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NEW LIGHT ON THE CONSTRUCTION OF THE EGYPTIAN *BARIS* AS PER HERODOTUS' NARRATIVE (2.96)

The description of the Nilotic freighter *baris* by Herodotus has long been recognized as being very important for the study of Egyptian shipbuilding in general and for that of the Late Period in particular. New archaeological finds from Thonis-Heracleion help better understanding this rare document. The text of Herodotus turns out to be very precise in spite of the originality of the described boatbuilding technique. The new archaeological material discussed in the article confirms that the description of Herodotus was made by an eye-witness.

Keywords: Herodotus, Late Period in Egypt, Ancient Shipbuilding, Underwater Archaeology.

Herodotus and the Egyptian shipbuilding of the Late Period

The beautifully illustrated treatise on Ancient Egyptian shipbuilding by B. Landström (1970)[1] contains 159 pages and 418 figures. The description of shipbuilding in the Late Period (664–332 BC) takes up only two pages of this volume and is illustrated by four figures. It seems that this ratio perfectly reflects the state of knowledge in this field. Iconographic evidence, rather rich for the other periods of Egyptian history, offers very little material for reflection as far as the Late Period is concerned. With the exception of a fleet of Nilotic ships represented on the so-called "blocks of Piankhy" dated to the rule of Psamtik I (26th Dynasty, 664–610 BC)[2], other documents are "*few, coarsely executed, and — in comparison with what have gone before — fairly uninteresting*"[3]. Until recently, only one actual Egyptian ship was dated to the Late Period, namely the boat of Mataria (*c.* 2450 ±50 B. P.), discovered in 1987 during construction works near Heliopolis[4]. This boat brought a lot of new data on naval architecture of the period; however, its hull was already damaged when the archaeologists first arrived on the site and it was only possible to record fragmentary information. If one looks for ancient texts on the subject, the situation is no better. The customs register of the papyrus palimpsest of Elephantine (*TAD* C 3.7) dated to *c.* 473–402 BC contains information on tonnage and cargo of foreign trade ships coming to Egypt but it is not helpful as far as naval architecture is concerned.

[1] Landström 1970.

[2] Perdu 2011.

[3] Landström 1970: 140.

[4] Haldane 1996a: 241–242; 1996b; Ward 2000: 129–135.

Thus the 23 lines of Herodotus' description of the Egyptian Nilotic freighter *baris* (Herodotus *Histories* 2.96; *c.* 450 BC) contain the most precious information on the question considered here. It is not surprising that this document has been thoroughly analyzed by all researchers touching upon the theme of Ancient Egyptian boatbuilding and that some sentences were interpreted in a different way causing controversy.

Why suggesting a new translation?

In 1998 S. Vinson [5] justified his new translation of the above-mentioned fragment by the considerable amount of work that had been done on the subject since the appearance of the translation and commentaries of A. B. Lloyd [6]. It is exactly on the same grounds that I would like to suggest mine.

More than 18 vessels discovered recently during a survey carried out by the Institut Européen d'Archéologie Sous-Marine (IEASM) in the port regions of the submerged city of Thonis-Heracleion [7] are dated to the Late Period [8]. The construction of one of the vessels, Ship 17, dated to the beginning of the 5th — middle of the 4th century BC, was analyzed in detail [9]. A number of original features shared by many ships of Thonis-Heracleion [10] seem to bear witness to an archaeologically unattested constructional type [11]. At the same time the construction of these ships brings more light on some aspects of the Herodotus' description as Ship 17 of Thonis-Heracleion has been actually identified as belonging to the *baris* type [12].

The origins of the term *baris* and the text-based evidence

The Greek term *baris* (βᾶρις) probably originates in the Ancient Egyptian boat type called *br* (*byr*, *byry*) [13] . At the same time it has been suggested that the Egyptian word *br* may have had a foreign origin [14]. The term *br* first appears in the 18th Dynasty and refers to a sea-going craft [15]. Egyptian sources mention this boat quite often [16] and it seems to be a rather common word for a transport ship at this time [17]. Demotic documents mentioning *br* are not numerous and contrary to hieroglyphic texts most of them probably refer to Nilotic cargo boats [18]. However, S. Vinson cites two documents that can indicate a military use of *br* ships [19]. J. C. Darnell suggests a parallel between the *br* ships of the defensive fleet of Ptolemy V that are mentioned on the Rosetta Stone (196 BC) and those employed by Ramses III (1187–1157 BC) to defend the Delta against the "Sea Peoples" [20]. Another interesting document is the Persian *P. Cowley* 26 (412 BC) that contains an inventory for a *br* boat built of cedar [21].

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[5] Vinson 1998.

[6] Lloyd 1976.

[7] Goddio 2007: 102–114.

[8] Fabre, Belov 2012.

[9] Author prepares a monograph based on his PhD dissertation devoted to construction of the Late Period Egyptian freighter from Thonis-Heracleion. Belov in print.

[10] Robinson 2015.

[11] Belov 2014b.

[12] Belov 2015a.

[13] Casson 1971: 341 note 64; Vinson 1998.

[14] Vinson 1993: 147 notes 69, 70; 1994: 44–45.

[15] Casson 1971: 341 note 64; Vinson 1994: 44–45; 1998: 252.

[16] Jones 1988: 136 no. 30.

[17] Vinson 1994: 45.

[18] Vinson 1998: 252–253. The author cites the following ostraca: O. Zürich 1867 (Roman); O. Leiden 136, 2; O. Uppsala 1185, 2; O. Leiden 340, 3.

[19] Vinson 1998: 253. Line 12 of the Rosetta Stone contains νῆες (ships) in the Greek text that correspond to the hieroglyphic *Kbn.wt* and to the demotic *byry*. Another example cited is the Roman *P. Krall* 14/8 mentioning *br* ships as part of a naval fleet.

[20] Darnell 1992: 72–73 notes 21, 54.

[21] Ray 1988: 268; Vinson 1988: 253. It is not only the imported wood of cedar used in the construction of this boat that attracts one's attention, but also the great quantity of nails. Bronze nails were widely employed in the construction of some of the ships of Heracleion-Thonis for attaching the frames to the planking. This is the case of Ship 61 (234–40 BC) and of Ship 11 (165 ±50 BC). These boats demonstrate a well-developed internal structure and seem to belong to a Greco-Roman type of construction.

In Greek literature, the *baris*[22] is connected with Egypt since the time of Aeschylus (525–456 BC)[23]. Textual evidence from Greek papyri suggests that the *baris* was primarily a freighter and transport vessel (Table 1)[24].

Papyrus	Title	Provenance	Date	Mention of baris	Comments
P. Hib. 1 100 V	Account. Receipt for Rent	Herakleopolites	267 BC	ὁ vac.? σιτομέτρης Ξάνθου παρ᾽ εὐφρά[ν]ορος δι᾽ Ἀντιπάτρου εἰς τὰ ἐκφόρια τοῦ Ἀλεξάνδρου κλήρου εἰς τὸ ιθ (ἔτος) ἐξ Ἀνατιεὺ κριθῶ(ν(?)) (ἀρτάβας) λ πρ( ) εἰς **βᾶριν** ἐφ᾽ ἧς κυβερνήτης vac.? ναύκληρος vac.?	Lines 10–15: *baris* loaded with barley
P. Cair. Zen. 4 59745	Account of payments to workmen	Philadelphia? (Arsinoites)	255–254 BC	δι᾽ ἐγγύου Πάσιτος κυ(βερνήτου) τῆς λιθηγοῦ **βάρεως**	Line 66: a stone-hauling *baris*
P. Coll. Youtie 1 7	Lettre d'Amadokos à Kléon	Magdola oder Ghoran (Arsinoites)	224 BC	κυβερνήτης Ἐροβάστις, ἀναπλέον κατὰ Τμοιενέτιν περικόψαι **βᾶριν** ἐν ᾗι ἐπέπλεον γυναῖκες	Lines 4–6: a *baris* transporting women involved in a collision
W. Chr. 11 A	Krieg zwischen Hermonthis und Krokodilopolis	Krokodilopolis (Pathyrites)	123 BC	σὺν [ὅπλοις κ]αὶ ἐπαγαγόν[τες κατ᾽ αὐ-] τὴν τὴν πόλι[ν . . . . ἐν] **βάρει**	Lines 21–22: *baris* transporting soldiers
P. Tebt. 3.1 701	Register of Official Business	Tebtynis (Arsinoites)	235 BC	\[Ἀρχι]τίμωι./ [σύντα] ξον ἐμβαλέσθαι εἰς τὸν Ἀθῦ[ρ ἐ]ν τῇ **βάρι**	Line 26: cargo loaded in a *baris*

Table 1. Greek papyri containing information on the *baris*

Text, translation and commentary

Herodotus *Histories* 2.96

	line
Τὰ δὲ δὴ πλοῖά σφι, τοῖσι φορτηγέουσι, ἐστὶ ἐκ τῆς	1
ἀκάνθης ποιεύμενα, τῆς ἡ μορφὴ μὲν ἐστὶ ὁμοιοτάτη τῷ	2
Κυρηναίῳ λωτῷ, τὸ δὲ δάκρυον κόμμι ἐστί. Ἐκ ταύτης	3
ὧν τῆς ἀκάνθης κοψάμενοι ξύλα ὅσον τε διπήχεα πλινθηδὸν	4
συντιθεῖσι ναυπηγεόμενοι τρόπον τοιόνδε· περὶ γόμφους	5
πυκνοὺς καὶ μακροὺς περιείρουσι τὰ διπήχεα ξύλα· ἐπεὰν	6
δὲ τῷ τρόπῳ τούτῳ ναυπηγήσωνται, ζυγὰ ἐπιπολῆς τείνουσι	7
αὐτῶν· νομεῦσι δὲ οὐδὲν χρέωνται· ἔσωθεν δὲ τὰς ἁρμονίας	8
ἐν ὧν ἐπάκτωσαν τῇ βύβλῳ. Πηδάλιον δὲ ἓν ποιεῦνται,	9
καὶ τοῦτο διὰ τῆς τρόπιος διαβυνέται· ἱστῷ δὲ ἀκανθίνῳ	10
χρέωνται, ἱστίοισι δὲ βυβλίνοισι. Ταῦτα τὰ πλοῖα ἀνὰ	11
μὲν τὸν ποταμὸν οὐ δύναται πλέειν, ἢν μὴ λαμπρὸς ἄνεμος	12
ἐπέχῃ, ἐκ γῆς δὲ παρέλκεται, κατὰ ῥόον δὲ κομίζεται ὧδε·	13
ἔστι ἐκ μυρίκης πεποιημένη θύρη, κατερραμμένη ῥιπὶ	14
καλάμων, καὶ λίθος τετρημένος διτάλαντος μάλιστά κῃ	15
σταθμόν· τούτων τὴν μὲν θύρην δεδεμένην κάλῳ ἔμπροσθε	16
τοῦ πλοίου ἀπιεῖ ἐπιφέρεσθαι, τὸν δὲ λίθον ἄλλῳ κάλῳ	17

[22] βᾶρις, ιδος (also -εως), Ion. ιος, ἡ — flat-bottomed boat, used in Egypt. See LSJ 1940. According to the Greek-Russian Lexicon edited by A. D. Veisman (Вейсман 1899: 243) βᾶρις is a term that specifically refers to an Egyptian boat or ship or, in a more general sense, to a ship of a non-Greek tradition. Cf. late βάρβαροι βάριδες (Procopius of Caesarea *De Aedificiis* 1.6).

[23] Aeschylus *Suppliant Maidens* 874. Arnaud 2015.

[24] Casson 1971: 340 note 60, 341 note 64; Vinson 1998: 254.

ὄπισθε᾽ ἡ μὲν δὴ θύρη τοῦ ῥόου ἐμπίπτοντος χωρέει	18
ταχέως καὶ ἕλκει τὴν βᾶριν (τοῦτο γὰρ δὴ οὔνομά ἐστι	19
τοῖσι πλοίοισι τούτοισι), ὁ δὲ λίθος ὄπισθε ἐπελκόμενος	20
καὶ ἐὼν ἐν βυσσῷ κατιθύνει τὸν πλόον. Ἔστι δέ σφι τὰ	21
πλοῖα ταῦτα πλήθεϊ πολλὰ, καὶ ἄγει ἕνια πολλὰς χιλιάδας	22
ταλάντων.	23

Translation[25]	**line**
Their boats with which they carry cargoes [1]	1
are made of the acacia [2]*, of which the form is very like that of*	2
the Kyrenian lotus, and its sap is gum. From this	3
acacia, then, they cut planks two cubits long [3] *and arrange them like bricks* [4]*,*	4
building their ships in the following way: on the strong and long tenons [5]	5
they insert [6] *two-cubit planks. When*	6
they have built their ship in this way, they stretch beams over them [7].	7
They use no ribs [8]*. They obturate the seams from within* [9]	8
with papyrus. There is one rudder,	9
passing through a hole in the boat's keel [10]*. The mast is of acacia-wood*	10
and the sails of papyrus [11]*. These boats*	11
cannot sail upstream unless a fresh breeze	12
continues; so they are hauled from the bank; but downstream they are thus managed [12]*:*	13
they have a raft made of tamarisk wood, fastened together with matting of reeds,	14
and a pierced stone of about two talents'	15
weight; the raft, made fast by a rope,	16
floats ahead of the boat, and the stone is made fast by another rope	17
behind. So, driven by the current, the raft floats	18
swiftly and tows the "baris" (which is the name	19
of these boats), and the stone dragging behind	20
on the bottom keeps the boat's course straight. They have	21
many of these boats; some transport many thousands of	22
talents [13].	23

Commentary

[1] πλοῖά σφι, τοῖσι φορτηγέουσι

Many constructional features of Ship 17 of Thonis-Heracleion allow classifying it as a cargo boat. The strong planking of the ship was composed by short and thick planks (average thickness of 14.7 cm) that witness a frugal use of boatbuilding material[26]. The elements of the internal structure of the ship (supports, bracing timbers, through-beams) demonstrate a strong asymmetry and a roughness of execution. The axial rudder employed in the construction of Ship 17 also seems more characteristic of the Egyptian Nilotic freighters.

[2] ἐκ τῆς ἀκάνθης ποιεύμενα

The wood of acacia, and especially that of *Acacia nilotica* (*snḏt*), was widely used in Ancient Egyptian boatbuilding among other local species[27]. Already in the Old Kingdom (*c.* 2543–2120 BC), Egyptians built Nilotic freighters of acacia that were about 32 m long[28]. Acacia wood was identified as construction material of the freighter boats from Lisht (Middle Kingdom, *c.* 1950 BC)[29]. Traditional boats of the Upper Nile are still built of *Acacia nilotica* (*sunt*)[30]. Acacia also dominates as con-

[25] The following English translations of Herodotus have been used for those parts of the text that did not require any amendments in the light of the new archaeological data: Macaulay 1890; Godley 1921; Lloyd 1979: 48.

[26] Cf. Ward 2004: 14.

[27] Ward 2000: 15–16.

[28] Boats *sekhet* and *satch* built by general Weni (*Wnj*) during the rule of Pepi I (6th Dynasty, 2232–2283 BC).

[29] Together with tamarix, see: Ward 2004: 15.

[30] Clarke 1920. Hornell 1943: 28: "*Timber — invariably local acacias, usually sunt (Acacia nilotica), an extremely hard wood but brittle and troublesome to work. It is difficult to obtain in long running lengths, so, apart from the keel plank, the hull is built up of comparatively short lengths of thick planking halved together in the strakes*".

structional material for the ships of Thonis-Heracleion. Preliminary xylological analysis showed that among 63 shipwrecks about 80% have planking made of acacia [31]. Ship 17 of Thonis-Heracleion was entirely built of acacia (*Acacia sp.*, *A. nilotica*, *A. raddiana* — 17, 6 and 2 samples out of 25 samples respectively).

[3] ὅσον τε διπήχεα

The length of these planks would correspond to about 105 cm (taking a Royal Egyptian cubit of 52.5 cm) and they were very short indeed. In normal shipbuilding practice, the longer the planks are, the better. However, acacia wood is not a good shipbuilding material and the Egyptians used it out of necessity. The wood is strong, tough and heavy [32]. In addition it is brittle while its high silica content rapidly blunts cutting tools. One great advantage for shipbuilding is that this wood is very durable if seasoned well and does not rot in the water. According to Theophrastus, Egyptians were able to cut 12-cubit planks of acacia (about 630 cm) [33]. Returning to the text of Herodotus, it is difficult to imagine a hull composed entirely of planks of exactly the same size [34]. However, the two-cubit planks could easily make up the greatest part of the planking. Taking into consideration the above-mentioned information of Theophrastus (repeated by Pliny the Elder) [35], Ch. Boreux suggested that Herodotus describes a *baris* of a modest size [36]. Indeed, lines 22–23 suggest the existence of *baris* ships of quite variable tonnage. An ethnographic parallel can be cited. The planks of the boats of the Upper Nile built of *Acacia nilotica* and called *nuggar* (*naggr*) are usually 4–6 feet (1.2–1.8 m) long and never exceed 8 feet (2.4 m) in length [37]. Ship 17 of Thonis-Heracleion provides statistical information on the planking. The length of the planks of its starboard varies from 0.49 to 3.77 m. Out of a total number of 102 planks measured on starboard, the majority (75.5 %) measures between 1.70 and 2.20 m in length. The mean average length of the planks of the starboard is 1.92 m. Thus, the majority of the planks of Ship 17 are almost twice as long as those of the *baris* described by Herodotus. At the same time, Ship 17 belongs to a larger class of Nilotic freighters with a reconstructed length of about 28 m and a displacement of 150 t. It seems logical to suppose that longer planks of acacia were necessary to build a larger hull. At the same time, it must be remembered that in any case the planks of Ship 17 remain very short if one compares them to the standards of Greco-Roman shipbuilding. These planks bear witness to a local, purely Egyptian tradition of assembling the hulls with short timbers [38].

[4] πλινθηδὸν συντιθεῖσι

The adverb πλινθηδὸν used by Herodotus, "in a brickwork fashion", is very expressive. Iconographic evidence for the Egyptian hulls that were built of short planks forming a kind of brickwork is known since the Old Kingdom and is quite exhaustive [39]. This specific technique has been identified in the construction of the Khufu-I ship [40]. To a certain extent it is also characteristic of the construction of the Middle Kingdom Dashur boats (*c.* 1878–1841 BC) and, finally, it is very pronounced in the planking plan of the Late Period Mataria ship (*c.* 450 BC) [41]. The planking of Ship 17

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[31] Fabre, Belov 2012: 109–110.

[32] *Acacia nilotica* has a density of 650–830 kg/m^3 at 15 % moisture content, reaching sometimes 1170 kg/m^3 (cf. Holm oak (*Quercus ilex*) has a density of 1100 kg/m^3 under the same conditions). See Fagg, Mugedo 2005.

[33] Theophrastus *Historia Plantarum* 4.2.8.

[34] Rougé 1975: 41.

[35] Pliny the Elder *Naturalis Historia* 13.63.19.

[36] Boreux 1925: 237.

[37] Hornell 1943. The author adds that "*the rougher and cheaper the boat, the shorter are these planks*" (p. 28).

[38] It seems that in some cases Egyptians continued to use short planks even when the wood type allowed for obtaining longer timbers. See Vinson 1998: 255. It must be noted, however, that the Egyptians were able to built ships with very long planks of imported cedar as evidenced by the two royal ships of Khufu (IVth Dynasty, *c.* 2566 BC).

[39] See, for example, the representation dating to the Old Kingdom (although rare at this time) in Basch 1996; Davies 1926: pl. 31; Middle Kingdom: Newberry 1893: pl. 29; New Kingdom: Davies 1927: pl. 30; 1933: pl. 42, 43.

[40] Ward 2000: 47–56.

[41] Ward 2000: 130 fig. 72.

of Thonis-Heracleion serves as another excellent example of this "brickwork" technique[42]. Moreover the system of the planking assemblage of this ship (see commentaries 5–6) gives even more weight to the term used by Herodotus. Not only this planking looked like a brick wall once assembled, but, more importantly, the whole assembling procedure implied adding the planks one by one, exactly like it is done when building a brick wall.

[5] γόμφους πυκνοὺς καὶ μακροὺς

The general meaning for the word γόμφος would be any bond or fastening and different translators interpreted it as "bolt", "stake", "pole", "treenail", "dowel" or "tenon" (Table 2)[43].

The planking of Ship 17 of Thonis-Heracleion was assembled transversally with very long pieces of wood reaching up to 199 cm in length. These tenons passed through rectangular channels cut in the middle of the plank's edges. It was established that a single tenon could assemble up to 11 strakes of the planking. There can be no doubt that two-meter tenons are long enough (μακροὺς) but what about the other adjective used by Herodotus — πυκνός? In a majority of publications, it is translated as "set close together"[44] but now it is possible to contest this reading. A.B. Lloyd and S. Vinson rightly observe that the large size of the fastenings is among the construction features that most astonish Herodotus as contrasting with the custom of the Greeks[45]. However, the mortise and tenon joinery of the Greek boatbuilding tradition was spaced very closely[46] and it is difficult to imagine that the joints of the Egyptian ships could have been placed more frequently. Moreover, available archaeological evidence confirms that they were not so[47]. The tenons of Ship 17 were spaced irregularly and wide apart from one another. Center-to-center distance between the channels varied from 27.5 to 69.8 cm with a mean average of 46.6 cm[48], so in no case could they be called "set close together". Now it is time to remember that the adjective πυκνός has another meaning — "solid, strong". The tenons of Ship 17 are strong indeed: their width varies from 7.5 to 20 cm and their thickness from 1.2 to 5.2 cm (12.8×4.1 cm on mean average). The extremities of the tenons were pegged to the planking and this is the second evidence of this technique from Egypt after the boat of Mataria (*c.* 450 BC)[49]. Pegged tenons are not characteristic of Ancient Egyptian boatbuilding as Egyptian ships, especially seagoing ones, were often dismantled for transportation or storage, something that pegged tenons would not allow doing easily[50]. Herodotus does not mention whether the tenons were pegged or not, either because he preferred not to go into too much details, or because pegging the tenons was a typical trait of Greek shipbuilding while he tried to emphasize more unusual aspects of the Egyptian technique[51].

[6] περὶ γόμφους [ἱ] περιείρουσι

The verb περιείρω[52] (reinforced by the preposition περὶ — "around") used by Herodotus describes well the technique of construction of Ship 17 of Thonis-Heracleion, where short and thick

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[42] Belov 2015a: fig. 1, 2.

[43] Barguet et al. 1964; Boreux 1925; Casson 1971; Godley 1921; Larcher, Pessonneaux 1889; Lloyd 1976; Macaulay 1890; Rawlinson 1880; Vinson 1998.

[44] Among the translations cited it is the one by P.-H. Larcher, revised and corrected by E. Pessonneaux (1889), that offers an alternative reading (see Table 2).

[45] Lloyd 1976: 385–386; Vinson 1998: 256.

[46] The joints of the Kyrenia ship (4th century BC) were spaced at 11.5–12 cm. See Steffy 1995: 75–101.

[47] The tenons of the Khufu-I ship (keeping in mind that they were only auxiliary fastenings after the lashings) were placed at about 1.0–1.2 m intervals (Ward 2000: 50). The space between the mortise-and-tenon joints of the Dashur boats exceeded 30 cm (Haldane 1984: 24 fig. 9). The planking of the seagoing ships from Mersa (Wadi) Gawasis had two lines of mortise-and-tenon joinery spaced at 40–60 cm (Ward, Zazzaro 2010).

[48] Belov 2014b: 322.

[49] Ward 2000: 133.

[50] See Pomey 2012; Ward 2009; Ward, Zazzaro 2007.

[51] The question on the possible origin of this technique is somewhat out of topic here but it is interesting to note that some shipbuilding scenes dating to the Old Kingdom show pieces of wood that much resemble in their proportions the tenons in question (Belov in print). On the other hand, the closest parallel for the pegged tenons is found on the Syrian ship of Uluburun (c. 1400 BC) (see Pulak 1987 and subsequent publications of G. Bass and C. Pulak). Thus there exists a possibility that this feature was adopted in Egypt through technological exchange with the Levant.

[52] Derived from εἴρω — "fasten together in rows, string, insert" (lat. "sero").

Translator	Year	Translation of γομφοσ
G. Rawlinson	1880	"A number of long stakes or poles"
P.-H. Larcher / E. Pessonneaux	1889	"Des chevilles fortes et longues" (strong and long treenails)
G. C. Macaulay	1890	"A great number of long bolts"
A. D. Godley	1921	"Long and close-set stakes"
Ch. Boreux	1925	"Chevilles assez rapprochées les unes des autres, et assez longues" (treenails set rather close to each other and rather long)
A. Barguet	1964	"De longues chevilles très rapprochées" (long treenails set rather close together)
L. Casson	1971	"Long, close-set dowels"
A. B. Lloyd	1976	"Long tenons set close together"
S. Vinson	1998	"Close-set, large tenons"

Table 2. Interpretation of the word γόμφος found in some of the English and French translations

planks were inserted one by one onto ("around") tenons already installed in the channels of the ship's proto-keel [53].

[7] ζυγὰ ἐπιπολῆς τείνουσι αὐτῶν

A. B. Lloyd puts forward very strong arguments in favour of his translation of the term ζυγὰ as "beams" [54]. Iconographic evidence and archaeological material (the Dashur boats) testify that Egyptian shipbuilders used through-beams that went through the planking to increase the solidity of the hull [55]. Larger ships could incorporate two (the "Great Ship of Sais" of the Piankhy blocks, 26th Dynasty, rule of Psamtik I, 664–610 BC) [56] or even three levels of through-beams (the obelisk barges of Queen Hatshepsut, 18th Dynasty, 1479–1458 BC) [57]. Remains of three through-beams forming a single level were preserved in the construction of Ship 17 of Thonis-Heracleion. It can be suggested on the grounds of their distribution pattern and the necessity to support a centrally-positioned mast that there were at least seven of them initially. Their form is characterized by the natural curvature of the large branches and trunks of acacia that served for their fabrication. It is interesting that the beams of Ship 17, protruding several centimeters outboard, were fastened to the planking by tenons. The through-beams were an important means for transversal tightening of the hull (τείνω — "to stretch, to tighten") and for supporting the weight of the deck-planking [58].

[8] νομεῦσι δὲὸὐδὲν χρέωνται

The Dashur boats bear witness that frameless vessels did exist on the Nile. There are very few supplementary frames in the construction of the Abydos boats and in that of the Khufu-I ship [59]. At the same time the frames from Lisht are massive and it seems that they formed a real "bulkhead" supporting the deck [60]. It is possible that the construction of the Mataria boat included frames as well. Thus, it appears that the hulls of larger ships and especially those of freighters probably required additional reinforcement [62]. As stated above (see comment 3), Ship 17 of Thonis-Heracleion is a freighter

[53] The details of this construction sequence are proposed in Belov 2014b.

[54] Lloyd 1979.

[55] Boreux 1925: 306; Landström 1970: 147.

[56] Perdu 2011: 229 fig. 3.

[57] Landström 1970: 128–133.

[58] Jones 1995: 76.

[59] The Khufu vessel has 16 frames in its construction inserted in the hull with a spacing of 2–3 m between them; however, their function was not to support the hull but to distribute the weight of the deck and of the upper structures on the planking through stanchions that support the carling (Ward 2004: 20).

[60] Haldane 1996.

[61] Haldane 1993: 246.

[62] See Boreux 1925: 286–293; Junker 1940: 74; Landström 1970: 20–21, 26, 28, 72; Vinson 1994: 25.

of considerable size. Ten bracing timbers, acting as half-frames, of rather irregular shape have been preserved in its construction. It seems that the bracing timbers were installed in the specific areas, which required reinforcement in shipbuilder's opinion [63]. The possibility of the bracing timbers being added progressively after the ship was brought into service cannot be excluded [64].

[9] ἔσωθεν δὲ τὰς ἁρμονίας ἐν ὧν ἐπάκτωσαν τῇ βύβλῳ

Much controversy has been caused by two different translations of the verb (ἐμ)πακτόω that completely change the meaning of the sentence. According to the first translation, it means "obturate, plug" and the complete phrase would be "*they caulk the seams from within with papyrus*" [65]. The alternative translation is based on the meaning of the verb πακτόω — "to fasten, close, make fast" [66]. Interpreted in this way, the text of Herodotus provides evidence for internal lashings of the *baris'* hull. The evidence of Ship 17 of Thonis-Heracleion helps in resolving this controversy. The traces of vegetal material [67] in the form of strands driven between the seams of the planks can be distinctly seen in both longitudinal and transversal joints *inside* the planking of the ship. The choice of the term "caulking" would not be correct as it suggests that the material was driven by force from the outer side of the hull [68]. This is not the case of Ship 17 where the gaps between the seams were filled from the inside; thus a term of "luting" is preferred in this case [69]. The width of the protective layer reaches 6 cm. It seems that only selected joints were luted. First of all, luting was applied in the joints between planks with complicated shapes, or of those with defects that might cause a leak [70]. The same technique of luting is applied for the planking of the *nuggar* with the only difference that old rags are used instead of vegetal material [71].

[10] Πηδάλιον δὲἓν ποιεῦνται, διὰ τῆς τρόπιος διαβυνέται

The verb διαβύνομαι is mono-semantic and means "to go through" while πηδάλιον and τρόπις are standard Greek terms for "rudder" and "keel". This phrase of Herodotus has never been illustrated by archaeological material so far; however, most researchers have accepted it *ad verbum* [72]. The construction of Ship 17 of Thonis-Heracleion confirms this information in the most convincing manner. The aftermost section of its proto-keel has two round openings carefully cut with a small chisel which have a respective diameter of 33 and 39 cm. The position of these openings at the preserved extremity of the hull allows for interpreting them as shafts of an axial rudder [73]. Two shafts for the axial rudder of Ship 17 were probably provided to allow for a better steering of the ship in ballast and being fully loaded [74]. Recently a similar opening was discovered at the stern of Ship 43 of Thonis-Heracleion, probably also belonging to the *baris* type [75]. At the same time the mention of a keel also finds parallel

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[63] The same idea is present in the construction of the Nilotic *nuggar*. Clarke 1920: 50: "*In these days the carpenter occasionally fortifies the hull by a few ribs, but these are in no way parts of a system attached to the keel, but are fixed to the interior of the skin, giving a little extra strength where the builder thinks it desirable*".

[64] P. Pomey, pers. comm., 31.01.2014.

[65] Translating (ἐμ)πακτόω as "to caulk". This translation is supported by Basch 1986; Boreux 1925: 236–239; Casson 1971: 14–15; Edgerton 1923; Jones 1990: 54; Lloyd 976: 387; 1979.

[66] This translation is supported by Foerster 1989; Haldane 1990; Morrison 1972: 230; Vinson 1996: 202; 1998. It can be immediately noticed that Herodotus uses this word in another form. A.B. Lloyd cites textual evidence from other Greek sources and says that "*Finally and most important, there is the lexicographical argument that the compound* ἐμπακτόω *could hardly refer to anything but stuffing material into cracks to make them water-tight*" (Lloyd 1979: 47).

[67] Although visually this material may well prove to be papyrus, its analysis has not yet been undertaken.

[68] An exhaustive analysis of the meaning of the term is proposed in Basch 1986; 2008.

[69] Luting means the application of waterproofing material between the joints of the planking in progression with the building process. See Pomey, Rieth 2005: 212; Steffy 1994.

[70] Cf. Santamaria 1995: 149.

[71] Clarke 1920: 50; Hornell 1943: 29–30.

[72] In particular Boreux 1925: 248; Edgerton 1923; Landström 1970: 26; Vinson 1998; Basch 1999.

[73] Belov 2014a.

[74] P. Pomey, pers. comm. 27.11.2012.

[75] Robinson 2015.

in the material from Ship 17. In the central part of the ship, the keel is twice as thick as its planking and it projects inside the hull. It seems that this element, classified as a proto-keel, played an important structural role in the longitudinal structure of the ship [76].

[11] ἱστῷ δὲ ἀκανθίνῳ χρέωνται, ἱστίοισι δὲβυβλίνοισι

The masts of the Egyptian ships of the period under consideration were probably situated at the middle of the hull [77]. This conclusion is supported by the discovery of the mast-step notch 46 cm long, 13 cm wide and 5 cm deep amidships of Ship 17 of Thonis-Heracleion. It is quite possible that there were no mast step but just lateral knees or a mast shoe to support the mast [78]. Two large mortises in the central strake of the Mataria boat seem to correspond to the middle of the hull and to be related to the position of a mast [79]. The construction of the boat of the Upper Nile *nuggar* may serve as an ethnographic parallel [80]. It has been estimated that the relation between the height of the mast and the length of the hull for the majority of the Egyptian boats must have been close to ⅔ [81]. Accepting this ratio the height of the mast of Ship 17 of Thonis-Heracleion can be estimated at 17–18 m. Obviously it would have been very difficult to obtain a mast of this length from the wood of acacia [82]. On the other hand, the idea of a mast consisting of several trees fished together [83] does not seem convincing as it would result in a great loss of mast's strength [84]. To conclude two hypotheses may be suggested: either the mast of the *baris* was considerably shorter than if obtained according to the above-mentioned ratio, or it was made of different wood species. Taking into consideration the precision of Herodotus' description so far, I would prefer the first of them [85]. The width of the rectangular sail of the *baris* must have considerably exceeded its height and it could have been made of matting woven from papyrus [86]. However, the sails from Lyon [87] and from Berenice [88] were made of linen.

[12] κατὰ ῥόον δὲ κομίζεται ὧδε᾽

An experiment carried out by G. Goyon in collaboration with the Central Hydraulic Laboratory of France confirmed the efficiency of the technique just described [89]. Mathematical manipulations proposed in a publication by J. V. Wehausen *et al.* fully confirm the experimental results [90].

[13] ἄγει ἔνια πολλὰς χιλιάδας ταλάντων.

According to the preliminary results of the reconstruction, Ship 17 of Thonis-Heracleion had a displacement of about 150 t and a deadweight of about 112 t. As 1000 talents would equate to approximately 25 t of cargo [91], Ship 17 was capable of taking aboard about 4000 talents of cargo.

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[76] Belov 2015.

[77] Assmann 1913: 148.

[78] For different systems of fastenings for the mast see Landström 1970: 47, 54 fig. 143–153, 72 fig. 211–377, 74 fig. 217–219, 262.

[79] Haldane 1996: 242.

[80] Clarke 1920: 49: "*The stout beam or tree stem is for making steady the short mast which has a socket in the keel and a strap or other form of stay to secure it to the beam*".

[81] Goyon 1971 : 22.

[82] Cf. Boreux 1925 : 349.

[83] Köster 1923: 17.

[84] The composite wooden main masts of the large sailing ships may indeed consist of many pieces (up to eight) but it is to remember that each of them remains equally long. On the other hand, each topmast (or topgallant mast, royal mast) is equipped with its proper rigging attached to the top or to the appropriate crosstrees. In any case multi-part masts can be ruled out with regard to Antiquity.

[85] Normally the wind was favorable for vessels going up river. The words of Herodotus that a *baris* cannot sail upstream but with a fresh breeze may contain a slight hint concerning the height of the mast. A short mast would permit hoisting a sail of modest size only and this could explain the difficulty of the ship sailing upstream while being heavily loaded.

[86] See the corresponding commentary in Lloyd 1976: 388–389.

[87] Dated to the second half of the 3rd century BC. Rougé 1987.

[88] Dated to the 1st century BC. Wild, Wild 2001.

[89] Goyon 1971: 38–41, annex 1.

[90] Wehausen et al. 1988.

[91] Taking 1 talent being equal to 26 kg.

Conclusions

The brief description of the Nilotic freighter called *baris* by Herodotus has long been recognized as being very important for the study of Egyptian shipbuilding in general and for that of the Late Period in particular. New archaeological finds from Thonis-Heracleion help better understanding this rare document. The text of Herodotus turns out to be very precise in spite of the originality of the described boatbuilding technique. Sharing the conviction of A. B. Lloyd that the narrative of Herodotus comes from an eye-witness, S. Vinson wrote:

> *Without wishing to make great claims for or against Herodotus' Book II as a whole, there is one thing I feel able to claim, and in fact wish to stress: that the description of Egyptian boat construction which is to be found in Chapt. 96 of Herodotus' Book II is the description of an eye-witness* [92].

The new archaeological material discussed in this article further supports this conclusion, to which I would like to adhere without any reservation.

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[92] Vinson 1998: 252.

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НОВЫЙ ВЗГЛЯД НА КОНСТРУКТИВНЫЕ ОСОБЕННОСТИ ЕГИПЕТСКОГО *БАРИСА* В СООТВЕТСТВИИ С ОПИСАНИЕМ ГЕРОДОТА (2.96)

Описание конструкции корабля типа *барис*, сделанное Геродотом в середине V в. до н. э., имеет огромное значение для изучения истории древнеегипетского кораблестроения. В частности, оно содержит важную информацию о судостроительных традициях Позднего периода. Новый археологический материал из Тониса-Гераклеона позволяет прояснить многие утверждения Геродота, которые до сих пор либо оставались непонятыми до конца, либо вызывали ожесточенную полемику среди комментаторов. В свете новых данных описание Геродота оказывается очень точным, несмотря на оригинальность конструкции корабля, что в целом свидетельствует о том, что Геродот был очевидцем постройки *бариса*.

Ключевые слова: Геродот, Поздний период в истории Египта, древнее кораблестроение, подводная археология.