excellent steam bending properties and toughness: Killen (op. cit) 4; Lucas (supra n. 1) 496-7.

13 Ficus carica, grew under 10 m and probably not used as timber: Killen (supra n. 1) 4.

14 Abies ciliata, growing in western Asia, cited by Theophrastus (supra n. 2) V. VII.1, as being a fine ship timber: Meiggs (supra n. 1) 56-57 and 61. V. Loree, "Quelques notes sur l'arbre 's," Annales du service 16 (1916) 33-51, and Glanville (supra n. 1) 9, identify fir with 's (though Glanville sees the term generically and would accept pine or some other conifer), the most ubiquitous timber in the NK dockyard lists. Meiggs (supra n. 1) 405-409 argues for a cedar identification based on, among other things, wood used in the Cheops boat. The arguments on both sides are formidable, but Egyptologists tend to favor the fir interpretation as we do here. The fir keel of the LBA wreck at Ulu Burun (C. Pulak, A Late Bronze Age Shipwreck at Ulu Burun. Preliminary Analysis [M.A. Thesis, Texas A&M University 1987] 129-132) certainly cannot be overlooked in this debate.

15 Carpinus betulus, a western Asian import growing up to 26 m high: Killen (supra n. 1) 4; Lucas (supra n. 1) 497.

16 Juniperus phoenicia and J. excelsa, J. phoenicia being common in Syria, and J. excelsa present today in Lebanon, growing to about 20 m: Sliwa (supra n. 1) 16; Meiggs (supra n. 1) 54.

17 Tilia europea, used in later periods, grew in western Asia up to 33 m; a softer hardwood: Rendle (supra n. 1) 42; Killen (supra n. 1) 4.

18 Acer pseudoplatanus, known today also as Sycomore, growing in western Asia to over 30 m. A very fine, high quality wood of wide applications: Rendle (supra n. 1) 56; Killen (supra n. 1) 5.

19 Quercus cerris, Q. iber and Q. ithaburensis; oak mentioned by Theophrastus (supra n. 2) IV. II.8. Q. cerris exceeds 40 m, whereas Q. iber reaches 20 m: Sliwa (supra n. 1) 16-17; Killen (supra n. 1) 5. H. Margalit, "Some aspects of the Cultural Landscape of Palestine During the First Half of the 19th Century," IEJ 13 (1963) 208-223, states that oak forests existed in Palestine on Mt. Tabor, Galilee, and between Zippori and Bethelhem before the Ottoman empire depleted those resources completely; M. Zohary, Plant Life of Palestine, Israel and Jordan (New York 1962) 83-152 and Vegetation of Israel and Adjacent Areas (Wiesbaden 1982) 30ff., cites existence of Q. ithaburensis and Q. calliprinos (evergreen oak) forests and macquis that must have been vast in antiquity.

20 Mirusops schimperi, mentioned in Theophrastus (supra n. 2) IV. II.5 and 18th Dynasty texts: Sliwa (supra n. 1) 12; Lucas (supra n. 1) 504-5.

21 Pinus halepensis and P. pinea. P. halepensis is mentioned by Theophrastus (supra n. 2) V. VII.1, as good ship timber which grew in Canaan up to 20 m: Meiggs (supra n. 1) 55. A. Nibbi, Wenamun and
Platanus orientalis, grows in western Asia: Killen (op. cit) 5.

Prunus domestica, grows quickly in western Asia up to 10 m. Ancient fragments from Damascus suggest that it could have been used in Egypt: Killen (supra n. 1) 6; a light, soft hardwood that does not bend, nor resist rot: Rendle (supra n. 1) 52.

Zizyphus spina Christi, native to Egypt, where it was called nbs: Sliwa (supra n. 1) 12. Various other species exist and were widely used: Lucas (supra n. 1) 505 and 506.

Ficus sycomorus, native to Egypt and mentioned in reliefs and Theophrastus (supra n. 2) IV.II.1: Lucas (supra n. 1) 506 and 507; Sliwa (supra n. 1) 11.

Tamarix articulata and T. nilotica, mentioned in Herodotus II.96 for raft-building: Sliwa (supra n. 1) 10 and 11; Lucas (supra n. 1) 507 and 508, cites large branches of it found, but it is not a tall tree.

Salix salaf, grew along the Nile: Lucas (supra n. 1) 508; Rendle (supra n. 1) 60.
VITA

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