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ΠΑΚΤΟΥΝ AND ΠΑΚΤΩΣΙΣ AS SHIP-CONSTRUCTION TERMINOLOGY  
IN HERODOTUS, POLLUX AND DOCUMENTARY PAPYRI

aus: Zeitschrift für Papyrologie und Epigraphik 113 (1996) 197–204

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The most important description of Egyptian ship construction from the Graeco-Roman period is that of Herodotus, in Book 2, 96. The passage is mostly straightforward, and remarkably consistent with what is known about actual Egyptian hull construction. One sentence, however, has remained problematic: ἔσωθεν δὲ τὰς ἀρμονίας ἐν ὧν ἐπάκτωσαν τῇ βύβλω. The standard modern interpretation may be found in LLOYD,<sup>1</sup> who translates “they caulk the seams from within with papyrus.” However, an alternative view — which is accepted here — has more recently been championed: that ἐν ὧν ἐπάκτωσαν τῇ βύβλω here means “they make fast from the inside with papyrus,” in the sense of lashing together vessel planks with papyrus webbing or ropes.<sup>2</sup>

HALDANE and SHELMERDINE showed that caulking is archaeologically unattested in surviving examples of Egyptian hull construction; that the archaeological attestation of hull lashing extends at least into the Middle Kingdom; and provided a useful discussion of the meaning of πακτοῦν (the compound ἐμπακτοῦν is found only in Herodotus) in literary texts in non-nautical contexts.<sup>3</sup> With this note, the author would like to extend their argument by focussing on the following issues: (1) whether it is possible to detect a difference in meaning between ἐμπακτοῦν and the simple form πακτοῦν, especially in light of P. Col. III, 43; (2) the appearance of πακτοῦν and its nominal form πάκτωσις as terms for hull construction in the Onomasticon of Pollux of Naucratis (1, 84); (3) the meaning and usage of the noun ἀρμονία, which is intimately connected to the meaning of the verb ἐμπακτοῦν; and (4) on the use of πακτοῦν and πάκτωσις as terms for vessel maintenance procedures in documentary papyri (P. Col. III, 43; P. Cairo Zenon III, 59483; P. Petrie III, 46). All of the texts discussed here have been long known — indeed, Pollux 1, 84 and P. Petrie III, 46 are cited in LSJ under πάκτωσις — but none has yet been brought to bear on this particular question.<sup>4</sup>

Before proceeding to details, a bit of background on pharaonic Egyptian and classical Greek ship construction may be helpful. In ancient Egyptian and Mediterranean ship construction, wooden vessels were not built by attaching hull planks directly to a pre-erected framework. Rather, the exterior skin was built first, with a vessel’s primary structural strength coming from the attachment of planks to each other. Planks were attached to one other with mortise-and-tenon joints, i.e., by means of a series of tenons, each inserted into a pair of corresponding mortises cut into the upper and lower edges of the planks to be fit together. Interior frames were added at a later stage; in Egypt, at least, they might be dispensed with altogether. In both traditions, planks were virtually sculpted to fit each other as closely as possible, and for this reason, caulking was not normally necessary.<sup>5</sup>

\* I would like to express my sincere appreciation to Prof. Roger Bagnall of Columbia University and Prof. Lionel Casson of New York University for kindly reading this paper, for correcting several slips and offering a number of useful suggestions.

<sup>1</sup> “Herodotus 2.96.1-2,” *Classical Quarterly* 29 (1979), p. 48. idem, *Herodotus, Book II Commentary 1-98 (Études préliminaires aux religions orientales dans l’empire romain)*, Leiden, 1976), p. 387. See also LSJ, ἐμπακτόω; L. CASSON, *Ships and Seamanship in the Ancient World* (Princeton, N.J., 1971), p. 14, n. 15; S. CLARKE in “Nile Boats and Other Matters,” *Ancient Egypt* 1920, p. 44.

<sup>2</sup> C. HALDANE and C. SHELMERDINE “Herodotus 2.96.1-2 Again,” *Classical Quarterly* 40 (1990), pp. 535-39; C. HALDANE, “Egyptian hulls and the evidence for caulking,” *International Journal of Nautical Archaeology* 19.2 (1990), pp. 135-36.

<sup>3</sup> For a summary of the various positions, see HALDANE and SHELMERDINE, *supra* n. 2, 535 with notes 1-8.

<sup>4</sup> The editors of P. Col. III, 60 and P. Petrie III, 46 translated πακτώσαι and πάκτωσις as “to caulk,” on analogy with the then-prevailing understanding of Herodotus 2, 96. CASSON also adopts “caulking” in a recent discussion of P. Col. III, 60; see “Skippers on the Nile in Ancient Times,” *American Neptune* 54 (1994), p. 7. LSJ defines πάκτωσις as “fastening, putting together,” but the article on the word makes no explicit mention of the word’s specifically nautical connotations. For πάκτωσις, PREISIGKE, *Wb.*, citing only P. Petrie III, 46, has “Zusammenfügung” and “Dichtung.”

<sup>5</sup> While the use of resin or pitch to waterproof hulls can be described as caulking, the word is here taken to mean the use of some fibrous material to physically plug gaps between planks. For discussion of caulking in this sense, see CASSON,

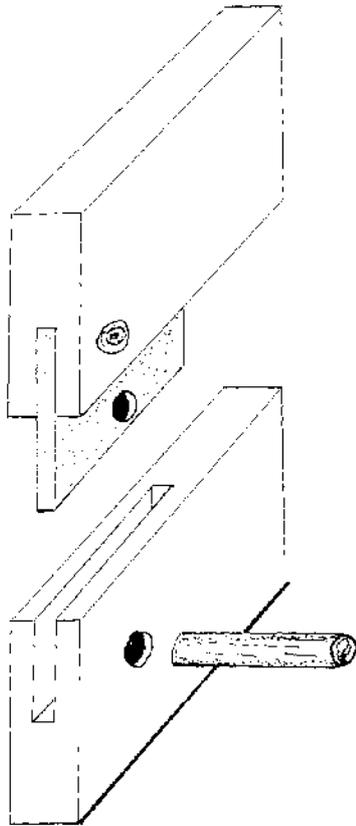


Fig. 1: Exploded view of planks with pegged mortise-and-tenon joint.

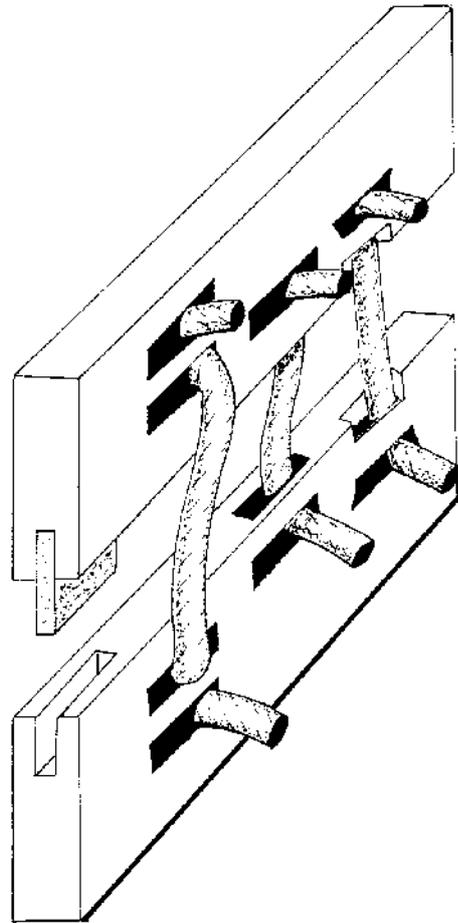


Fig. 2: Exploded view of planks with unpegged mortise-and-tenon joint and three different types of lashing: left to right, lashing through V-shaped holes (entrance and exit in same surface); through L-shaped holes (entrance and exit in perpendicular surfaces); and reconstructed Dahshur-boat ligatures.

However, the method of finishing the joinery differed between Egypt and the classical Mediterranean world. In classical Graeco-Roman ship construction, the mortise-and-tenon joints were locked by means of pegs hammered through the vessel's skin and transfixing the tenon on either side of the joint (Fig. 1). For most of Egyptian history, the tenons served only to keep the planks in proper alignment. Hull planks were actually held together with interior lashing (Fig. 2).<sup>6</sup> The earliest-known lashing technique in Egyptian ship-construction is the "rail-to-rail" lashing of the Cheops vessel (c. 2500 BCE), in which ropes are fed laterally through V- or L-shaped channels cut into the interior surfaces of planks.<sup>7</sup> This method of lashing, in concert with mortise-and-tenon joinery, is actually

*supra* n. 1, p. 209, with n. 38; and p. 339, where CASSON points out that caulking is primarily found in ship-building traditions (ancient and modern) in which planks are nailed to pre-erected frames, rather than attached to one another as in Egypt and the classical Mediterranean world; HALDANE, *supra* n. 2, passim; P. LIPKE, *The Royal Ship of Cheops* (BAR International Series 225 = National Maritime Museum, Greenwich, Archaeological Series No. 9, Oxford, 1984), p. 105 and note 52 on p. 130. See also the process for fitting planks together described in CLARKE, *supra* n. 1, pp. 46ff., esp. p. 49.

<sup>6</sup> Note, however, that Egyptian carpenters had actually begun to use pegged mortise-and-tenon joints in furniture manufacture as early as the First Dynasty, or around 3000 BCE, but as far as current evidence goes, never in pharaonic hull construction; see W. EMERY, *Great Tombs of the First Dynasty II* (London, 1954), fig. 42 on p. 50.

<sup>7</sup> LIPKE, *supra* n. 5, passim, but especially pp. 117ff. on the sequence of construction.

documented as early as the First Dynasty, or about 3000 BCE,<sup>8</sup> but not positively confirmed as a ship-construction technique before the Old Kingdom. Other lashing techniques are documented archaeologically for hull construction in the Middle Kingdom,<sup>9</sup> and an important Ramesside Egyptian letter, preserved in the collection of miscellaneous compositions P. Anastasi IV, seems likely to contain allusions to hull lashing in the 19th Dynasty.<sup>10</sup> The archaeologically-documented hull lashing methods from Egypt all have one essential point in common: the holes through which the lashings pass do not as a rule penetrate the exterior of the hull. Instead, the lashings enter into and exit from an interior surface; i.e., the joints attaching the hull planks to each other were “made fast from the inside.”

It is a fact that by the time Herodotus was in a position to observe shipbuilding on the Nile, the use of pegged mortise-and-tenon joinery in hull construction had indeed penetrated the Nile, as the al-Matariya boat shows.<sup>11</sup> Herodotus, however, was expressly discussing native Egyptian vessels, βῶρις-boats.<sup>12</sup> The presence on the fifth-century-BCE Nile of vessels constructed with Graeco-Roman methods certainly cannot be taken as *prima facie* evidence that the indigenous tradition had died out. On the contrary; the fact that Herodotus was interested in the local craft suggests that they had features which could be contrasted with the ships his Greek readers were familiar with.

For the correct interpretation of the Herodotus passage here discussed, the crucial issue is of course the meaning of ἔμπακτοῦν. That the simple form πακτοῦν has throughout Greek the common meaning of “to fasten close, make fast”<sup>13</sup> was amply demonstrated by HALDANE and SHELMERDINE. LLOYD had assumed the possibility of an extended or separate meaning for the compound ἔμπακτοῦν, but comparison with P. Col. III, 43, an account from the Zenon archive, suggests that in the context of ship construction or repair, the words could be used interchangeably. This text, drafted in the name of the κυβερνήτης Phamounis, records in lines 9-10 an expenditure of two drachmas, five obols for θρύα ὥστε πακῶσαι τὸ πλοῖον, “reeds in order to πακῶσαι the boat.” Phamounis here uses the simple verb-form πακῶσαι, not Herodotus’ ἔμπακτοῦν; yet the mention of reeds and the nautical context make it extremely likely that the reference is to the same process. This suggests that there is little reason to assume a separate meaning for the compound ἔμπακτοῦν. This was evidently the view of

<sup>8</sup> S. VINSON, *Egyptian Boats and Ships*, (Shire Egyptology Series 20, Princes Risborough, UK, 1994), pp. 18-19 with fig. 10.

<sup>9</sup> For lashing of hulls in the Middle Kingdom, see HALDANE, *Ancient Egyptian Hull Construction* (Texas A&M University dissertation, College Station, Texas, 1993), 220-224. (the Dahshur boats) and pp. 172ff. (the Lisht timbers); for the Lisht timbers, see also HALDANE, “The Lisht Timbers: A Report on Their Significance,” in D. ARNOLD, *The Pyramid Complex of Senwosret I (The South Cemeteries of Lisht, Volume III)*, New York, 1992), pp. 102-112 and plates 102-104, 115-133 and figs. 20 and 21 on 105.

<sup>10</sup> rt. 7/9 - 8/7. Text in A.H. GARDINER, *Late-Egyptian Miscellanies (Bibliotheca Aegyptiaca VII)*, Brussels, 1937), pp. 42ff.; translation and commentary in R. CAMINOS, *Late-Egyptian Miscellanies (Brown Egyptological Studies I)*, London, 1954), pp. 159ff. The text appears to have been composed in the late 19th Dynasty; see GARDINER, *loc. cit.*, p. xv. See also text and discussion, but no translation, in S.R.K. GLANVILLE, “Records of a Royal Dockyard of the Time of Tuthmosis III,” *ZÄS* 68 (1932), pp. 13-14 and pp. 37-38. The text will also be the subject of a forthcoming article by the present author.

<sup>11</sup> C. HALDANE, *supra* n. 9 (*Ancient Egyptian Hull Construction*), p. 244.

<sup>12</sup> βῶρις = Egyptian *br*; see A. ERMAN and H. GRAPOW, *Wörterbuch der ägyptischen Sprache* (Berlin and Leipzig, 1926 ...) I, 465, 8-9; W. ERICHSEN, *Demotisches Glossar* (Copenhagen, 1954), p. 119; W. CRUM, *A Coptic Dictionary* (Oxford, 1939), p. 42, column a.

<sup>13</sup> As defined in LSJ; cf. the Suda’s, “κλείειν, ἀσφαλίζεσθαι.” As this article was in press, Prof. CASSON was kind enough to bring to my attention his article “The Nautical Imagery in *Anthologia Graeca* 10.23,” *CQ* 42 (1992), pp. 555ff. On p. 557, with notes 16 and 17, Prof. CASSON replies to HALDANE and SHELMERDINE. Prof. CASSON stands by the standard translation of Herodotus 2, 96; he argues that πακτοῦν means “shut” or “close,” not “bind” or “secure,” and points out that it is occasionally glossed with κλείσαι. In personal communication (letter of April 29, 1996), Prof. CASSON added that “in contexts dealing with hull construction ‘shutting’ can only mean ‘caulking.’” As will be seen below, I remain convinced that Pollux 1, 84 presents πακτοῦν and πάκτωσις as wood joinery terms. Moreover, it is not clear that a word meaning “to shut” or “close” when used of a door could only mean “to caulk” when used of the joints of a ship’s hull; cf. the scholion to Od. 5, 248 (quoted *infra*, note 22 of the present article) in which συνέκλεισε glosses ἄρασεν.

Byzantine commentators. The Suda does not admit ἐμπακτοῦν as a separate word, and in his comments on Od. 5, 248, Eustathius cites Herodotus 2, 96 using the simple form πακτοῦσι.

P. Col. III, 43 admittedly sheds little light on the exact meaning of (ἐμ)πακτοῦν as a ship-construction term. Fortunately, the word appears in the Onomasticon of Pollux of Naucratis in his list of synonyms for the activity of building a ship's hull:

ἐρεῖς δὲ γομποῦν καὶ πηγνύειν καὶ ἀρμόζειν, πακτοῦν καὶ πάκτωσις καὶ τὰ ὅμοια.

You will say “to peg” and “to fasten” and “to join,” “to make fast” and “fastening” and the like.

The first three terms in this list all refer specifically to the joining of wooden planks, and there is no reason not to conclude that the verb πακτοῦν and the noun πάκτωσις refer to the same category of activity. It is worth noting that while πακτοῦν is attested in Greek literature in diverse contexts,<sup>14</sup> the noun πάκτωσις seems to appear only as a term for hull construction, and outside of Pollux, only in documentary papyri.<sup>15</sup> It seems possible that in πάκτωσις we may have a genuine technical term evolved to describe the peculiarities of Nilotic vessel construction.<sup>16</sup>

Consideration of the meaning and usage of ἀρμονία, the other key word in this passage, strengthens this conclusion. The word has of course a wide variety of applications. As a philosophical term, it can refer to an especially intimate connection, indeed a merging -- in a word, “harmony.” See, for example, the usage in Aristotle, *De Anima*, 1,4:

ἀρμονίαν τινὰ τὴν ψυχὴν λέγουσι, καὶ γὰρ τὴν ἀρμονίαν κρᾶσιν καὶ σύνθεσιν ἐναντίων εἶναι.

(Some) call the soul a type of ἀρμονία, since (they say) ἀρμονία is the combination and synthesis of opposites.

More concretely, it appears often as a term for the structure of the human body; here a physical connection is obviously implied. As a ship-construction term, ἀρμονία can — like the English word “joint” — refer either to a seam, i.e., the line of contact between two planks,<sup>17</sup> or to the physical connection between them. ἀρμονία certainly seems to mean “seam” in a Josephus, *Jewish War* 4, 8, 4, where bitumen from the Dead Sea is said to be χρήσιμος ... εἰς ἀρμονίας νεῶν, “useful for ships’ joints.”<sup>18</sup> It may also have this meaning in Strabo 4, 4, 1, a description of the ships of the Veneti:

... οὐ συνάγουσι τὰς ἀρμονίας τῶν σανίδων, ἀλλ’ ἀραιώματα καταλείπουσι. ταῦτα δὲ βρῦοις διανάπτουσι ...

... (T)hey do not bring together the joints/seams of the planks, but leave gaps; these they caulk with seaweed ...

This passage finds its explanation in the fact that Celtic ships, like modern western wooden vessels but unlike Graeco-Roman and ancient Egyptian boats and ships, often had planks nailed directly to pre-

<sup>14</sup> See HALDANE and SHELMEARDINE, *supra* n. 2, pp. 536-7, notes 13 and 14 for all citations in LSJ or obtained from the TLG CD-ROM; add Pollux 1, 84 and Pollux 7, 113 to their list.

<sup>15</sup> The *Thesaurus Graecae Linguae* of Stephanus cites only Pollux; a search of the TLG CD-ROM produced no citations.

<sup>16</sup> It is not to be doubted that Pollux, writing in Egypt during the second century CE, could have collected information about specifically Egyptian ship-construction techniques in compiling his Onomasticon. Note also that he includes the native Egyptian vessel name βᾶρις among vessel types in 1, 82.

<sup>17</sup> Cf. J.R. STEFFY’s definition of “seam” in “The Kyrenia Ship: An Interim Report on its Hull Construction,” *AJA* 89 (1985), p. 71: “the longitudinal line or joint between two planks.”

<sup>18</sup> For pitch used on the (otherwise uncaulked) planking of the fourth century BCE Kyrenia wreck, see Steffy, *supra* n. 17, p. 87, 99. Pitching of hulls is attested in Egypt, although rather late; see Philae Demotic graffito 417, ls. 7-8 (late Roman), in which the pitching of the bark of Isis is mentioned as a devotional act. See in F. LI. Griffith, *Catalogue of the Demotic Graffiti of the Dodecaschoenus I*, Text (Oxford, 1937); *II*, Plates (Oxford, 1935). The mention of wax issued to κυβερνήται in the Zenon archive (P. Cairo Zenon IV, 59754 and 59790, P. London VII, 2165) might point to the use of encaustic paint for waterproofing.

erected frames, not attached to one another.<sup>19</sup> συνάγειν τὰς ἀρμονίας evidently refers to this mutual attachment of planks in Graeco-Roman ship construction — or rather, its lack among the Veneti. Strabo implies that if the Veneti's hull planks were “brought together” (or perhaps better: “united”) in good Graeco-Roman style, the ἀρμονία would have no gaps and need no caulking. (It may be noted here parenthetically that if hull lashing on the fifth-century BCE Nile was long obsolete, as LLOYD maintained, the only technique with which it is likely to have been replaced is precisely this water-tight Graeco-Roman-style construction.) It is noteworthy that the locution “bring together/unite the seams” is used when, strictly speaking, it is the planks whose line of contact defines each seam which are brought together and/or united. Thus, even when ἀρμονία means “seam,” it can appear as object of a verb which denotes an action performed on the ship's planking and joinery. If a translation of “seam” is insisted upon for ἀρμονία in Herodotus,<sup>20</sup> ἐμπακτοῦν τὰς ἀρμονίας must — on analogy with Strabo's συνάγειν τὰς ἀρμονίας — mean that the planks were made fast to one another, not that gaps between the planks were caulked or stopped.

Elsewhere, ἀρμονία is unambiguously used to refer to a physical connection between hull planks.<sup>21</sup> Two passages from the Odyssey, both referring to the vessel built by Odysseus to escape the island of Kalypso, are pertinent here. First, Od. 5, 248:

γόμεφοισιν δ' ἄρα τήν γε καὶ ἀρμονίησιν ἄρασσεν

“then he hammered her (scil., the vessel) with pegs and joints.”

As an instrumental dative used with the verb “to hammer,” ἀρμονίησιν here cannot possibly mean “seams.” Quite the contrary: the word clearly refers to the means of attachment of the hull planks to one another.<sup>22</sup> As CASSON has shown, the use of γόμεφοισιν in parallel with ἀρμονίησιν suggests that poet of the Odyssey is specifically describing the classical Graeco-Roman pegged mortise-and-tenon joint.<sup>23</sup> A similar meaning is indicated in Od. 5, 361, in which Odysseus is beset by a storm and considers abandoning his ship. He resolves to remain on board only

ὄφρ' ἂν μὲν κεν δούρατ' ἐν ἀρμονίησιν ἀρήρη

so long as the planking will hold together with the joints ... .

Again, ἀρμονίησιν appears here as an instrumental dative and can only refer to the mechanical means by which the planks will hold themselves together. With this in mind (and considering

<sup>19</sup> CASSON, *supra* n. 1, pp. 338ff., esp. p. 340, n. 59.

<sup>20</sup> So CASSON, *supra* n. 1, p. 14, n. 15, “they caulk seams from the inside, using papyrus fibers.” CASSON's translation is surprising, since he elsewhere takes the word ἀρμονία to refer to mortise-and-tenon joints, not plank seams — *supra* n. 1, p. 46, n. 19; p. 218; p. 222. HALDANE and SHELMERDINE, *supra* n. 2, p. 539, also adopt “seams” without comment as a translation for ἀρμονία “They bind in the seams from within with papyrus.”

<sup>21</sup> It would seem permissible to understand Pollux, 1, 114 in either sense: τὰ δὲ πάθη οὕτως ἂν εἴποις ... διαλυθείσης τῆς νεώς, ἀνοιχθείσης, διαστάσης τῆς ἀρμονίας, τοῦ ἴστου ἀποκλασθέντος ... “But you could express the misfortunes (of a ship) in these ways: ... breaking up of the ship, opening up, coming apart of the joint, breaking away of the mast (etc.)”

<sup>22</sup> Cf. the scholion to Od. 5, 248: γόμεφοισιν δ' ἄρασσεν, ἀντὶ τοῦ κατεγόμεφωσεν. ἀρμονίησιν (sic, for ἀρμονίησιν) ἄρασσεν ἀντὶ τοῦ συνήρμοσε καὶ συνέκλεισε. “He hammered with pegs’, rather than ‘He pegged.’ ‘He hammered with joints’ rather than ‘he fit together’ and ‘he put together.’”

<sup>23</sup> *Supra* n. 1, pp. 217ff., esp. p. 218. This conclusion seems right to me, but it is only fair to point out one loose end. The word γόμεφος might be taken to mean “tenon,” rather than “peg,” a meaning it certainly has in Herodotus 2, 96. The minor scholion to Od. 5, 248 seems to raise this possibility: γόμεφοισιν] οἷς ἀρμόζεται τὰ ξύλα πρὸς ἄλληλα. ἢ πασσάλους, ἢ πλατέσιν ἐπιούρους, ἢ σφήναις: “γόμεφοισιν with which the planks are joined to each another. Either pegs, or tenons, or wedges.” However, as CASSON points out, the scholion attributed to Aristarchos seems to clinch the matter in observing that Odysseus' construction procedure was first to prepare the joints, then judge by eye whether they would fit to one another, then to physically put them together and finally peg them. Hammering was the final step in the process of attaching the planks to one another: διὰ γὰρ τοῦ ἄρασσε τὸ τέλος τῆς ἀρμογῆς παρέστηκε, “He expressed the completion of the joinery through ‘He hammered.’” Note that hull construction with pegged mortise-and-tenon joinery is in fact attested archaeologically in the Late Bronze Age: see G.F. BASS, “A Bronze Age Shipwreck at Ulu Burun (Kaş): 1984 Campaign,” *AJA* 90 (1986), p. 275.

Herodotus' frequent implicit or explicit emulation of Greek epic),<sup>24</sup> the pairing of the words ἐμπακτοῦν and ἀρμονία in Herodotus raises the suspicion that ἀρμονία refers specifically to the hull planks' mortise-and-tenon joints, and that ἐμπακτοῦν refers to a method for making this joinery fast.

In this connection, it is interesting to quote Eustathius *ad Od.* 5, 248 more fully:

ἀρμονίαι δέ, ἄδηλον οἶαι τῇ σχεδία πεποιήνται, εἰκὸς δὲ ἀπὸ φυτῶν τινων γενέσθαι, δι' ὧν ἦν ἀναπληροῦσθαι τὴν τῶν στυππειῶν χρῆσιν. ἐπεὶ καὶ τοιοῦτοις τὸ παλαιὸν αἱ νῆες ἡρμόττοντο. καθὰ δηλοῖ καὶ Ἡρόδοτος ἐν τῷ, πακτοῦσι τὰς ἀρμονίας, βύβλω. τουτέστι κατασφαλίζονται.

Now it is unclear what sort of joints were constructed for the vessel, but it seems reasonable that they were of plants of some sort, through which the requirement for hemp would have been satisfied, since ships were put together with such in antiquity. Herodotus would indicate this when he says “they fasten the joints with papyrus.” That is, they are made fast.

Eustathius was writing at a time when the use of pegged mortise-and-tenon joinery in Mediterranean hull construction had died out, and he seems to have misunderstood the details of the construction methods used by Odysseus. Nevertheless, he correctly understands ἀρμονία as a physical connection between hull planks in the *Odyssey*, and takes it for granted that Herodotus uses the word in the same sense. And, as HALDANE and SHELMERDINE point out,<sup>25</sup> he takes it equally for granted that (ἐμ)πακτοῦν refers to a method for joining hull planks together. In light of Pollux 1, 84, this is exactly what it should mean. Since Herodotus and P. Col. III, 43 make it clear that reeds (presumably in the form of ropes or webbing<sup>26</sup>) were required in order to (ἐμ)πακτοῦν the ἀρμονία of a Nile boat, an understanding of πακτοῦν in this context as “to lash together” and πάκτωσις as “hull lashing” seems all but inevitable. Thus, the contrast between classical Greek and Nilotic hull construction is complete:<sup>27</sup> while Odysseus hammered (ἄρασσεν) his vessel together with pegs (γόμοφουσιν) and mortise-and-tenon joints (ἀρμονίησιν), Nile River boatwrights fastened (ἐν ἐπάκτωσαν) the mortise-and-tenon joints (τὰς ἀρμονίας) of their boats with papyrus (τῇ βύβλω).

In consequence of this difference in construction methods, Egyptian ships differed fundamentally from Graeco-Roman ships in their maintenance needs and procedures. A lashed-together hull could easily be partially or completely disassembled when necessary,<sup>28</sup> for repair or even portage.<sup>29</sup> Unfortunately, the lashings might also gradually come undone by themselves. The 19th-Dynasty P. Anastasi IV, rt. 7/10 appears to refer to this problem when it describes a derelict hull with the stative form of the Egyptian verb *sfh*, literally “loose.”<sup>30</sup> This particular vessel had been out of the water and in a shipyard

<sup>24</sup> On which see, e.g., H. Erbse, *Studien zum Verständnis Herodots* (Berlin, New York, 1992), pp. 122ff.; D. Lateiner, *The Historical Method of Herodotus* (Toronto, Buffalo, London, 1989), p. 19.

<sup>25</sup> *Supra* n. 2, p. 537.

<sup>26</sup> See an expense item for a papyrus rope in the Ramesside ship's log P. Turin 2008 + 2016, vs. 1/13, in J. JANSSEN, *Two Ancient Egyptian Ship's Logs, Papyrus Leiden I 350 verso and Papyrus Turin 2008 + 2016 (Oudheidkundige Mededelingen uit het Rijksmuseum van Oudheden te Leiden, Supplement op XLII, 1961, Leiden)*; also JANSSEN, *Commodity Prices from the Ramessid Period* (Leiden, 1975), p. 111. For webbing, see HALDANE, *supra* n. 9, on the Lisht fragments.

<sup>27</sup> As desired by LLOYD, *supra* n. 1 (CQ), p. 47.

<sup>28</sup> Recall that the Cheops funerary ship was found completely disassembled in its burial pit next to the Great Pyramid; see LIPKE, *supra* n. 5, p. 1.

<sup>29</sup> The transport of pre-fabricated ships from the Nile Valley to the Red Sea is perhaps suggested in Wadi Hammamat graffito 114 (late 11th Dynasty) of *Hnw* (ls. 10-14) *ḫw h3b.[n wī nb c.w.]s. r sb.t Kbnj.wt r Pwn.t ... ḫc.n ph.n(= i) w3d-wr ḫc.n ḫr.n(=i) ḫc.w pn*. “[The Lord (life, prosperity,] health) dispatch[ed me] to transport Byblos-ships to Punt. ... I reached the sea. I built this fleet.” See in J. COUYAT and P. MONTET, *Les inscriptions hiéroglyphiques et hiératiques du Ouâdi Hammâmât (MIFAO 34, Cairo, 1912)*. At all events the material for these ships must have been transported overland to the Red Sea; hauling pre-fabricated components would have been the most efficient use of manpower. Similarly P. Harris I (Ramses III), 77/8ff.; see the comments of P. GRANDET in *Le Papyrus Harris I, Vol. 2 (Bib. d'Étude CIX, Cairo, 1994)*, pp. 256ff.

<sup>30</sup> ERMAN and GRAPOW *Wb.* IV, 116, 2ff. CAMINOS, *supra* n. 10, pp. 160-61, understood the word in an extended sense: “cast off, discarded, out of order.” However, given what is known about ancient Egyptian hull construction

for a number of years,<sup>31</sup> but at least one Ptolemaic text, P. Petrie III, 46 (1) appears to suggest that re-lashing might be necessary on a yearly basis — at least on older hulls. The text begins by stating that a πάκτωσις and other, lost, maintenance procedures had recently been performed on the boat in question at a cost of 80 drachmas,

ἐφ' ᾧ παρέξεται πλέουσας τὴν λιθηγὸν στεγνὴν μῆνας ἰβ<sup>32</sup>

with which he (scil., the captain of the vessel, who had evidently arranged for the repairs) would keep the stone-hauler sailing and water-proof for 12 months (ls. 3-5).

Now, however, the captain was claiming that, because the vessel had already gotten “older” (διὰ τὸ παλαιὸν ὅτερον<sup>32</sup> ἤδη εἶναι), the vessel needed another πάκτωσις. The writer of the letter authorized the recipient to pay the captain another 40 drachmas (this time specified to be copper drachmas) to have the procedure repeated, but only pending investigation by an unnamed διοικητής. If it should turn out that the expense was being fraudulently claimed,

πραχθήσεται τὰς μ (δραχμὰς) ἐκ τῶν διδομένων αὐτῷ ναύλων

He will have to pay the 40 drachmas out of his freight-fees (ls. 11-13).

Like the captain of the boat discussed in P. Petrie III, 46, Zenon's κυβερνήτης Pais seems to have had persistent problems with the freight boat under his command. In P. Mich. I, 60, l. 7, he requests permission to repair (ναυπηγήσαι) the vessel, and in PSI IV, 382, his request appears to have been approved. Whether this first round of repairs was actually carried out is not clear, but the situation seems to have worsened. Pais describes the situation in these terms (ls. 1-15):

Pais to Zenon, greetings. You know that I arranged with you to repair (ἐπισκευᾶν) the prow of the boat. But now it has come to the point of taking the whole thing apart (διαλύσαι) and reconstructing (ἐπισκευάζειν) it. And we have been looking for wood everywhere. With difficulty we have found an acacia, for which Demetrios the sitologos paid 50 drachmas as down-payment. Would you please write to him to hand (it) over to us, for it is worth 80 drachmas. Otherwise, write to Hermolaos about the acacia in Kerke in 10 days, to arrange cutting for us. ...

In this text, Pais uses the words ἐπισκευᾶν and ἐπισκευάζειν, “to repair,” but in P. Cairo Zenon III, 59483, Pais writes (ls. 1-6):

To Zenon, greetings (from) Pais. If it seems right to you, arrange to pay whatever would seem right to you for the πάκτωσις of the boat, for we are about to head downstream ...

It is of course not absolutely certain that these three letters<sup>33</sup> were written in the order presented here,<sup>34</sup> although the progression of events seems a logical one. But it does seem a fair inference that

techniques, there is every reason to take the verb literally. The usage would then parallel Iliad 2, 135, describing the state of the Achaian ships after 10 years of being beached at Troy: καὶ δὴ δοῦρα σέσηπε νεῶν καὶ σπάρτα λέλονται, “And the planks of the ships were rotten and the cords loosened.” As CASSON has pointed out, *supra* n. 1, n. 27 on p. 10, this appears to refer to the Greek belief that ships in the Heroic age were lashed together, rather than built with pegged mortise-and-tenon joints, and could be an authentic reminiscence of archaic Aegean ship construction techniques.

Also in P. Anastasi IV rt. 7/11-8/1, the vessel has a component called a *q3s*, whose function is to help the ship's bulwarks “grip” the hull. This word may refer to ligatures binding the bulwarks to the deck beams or hull; see VINSON, forthcoming, for details.

<sup>31</sup> rt. 7/10.

<sup>32</sup> For the reading, see BL I, 382.

<sup>33</sup> It seems possible that P. London VII, 2063 also belongs to this body of correspondence. Unfortunately, the text is too fragmentary to shed additional light on the situation.

<sup>34</sup> P. Cairo Zenon III, 59483 is undated. P. Mich. I, 60 is dated to Phamenoth 20, regnal year 38; PSI IV, 382 is dated to the month of Epeiph, regnal year 38. Which of the latter two letters was written first depends on which calendar is being used. Under the Macedonian calendar, PSI IV, 382 would be the earlier; under the Egyptian or financial calendars, P. Mich. I, 60 would be the earlier. The editor of P. Mich. I, 60 assumed this text was written first, primarily because it seems logically to come before PSI IV, 382; CASSON accepts this, *supra* n. 4, p. 8. PESTMAN cautions that there is no proof one way or the other; see his comments in *A Guide to the Zenon Archive (P.L. Bat. 21) A, Lists and Surveys (Chapters I - X)*

Pais uses the infinitives ναυπηγήσαι, ἐπισκευᾶν, ἐπισκευάζειν and the noun πάκτωσις in more or less same sense — that is, referring to the repair of his vessel. πάκτωσις seems certain to refer to an expensive,<sup>35</sup> thorough renovation in P. Petrie III, 46. As Pais makes clear in PSI IV, 382, the renovation of his boat was to be no mere caulking. Rather, a major undertaking was contemplated, including disassembly and reconstruction, with wholesale replacement of rotten or otherwise damaged wood.<sup>36</sup> Major hull overhauls, including the replacement of planking, were of course possible on ships constructed along Graeco-Roman lines.<sup>37</sup> But should not escape notice that to disassemble (διαλύσαι) the hull would have been considerably simpler on a lashed-together ship, whose hull could be taken apart with relative ease, than it would have been on a Graeco-Roman-style vessel with its permanent hull joinery.

In conclusion, the following points seem clear: (1) comparison of Herodotus, P. Columbia III, 43 and Eustathius *ad Od.* 5, 248 strongly suggests that there is no difference in meaning between Herodotus' ἐμπακτοῦν and the simple form πακτοῦν; (2) a straightforward reading of Pollux suggests that the verb πακτοῦν and its synonym πάκτωσις refer to the joining of hull planks in ship construction; (3) Herodotus' description of Nilotic boat construction is entirely comprehensible in this light, especially in view of the most probable meaning of ἀρμονία; and (4) documentary texts related to ship repair show that the words πακτοῦν and πάκτωσις could be applied to vessel renovation, as well.

One can only speculate as to why Herodotus chose to coin the compound ἐμπακτοῦν, and why he wished to further emphasize the fact of internal lashing with the adverb ἔσωθεν. By itself, the fact that the joinery was completed from the inside did not offer a contrast with Greek hull construction practices: the pegs used by classical Greek shipwrights to lock their hulls' mortise-and-tenon joints might likewise be installed from within the hull.<sup>38</sup> On the other hand, the lashing itself was certainly a typically Egyptian feature, and the fact that it was accomplished entirely from the inside must have been striking. Perhaps it was simply Herodotus' intention to stress something that struck him as characteristically Egyptian.

Be that as it may, the material examined here suggests that hull lashing as a Nilotic hull joinery technique lasted through the entire pharaonic period and was evidently still known — by name at least — to Pollux in the second century CE.<sup>39</sup> ἔσωθεν δὲ τὰς ἀρμονίας ἐν ᾧ ἐπάκτωσαν τῇ βύβλω should accordingly be translated: “They lash the joinery together from the inside, using papyrus.”

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(Leiden, 1981), p. 136. In either case, P. Cairo Zenon III, 59483 cannot be certainly placed. If we are to conclude that the repairs to the prow of PSI IV, 382 were actually carried out, and that the complete renovation later found necessary was a separate round of repairs, then P. Cairo Zenon III, 59483 could conceivably refer to a payment for either operation, or perhaps less likely, even a third.

<sup>35</sup> The 120 (of which at least 40 copper) total drachmas paid for the two operations described in this document could equal approximately one year's wage for a boat captain in the early third century BCE; cf. P. Cairo Zenon IV, 59649.

<sup>36</sup> Exactly the procedure contemplated in P. Anastasi IV, rt. 8/6-7.

<sup>37</sup> See STEFFY, *supra* n. 17, pp. 95ff.

<sup>38</sup> STEFFY, *supra* n. 17, p. 81.

<sup>39</sup> Interesting in this connection is the not-infrequent mention of πάκτων-boats in Roman-era papyri. *Pace* HALDANE and SHELMERDINE, *supra* n. 2, p. 537, this word nearly always refers to wooden freight vessels, not rafts. The only authority for this dictionary definition seems to be Strabo, 17, 1, 50 — see CASSON, *supra* n. 1, p. 342. In documentary texts, vessels described as πάκτων-boats are seen in general freight service, with, e.g., three mentioned as having a capacity of 200 artabas (or about six metric tons) in P. Köln V, 229 (second century CE); one with a 550-artaba capacity in P. Oxy. XIV, 1650; and one used to haul sand for a construction project in VBP IV, 79 (also second century CE). A σκαφοπάκτων with a capacity of at least 800 wine jars (κεράμια) appears in P. Oxy. XLIII, 3111 (third century CE). In P. Merton I, 19, l. 5, a πάκτων is specifically described as having been built out of willow planks (ἀπὸ ἰτείνων ξύλων). Does πάκτων in this connection refer to vessels built with the traditional Egyptian technique of hull lashing? If so, it might stand in semantic contrast to Ἑλληνικόν-vessels, an appellation which, as CASSON has speculated, *supra* n. 1, p. 340, could refer to Nile vessels built with the Graeco-Roman technique of pegged mortise-and-tenon joints.