Boat-building and its social context in early Egypt: interpretations from the First Dynasty boat-grave cemetery at Abydos

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The boat-grave cemetery at Abydos has provided the world's oldest sewn planked hulls, and vivid evidence for the way early Egyptian wooden boats were built. As well as sailing on the Nile, they were designed to be dismantled for carriage over land to the Red Sea. By the mid-fourth millennium BC the ship was a major technical force in the Egyptian political economy as well as an iconic force in ceremonial burial.

Keywords: Dynastic Egypt, boat-burial, boat-building, carpentry

Introduction

Studying the origins and techniques of boat-building provides new data for examining social organisation, regional trade and technological conservatism in a nascent state society. A total of 22 boats have been found in Egyptian contexts dated between *c*. 3050 and 450 BC, either whole or disassembled and recycled in mortuary complexes, or abandoned on the river's edge (Ward 2000). Fourteen of these, buried as part of a First Dynasty funerary monument at Abydos, are the world's most ancient complex watercraft (Ward 2003; O'Connor 1991). In addition to making direct contributions to our understanding of the cultural value and social significance of watercraft, partial excavation of one boat at Abydos (Ward 2003, 2004) revealed details indicating a codification of early technologies by the developing state as early as 3300-3100 BC.

Just as this period established principles for an artistic canon (Iversen 1975: 60-6; Davis 1989), so it marks the creation of a specialised repertoire of techniques, materials and cultural behaviour for building boats and other artisan crafts. Other scholars have examined maceheads, ivory-handled flint knives and architectural details in works discussing the development of the Egyptian state (e.g. Hoffman 1991; Kemp 1991; Bard 1994; Trigger 1995), but until recently, it was not possible to consider another major artefact class – boats – in a similar study.

The Egyptians built wooden boats like no other culture in the world then or since. I argue here that wooden boat-building technology evolved independently within Egypt in response to local conditions and that the way the boats are built reflects aspects both of the

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legitimisation of power and participation in a regional trade network at least occasionally accessing the Red Sea before the third millennium. Expansion of boat-building technology coincides with the expansion of early chiefdom-level settlements such as Nekhen, Thinis and Nagada, and is likely to be directly related to the demonstration of status and hierarchy through acquisition of both prestige and exotic goods by long distance travel (Figure 1).

Figure 1. Location of major sites mentioned in the text.

Origins of wooden boats in Egypt

Early boat-builders in Egypt had raw materials, easy conditions for travelling on the Nile and other resources that made travel attractive to sedentary populations. Abundant native timbers and buoyant grasses or reeds allowed experimentation and evolution, both of which are visible archaeologically in the earliest villages in Egypt. Pottery from Palestine, shells from the Red Sea at villages in both upper and lower Egypt, and southern pottery finds in northern sites indicate a regular trade between upper and lower Egypt by the fourth millennium. Movement on the Nile itself is facilitated by its current flowing from south to north, and its steady winds blowing from north to south.

Although the earliest rivercraft were probably simple rafts made of bundles of reeds or papyrus, Hendricks and Vermeer (2000: 35) have pointed out that these were adequate by 7000 BC to fish the main channel of the Nile. An important feature of this early water transport is that individual bundles of reeds were lashed together in symmetrical lines that run across the hull. From the side, the lines appear as regular, vertical divisions of the hull. Several Badarian models illustrate this concept, as do a number of early fourth millennium examples (Brunton & Caton-Thompson 1928: pl. 23; Petrie 1933; Aksamit 1981). The feature is seen repeatedly on representations of other early Egyptian boats, and indicates 'accepted practice': the correct way to build and to portray a boat incorporated transverse lashing of major components.

By the fifth millennium BC, some boats were able to move large loads because they relied on displacement rather than simple buoyancy. Representations on pottery and rock faces in both the western and eastern deserts of upper Egypt suggest that the shift to wooden boats took place in the middle of the fourth millennium BC and was documented in drawings of large vessels along seasonal watercourses (wadis) and elsewhere in the desert between the Nile and the Red Sea. The long, curved watercraft (Figure 2a) typically feature paddles,

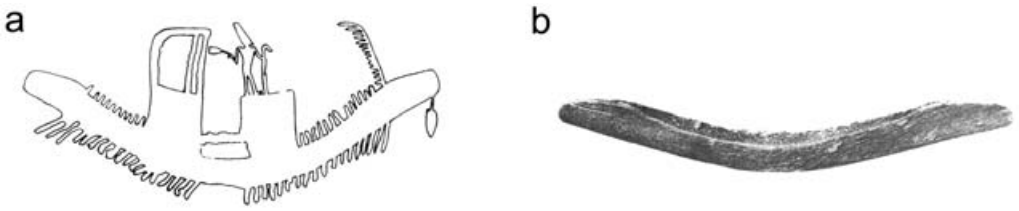

Figure 2. Early boat representations include (a) petroglyph from Wadi Abbad and (b) wooden model EM 4814, a long, low vessel with ends that resemble those on Nagada II pottery and Boat 10 at Abydos.

steering oars, upright and curved ends, and, often, deck structures and passengers (Winkler 1938: pl. 36.45, for example, and Winkler 1939; Vinson 1994: 11-6; Wilkinson 2003). A wooden model in the Egyptian Museum (EM 4814) likely represents the same boat type (Figure 2b) and is strikingly similar to the full-sized boats found at Abydos (see below). A form of the sail was probably introduced in the mid-fourth millennium.

The transition from tying bundles of buoyant reeds together (a raft) to the creation of a large, plank-enclosed space (a boat) marks a major shift in technology. In many of the world's boat-building traditions, the earliest examples of planked wooden hulls rely on lashing or sewing to hold plank edges together (Hornell 1946; McGrail 2001; Wright *et al.* 2001). Unlike any other tradition, however, Egyptian boat-builders lashed planks together across the hull, rather than along plank edges, in a unique transfer of technology. It can be suggested that the practices by which the transition was accomplished were rapidly standardised and can be traced through Egyptian boat-building for more than a thousand years. Examination of woodworking and standard boat-building techniques in the fourth and third millennia supports this hypothesis.

Development of woodworking technology in tombs

It is possible to examine the development of woodworking skills through tools, artefacts and features in tombs at several sites. By the mid-fourth millennium, evidence for sophisticated woodworking exists, and specialised carpenters had probably become a part of ordinary life in regional centres such as Maadi, Nagada or Nekhen. Local woods such as tamarisk, acacia and sycamore fig were regularly exploited and, occasionally, archaeologists find small fragments of imported woods such as cedar (Brunton & Caton-Thompson 1928: 62; Rizkana & Seeher 1989: 24-5; Gale *et al.* 2000: 335-52).

Stone tools for woodworking increased in number during the middle Predynastic period, and copper tools became more common after 3500 BC. One of the earliest large copper tools from Egypt is the most typical woodworking tool, an adze from the Middle Predynastic Tomb 39 at Nagada (Davies 1987: 28, n. 23). Smelted and cast copper axes, saws, adzes and chisels from Minshat Abu Omar (Wildung 1981: 29, 32, Figure 21), Tarkhan (Petrie *et al.* 1913: 8) and other Predynastic and First Dynasty sites such as Maadi are fully developed and imply efficient woodworking capabilities.

Grave enclosures in the Predynastic Naga-ed-Dêr cemetery (Lythgoe & Dunham 1965; phase dates in Savage 1998) demonstrate an increased standardisation and complexity of woodworking technology. The oldest graves (Phase 1) date to about 3800-3700 BC and

wood, when present, is limited to simple platforms of poles and twigs. In some graves from Phase 2, about 3640-3510 BC, the body is laid out on a plank. The earliest graves with wood roofs or planks set on edge indicate a desire to form a separate and delimited space for the body and appear just after 3500 BC (Phase 3). Incorporation of additional wooden elements corresponds to an increase in the number of grave goods deposited and the number of architectural elements in graves from Phase 4, about 3340-3100 BC (Savage 1997).

The relatively rapid increase in the number of graves with wood enclosures and an accompanying elaboration of carpentry techniques used to build the enclosures show that the control, acquisition and access to material and intellectual resources support Savage's argument (1997: 255) that the Nagd-ed-Dêr cemetery exhibits 'competitive burial' practices that increased demand for specialised woodworking skills. Social response to desires for displaying access to resources led to more complex means of joining boards and using those boards to build larger grave enclosures. Knowledge and control of raw materials, production and design are reflected in technological standardisation visible by the third phase of Nagd-ed-Dêr burials when a limited range of techniques was repeatedly used to join individual planks of uniform thickness and width with lengths of 2m or more (Lythgoe & Dunham 1965: xiv-xv, 202-5).

In early Phase 3 graves, plank ends were shaped to butt directly against one another or mitred (angled) to fit tightly against one another at 90° angles. In slightly later graves, cords through simple holes keep plank ends aligned. Of particular interest to the long-term trajectory of wooden hull construction in Egypt is the addition of vertical posts to reinforce corners of late Phase 3 and Phase 4 enclosures (Figure 3). Posts lashed to side planks through holes drilled at plank ends permitted lashings to be drawn more tightly, contributing rigidity to the structure, a simple technique paralleled by the use of battens over plank seams in sewn boats.

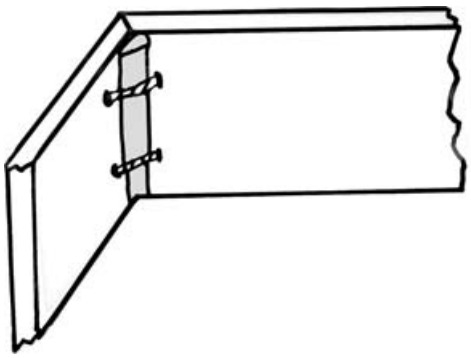

Figure 3. The wood enclosure at Nagd-ed-Dêr Grave 7190 included corners reinforced with a post lashed to planks.

Other joinery techniques have been observed at Nekhen, where a *c.* 3300 BC grave contained a wooden bed with bull's feet (Adams & Hoffman 1987: 178), and at Tarkhan, where graves dating to 3300-3000 BC provide a wealth of information about the level of technology available (Petrie *et al.* 1913: 6-23; Mackay 1915: 23-30; Killen 1980; Gale *et al.* 2000: 355-67; Spencer 1980: 104, pl. 80). One of the most important indigenous woodworking techniques was the fixed mortise-and-tenon joint. A fixed tenon is made by shaping the end of one timber to fit into a mortise (hole) cut into a second timber (Figure 4a). A variation of this joint using a free tenon eventually became one of the most important features in Mediterranean and Egyptian shipbuilding. It creates a union between two planks or other components by inserting a separate tenon into a cavity (mortise) of the corresponding size cut into each component (Figure 4b). Wood repair patches, fixed tenons and other simple lashing techniques are represented in Tarkhan coffins. In addition,

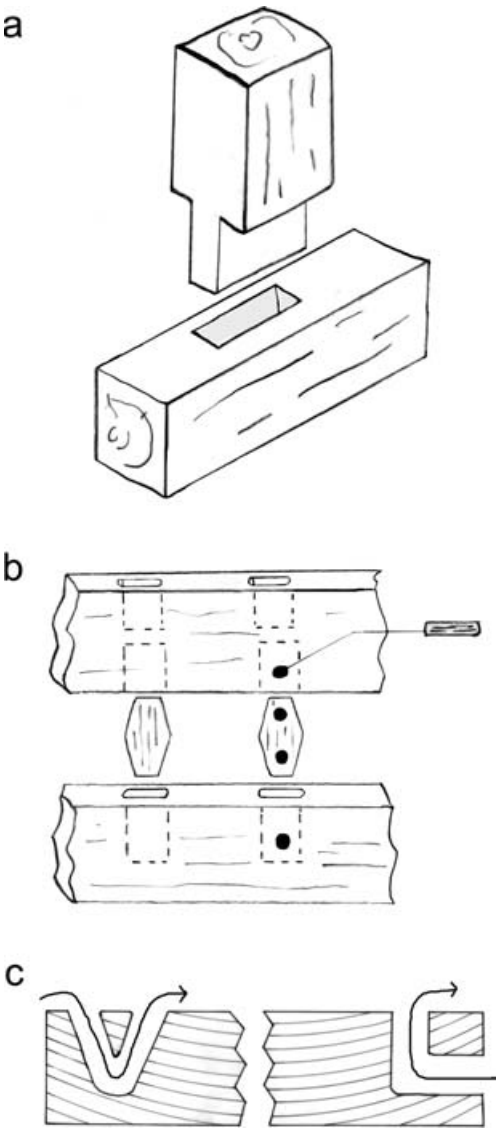

Figure 4. Fastening techniques include (a) fixed tenons (b) free tenons with and without locking pegs and (c) V- and L-shaped lashing channels.

Egyptian furniture specialists, like later Mediterranean shipwrights, locked mortise-and-tenon joints (both fixed and free tenons) with pegs that passed perpendicularly through the tenon and timber around it, locking the tenon in place.

The coffins show consistency in methods used to join planks only 1.5 to 3.5cm thick and include complex joinery techniques. In addition to both locked (pegged) and unlocked mortise-and-tenon joints, leather and linen cordage was passed through V-shaped and L-shaped channels (Figure 4c) (Mackay 1915: pl. 25) and through simple holes to connect planks. Plank edges were not necessarily parallel, but curved along the grain of the tree, and were fitted to planks with similar curved edges, thus limiting wastage. Carpenters continued to use the same fastening and planking techniques for the next 500 years.

Boat-building technology

Even before the third millennium, boat-building practice diverged in significant ways from furniture and coffin building. The study of ancient Egyptian ships is facilitated by the practice of burying them at funerary monuments during times of great social prosperity (First, Fourth and Twelfth Dynasties). Up to 1991, the principal finds were two watercraft (Figure 5) beside Khufu's pyramid at Giza (2550 BC) and four outside the pyramid of Senwosret III at Dashur (*c.* 1850 BC) (O'Connor 1991, 1995; O'Connor & Adams 2001; Lipke 1984; Ward 2000, 2001, 2003). A number of First Dynasty boat-burials at tombs of high officials at Saqqara (Emery 1954, 1958) and of less highly ranked persons at Helwan (Saad 1969) were known, but the boats were poorly preserved and incompletely recorded (Table 1). In addition, disassembled hulls of large boats were used as foundations for causeways and other purposes at several Middle Kingdom pyramids (Petrie *et al.* 1923) including planks from around Senwosret I's pyramid at Lisht (*c.* 1950 BC) (Ward 2000: 107-28; [Ward] Haldane 1992). A locally built working boat abandoned on the Nile in Mataria, north of

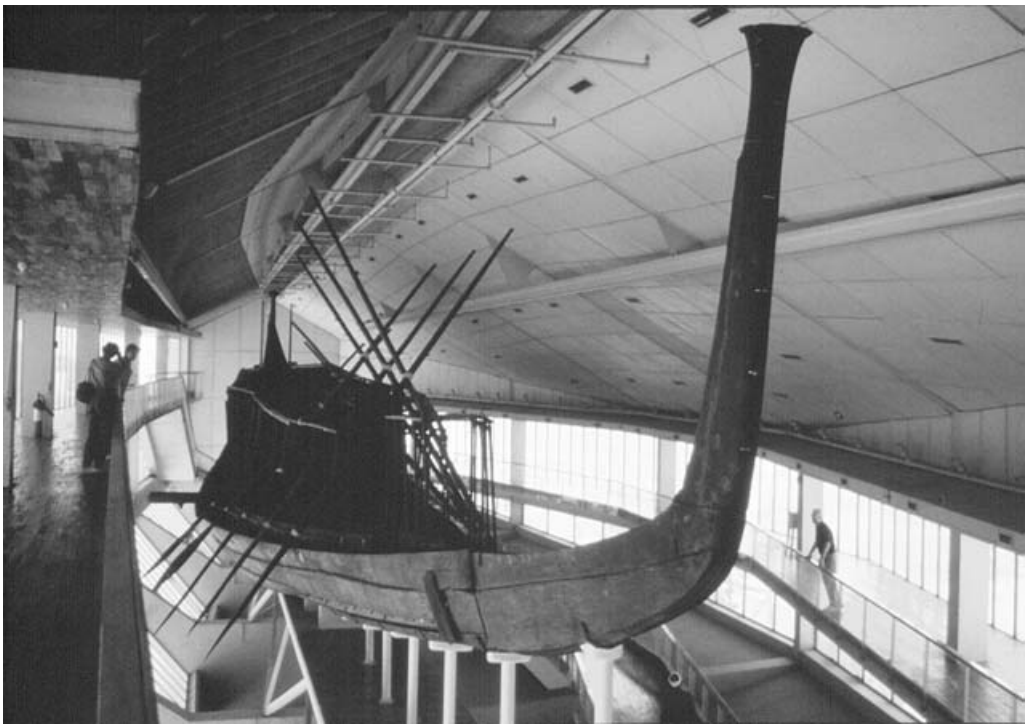

Figure 5. The reconstructed royal ship of Khufu, built from more than 1600 individual pieces of cedar and other woods about 4500 years ago, is one of the world's most extraordinary archaeological discoveries.

Table 1. Dimensions of some mud-brick boat graves associated with First Dynasty rulers and high-ranking officials.

Location	Dimensions in metres
Abydos (Aha)	19-29 × 3.5 × 0.6 (14 boats)
Saqqara 3357	19.3 × 3.2 × 1.0
Saqqara 3503 (Merneith)	17.75 × 4.25 × 0.8
Saqqara 3506	22.15 × 3.4 × 1.1
Saqqara tomb 3036 (Ankh-ha)	14.3 × 2.15 × 0.75

Cairo, about 450 BC, is an example of vernacular construction with significant links to technological practice established more than 2000 years earlier (Ward 2000: 129-36).

In 1991, the discovery of a fleet of boats at Abydos, the burial place of Egypt's first kings, greatly augmented this evidence. Several seasons of excavation under the direction of David O'Connor of the Pennsylvania-Yale-Institute of Fine Arts Expedition to Abydos revealed a long row of mud-brick boat-graves between two funerary monuments there. These constitute the earliest boat-burials found in upper Egypt. The boats were smaller than the graves that enclosed them in each case, but had similar overall long and narrow proportions (at least six times longer than wide). Exterior treatment was also similar to the tombs, as several boats were plastered; the excavated Abydos boat was covered with white plaster and painted dark yellow (ochre).

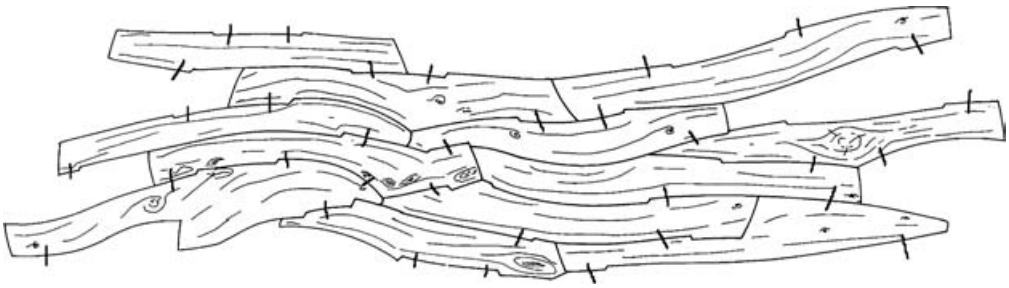

Figure 6. Joggled edges and ligature locations (vertical lines) of Lisht timbers in a reconstructed planking plan. The ligatures are not visible from the outside of the hull.

A limited excavation of the north end of Boat Grave 10 exposed about 3m of its 22m length (Ward 2003). Some of its planks were almost completely preserved while others were almost completely consumed by insects, probably termites. However, even in the worst cases it was possible to obtain a complete record of overall dimensions, although details were sometimes obscured. The techniques exhibit a remarkable degree of expertise and standardisation in a number of features. No mortise-and-tenon joints or pegs were used to join the edges of planks that made up the angular bottom and sides of Boat 10 (Figure 7). Instead, the planks relied completely on lashing threaded through angled and L-shaped channels in transverse lines to create the hull (Figure 4c). The planks are of even thickness (6cm), and the regular size of the channels and their positions relative to plank edges was remarkable. Lashing channels have an average length of one Egyptian palm (about 7.5cm) and a thickness of one digit (about 1.9cm), the same dimensions as lashing channels cut into timbers from the site at Lisht. Most of the lashing had decayed, but a broad, woven strap filled several channels. It was startling to realise that the strap shows the same weave and approximately the same dimensions as similar remains from Lisht planks created more than a thousand years later.

All boat-builders solve similar problems, and some of the worst problems are weakness and leaks generated by planks moving against one another along their edges (longitudinal slippage) (Coates 1985). To combat slippage, Mediterranean shipwrights used locked (pegged) mortise-and-tenon joints as seen in the late fourteenth century BC Uluburun ship (Pulak 1998). In Egypt, however, the only use of locked mortise-and-tenon joints is in prefabricated panels on the Khufu ships' cabins, a repair to a plank on the Carnegie Dashur boat, and in a repair to a mortise-and-tenon joint in a Lisht plank (Ward 2000: 67, 98, 112). Rather than locking joints, the Egyptian boat-builders fastened planks with symmetrically placed ligatures, single 'stitches' connecting adjacent planks, and used joggles, small notches cut along plank edges to fit precisely into a recess on an adjacent plank, to effectively stop slippage (Figure 6).

Why did Egyptian boat-builders reject locked joints, when contemporary Egyptian furniture carpenters took advantage of their properties? I suggest that unpegged joints permitted boats to be more easily disassembled and the planks transported, reassembled and 'recycled'. Egyptian boats were built to be taken apart, and this intention to disassemble the hull is also discernible in boat timbers from the world's oldest planked hulls at Abydos.

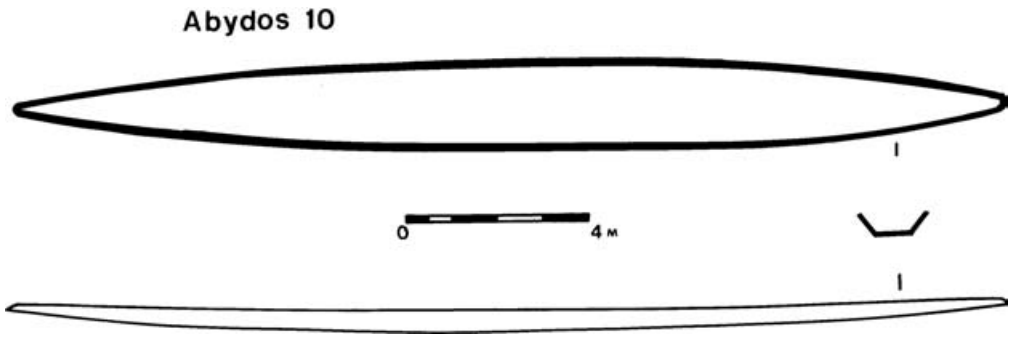

Figure 7. Abydos boat 10, reconstructed plan (above) and sheer view.

At Abydos, the boat-builder's tool kit included tools known for at least 500 years, and tool marks provide a range of information about tool type, size and sharpness. Metal saws were used to shape the planks, and lashing channels were cut with a chisel. Sandstone polishers were probably used as well, as the few toolmarks visible were located inside channels and on an 8cm area of one plank. The planks are a local wood, probably tamarisk. Many scholars look to the eastern Mediterranean for the source of wood used to build ancient Egyptian watercraft, in part because the reassembled Khufu ship is a 43m long, locally built vessel, built primarily of imported cedar (Lipke 1984: 25; Ward 2000: 45-68). Local production of royal ships from imported wood, as documented on the Palermo Stone for the Fifth Dynasty king Sahure and implied by a Second Dynasty Egyptian axe found near Byblos, was an important aspect of the power of the early state (Hoffman 1991: 336-9). But the use of local wood at Abydos to build at least 14 boats, each more than 17m long and weighing more than a ton, proves that the Egyptians could build large hulls without going to the Levant for raw materials. The ritual burial of the boats at one of the earliest funerary monuments in Egypt demonstrates their importance as objects of conspicuous consumption and social dominance.

Functional and social roles of boats

Bard (2000) describes the development of the early state and the role of prestige grave goods in reinforcing social position and power, and she notes that one of the most critical changes in society was the development of a state religion focused on the king and with considerable economic and human resources devoted to mortuary cult. The Abydos boat-burials function at multiple levels within a complex social process that transformed Egypt from a collection of chiefdoms under a single ruler into a state that persisted over 3000 years. Rathje (2002) describes similar practices for an emergent Olmec civilisation that removed scarce and desired objects from circulation through what seemed pious sacrifice, but actually served to allow social leaders to avoid sharing those prestige items with potential competitors, a dual approach that reinforced existing chains of power. Recent studies of the material remains of early state societies identify common practices related to consumption displays that result from the control of resources, technology and skilled specialists as is characteristic of early Egypt. Earle (1997: 73) notes that emerging elites often dominate the economy and

landscape through controlling producers, transport and trade routes, an idea that expands upon Arnold's (1995) conception of maritime transport as a key component in developing chiefdoms on the Channel Islands of California.

I believe control of water transport offered similar paths to complexity in Egypt and that the technological standard of boat disassembly and relative ease of reassembly for pharaonic Egyptian hulls is significant in understanding the rise of the Egyptian state. That boats were dismantled and their parts recycled has been argued (above) and is supported by the observed reuse of boat timbers at sites such as Lisht, and in the documentation of reused planks and other components in a royal dockyard (Ward 2000: 107-28, 138-41; Simpson 1965). Because the boats could be taken apart, they also could be carried across the desert and put back together on the coast for a Red Sea voyage (Sayed 1983). Excavations at Mersa Gawasis (Sayed 1978, 1980; Bard & Fattovich 2003), a small bay about 18km north of Quseir, revealed inscribed shrines built of non-local limestone anchors, broken copper chisels and cedar plank fragments, some sawn ends from longer planks, of similar width and thickness to planks from Lisht and Dashur and bearing mortises of identical dimension to those in Abydos, Lisht and Dashur planks.

Predynastic and early dynastic drawings of wooden boats along half the route we know the Egyptians used to reach the Red Sea from Upper Egypt imply connections between people living in the desert and the Nile (Winkler 1939; Wilkinson 2003). It is probable that journeys to the sea by people carrying disassembled 'boat kits' (Kenneth Kitchen, pers. comm.) like the two disassembled hulls buried by Khufu's pyramid had already begun by the mid-fourth millennium BC. Evidence for early travel to or on the Red Sea is indirect but indicated by finds from a number of Predynastic and early dynastic graves and sites. For example, Red Sea shells are reported at Faiyum A sites in lower Egypt (late sixth and early fifth millennium BC) and at Badarian sites of the early fifth millennium (Caton-Thompson & Gardner 1934). J. Zarins has pointed out that obsidian in Predynastic sites by about 4000 BC is chemically identical with the Ethiopian/south-west Arabian sources and suggests that cross-sea travel was involved (Zarins 1989; see Kitchen 2002: 384-6 for his view that obsidian was traded between local Red Sea residents rather than by Egyptians crossing the Red Sea).

Travel between the Nile and the Red Sea is attested to in texts and in the archaeological record left by multiple journeys by thousands of people over a trek of at least 115km. The route through the Wadi Hamamat slightly north-east towards the Red Sea coast is indicated not only by inscriptions on its walls but also by evidence of repeated visits to Mersa Gawasis. Textual evidence shows that Sahure (Fifth Dynasty), Senwosret I (Twelfth Dynasty), Hatshepsut (Eighteenth Dynasty) and Ramses III (Twentieth Dynasty) equipped expeditions to Punt that departed from the Red Sea; the popularity of Red Sea shells in jewellery and decorative motifs is constant from the Predynastic period onward. Punt was the name for a region that provided aromatic resins, gold and other commodities important to the socially competitive Egyptian culture centred on the Nile. The Egyptians indicated that one reached Punt by travelling southwards along the Red Sea coast, but today scholars disagree on the precise position of Punt. The most likely location is Ethiopia/Eritrea (Kitchen 1971, 1982, 2002) or Somalia (Fattovich 1991, 1993), or both, at different times.

Conclusion

The dynamics of early Egyptian politics required substantial yet portable boats. There were no permanent Egyptian supply stations or settlements along the Red Sea coast, though an early orientation towards the Red Sea is apparent. I believe that a desire to transfer boats from the Nile River across the Eastern desert to the Red Sea is likely to be the primary reason boats were designed for disassembly, with reuse and recycling of individual components secondary. Local travel on the Nile cannot account for developing and maintaining technological practices specifically linked to disassembly.

Examination of the details of hull construction over a period of 1200 years indicates regularities in design, plank shape, plank fastenings and even the dimensions of individual components. One explanation for the enduring tradition could be the establishment of communities of specialists with an extensive apprenticeship programme that maintained group practice over a very long period. Although it is possible that the state, in the form of the ruler, mandated some aspects of boat design, it is unlikely that the dimensions and arrangement of plank fastenings received his direct attention. What did receive attention was the role of the vessels in demonstrating prestige, access to specialists, control of resources and even exhibition of power connected to warfare and domination. Many of the earliest representations of watercraft from Egypt, including a Predynastic textile from Hierakonpolis and the Narmer palette, are associated with scenes of conflict or control.

William Rathje (2002) has suggested that one of the prime factors that pushes a society from chiefdom to state may be the shift from accumulating material goods through peer exchange (social production dispersal) to embedding production through the construction of monumental structures or by quite literally burying surplus wealth in the ground. When considering the insect-riddled, 5000-year-old wooden boats at Abydos, if we imagine their 20m length wrapped in thick gold foil, we can perhaps better perceive what they represented to the early state. Boats for war, boats for administering justice, boats for trade and boats to travel to the next world are some of the earliest symbols of royal power (Williams 1988: 38) and have been a part of ancient Egyptian culture for at least 7000 years. The burial of boats in ancient Egyptian funerary monuments is as significant a socio-economic statement about the nature of power as the construction of massive mudbrick and wood tombs or even pyramids.

Acknowledgements

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