

How Did Byzantines Weave? A Synthesis of Textual, Pictorial, Ethnographic, and Archaeological Evidence

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ON BYZANTINE WEAVING PRACTICES, the scholarship to date remains scant and fragmentary. The most serious exploration comes from Anna Muthesius and confines itself to the weaving of silk. Based primarily on technical analyses of surviving silk textiles and comparative insights from better-documented weaving practices, her work concluded that these silks must have been woven on looms with special pattern-producing devices that created simple or complicated forms. Some might even have been produced from sophisticated hand drawlooms comparable to those available in modern India.¹ Regula Schorta, who also adopted a technical approach but addressed extant high-end silk textiles of the High Middle Ages more generally, believed that they were woven on looms with shafts, often controlled by pedals that could open sheds both upwards and downwards.² To create

¹ For an overview of her work see A. Muthesius, “Material Culture and Well-being in Byzantium,” in *Studies in Byzantine, Islamic and Near Eastern Silk Weaving* (London 2008) 258–260. Her viewpoints are exemplified in her “Essential Processes, Looms, and Technical Aspects of the Production of Silk Textiles,” in A. Laiou et al. (eds.), *The Economic History of Byzantium* (Washington 2002) 152–158.

² In textile literature, the shed is the temporary opening between two selected groups of warps (longitudinal threads) created to insert wefts (latitudinal threads). Sticks and shafts are possible devices to create the shed (shedding).

pattern repeats, she also expected the mechanism of draw-ooms: the pattern could have been stored and reproduced through a complex system of cords, each bound to a group of selected warps.³ In her study of middle Byzantine silk, Julia Galliker devoted scattered discussions to the Byzantine loom through technical analyses as well. She envisaged both simple looms, equipped with shed sticks or dedicated shafts, and drawlooms which would have been used for weaving patterned silk.⁴

For advancing our knowledge of the Byzantine weaving practice, these approaches, which focus on technical analyses, have severe limitations. On the one hand, the information we can get from examining extant textiles is minimal and obscure. The deduction from the textiles' observed traits to the weaving apparatus' features remains largely conjectural with no conclusive proof. The same textile could have been made either on highly sophisticated looms or on simple ones with higher labor investment. To place a conclusion within such a spectrum of possibilities is difficult.⁵ On the other hand, these studies are confined not only to silks, certainly a rare textile material compared with wool and linen, but to those high-grade pieces among them that have managed to survive to the present.⁶ How such analyses can elucidate the common weaving practice in Byzantium remains uncertain. Apart from silk specialists, the subject also draws sporadic attention in broader studies or

³ R. Schorta, *Monochrome Seidengewebe des hohen Mittelalters: Untersuchungen zu Webtechnik und Musterung* (Berlin 2001) 25–30, 52.

⁴ J. Galliker, *Middle Byzantine Silk in Context: Integrating the Textual and Material Evidence* (diss. Birmingham 2014) 224–225, 273, 308.

⁵ For concerns about such a pitfall see J. Wild, "The Roman Horizontal Loom," *AJA* 91 (1987) 461; A. Geijer, *A History of Textile Art* (London 1979) 19–20.

⁶ For a detailed discussion of the origins of the extant Byzantine silk textiles see Galliker, *Middle Byzantine Silk* 178–198.

those focusing on a specific type of evidence, such as pictorial evidence or archaeological finds.⁷ Such discussions, although revealing, are too brief and isolated to create a meaningful picture. There has not been an attempt to bring all such disparate evidence together.

Considering these problems and gaps in the scholarship, this article seeks to reconstruct the Byzantine weaving practice by synthesizing textual records, pictorial representations, and archaeological data. In addition to these, ethnographic studies will also be consulted to verify the feasibility of the reconstruction and, more importantly, to shed light on unattested details with examples from similar weaving practices. It should be emphasized that this use of ethnographic evidence is based only on the similarity of weaving practices. It has no intention to claim Byzantine survivals among modern peoples historically related to Byzantines, a highly risky approach that accepts the unwarranted assumption that such survivals must exist. Therefore, the comparative weaving practices will be chosen from among those that have been well studied, allowing us to formulate a relatively comprehensive picture of them, regardless of whether they derive from former Byzantine territory or not. Under this premise, they should also bear a strong resemblance to Byzantine practice in the aspects we can reconstruct from the available historical evidence. Byzantines from disparate parts of the empire or different social groups might have woven differently. Various types of textiles may also have been treated differently. Thus, contextual differences, e.g. domestic vs. pro-

⁷ E. Turnator, *Turning the Economic Tables in the Medieval Mediterranean: The Latin Crusader Empire and the Transformation of the Byzantine Economy, ca. 1100–1400* (diss. Harvard 2013) 346–348 n.8; N. Conostas, *Proclus of Constantinople and the Cult of the Virgin in Late Antiquity* (Leiden 2003) 315–358. On pictorial evidence see M. Parani, *Reconstructing the Reality of Images: Byzantine Material Culture and Religious Iconography (11th–15th Centuries)* (Leiden 2003) 204; M. Meyer, *An Obscure Portrait: Imaging Women’s Reality in Byzantine Art* (London 2009) 153–161.

fessional vs. monastic or Constantinopolitan vs. provincial, as well as textile features, e.g. material, size, and quality, will be clarified when possible. Similarly, Byzantine weaving practice could have also evolved over time. Therefore, the study will focus on the period of the eleventh to thirteenth centuries when the available sources cluster. For contextualizing purposes, sometimes we will also include materials outside of this chronological scope.

1. *Textual descriptions*

We start with Theophylact (1050–after 1126), archbishop of Ohrid. In commenting on the garments of the crucified Jesus in the Gospel of John, Theophylact suggested that weaving on looms (ἱστούς) at that time in Palestine went from top to bottom, while in his everyday experience, presumably in the Byzantine province of Bulgaria, weaving went upward (ἀναβαίνοντος), with warps (τοῦ μίτων καὶ τοῦ στήμονος) seen on the loom's upper part and the finished cloth on the lower part.⁸ The weaving certainly was on vertical looms, and Theophylact indicates that Byzantines did it from the bottom up. Since no specification is provided by the context, we may assume that he was describing a general feature of Byzantine weaving.

The next record comes from Michael Psellos (1018–after 1081) concerning the festival of Agathe (τῆς Ἀγάθης) in contemporary Constantinople, which featured groups of female textile artisans in the festive procession.⁹ They are described as loom-workers (ἱστουργουσῶν / τὰς ἱστουργούσας) or craftswomen (ἡ τεχνουργούσα) engaged in weaving (ὑφαινούσας), carding (ξαινούσας / ξέομενος), and spinning (ἐλίττουσιν τὴν ἄτρακτον /

⁸ PG 124.276D–277A: ἐν Παλαιστίνῃ ὑφαίνουσι τοὺς ἱστούς, οὐχ ὡς παρ' ἡμῖν, ὄντων ἄνω μὲν τῶν μίτων καὶ τοῦ στήμονος, κάτω δὲ ὑφαινομένου τοῦ πανίου, καὶ οὕτως ἀναβαίνοντος, ἀλλὰ τοῦναντίον, κάτω μὲν εἰσιν οἱ μίτοι, ἄνω δὲ ὑφαίνεται τὸ ὑφασμα.

⁹ C. Sathas, *Μεσαιωνικὴ Βιβλιοθήκη* V (Venice 1876) 527–531.

ἀνατυλίπτουσιν τὴν ἡλακάτην).¹⁰ They seem to have been organized professionals specializing in cheap textiles including wool (τὰ ἔρια) and linen (λίνοσ), both of which are mentioned.¹¹ Where Psellos is certainly describing weaving, he says that the craft involved the use of a tool called a κερκίς.¹² And the artisan should pay special attention to get the correct number of warp threads when gathering them with the fingers,¹³ which indicates that the weaving must have involved intensive and meticulous finger movements.

On silk weaving in Thebes, a prominent silk industrial center during this period,¹⁴ we have sparse information from John Tzetzes (ca. 1110–1180s). In a letter to his friend John Ismeniotēs in 1148 expressing thanks for Ismeniotēs' gift of a Theban silk textile,¹⁵ Tzetzes implies that silk weaving in Thebes also

¹⁰ Sathas, *Μεσαιωνική* V 528–530.

¹¹ Sathas, *Μεσαιωνική* V 529–530.

¹² Sathas, *Μεσαιωνική* V 530: οὐδὲ τῆ κερκίδι τὴν ἰστοουργικὴν πράξιν ῥυθμίζουσιν.

¹³ Sathas, *Μεσαιωνική* V 530–531: μὴ δὲ τὰς μίτους τῶν στημόνων ταυτίζουσα, δις τοσαύτας τοῖς δακτύλοις συνήθροισε.

¹⁴ E. Weigand, “Die helladisch-byzantinische Seidenweberei,” in *Eἰς μνήμην Σπυρίδωνος Λάμπρου* (Athens 1935) 503–514; D. Jacoby, “Silk in Western Byzantium before the Fourth Crusade,” *ByzZeit* 84/5 (1991/2) 452–500; A. Savvides, “Ἡ Βυζαντινὴ Θήβα, 996/7–1204 μ.Χ.” *Ἱστοριογεωγραφικά* 2 (1988) 33–52; Ch. Koilakou, “Jews and Silk Trade in Byzantine Thebes,” in *Εγκυκλοπαίδεια Μείζονος Ἑλληνισμοῦ, Βοιωτία*, <http://boeotia.ehw.gr/Forms/fLemmaBody.aspx?lemmaid=14506>. For a more skeptical stance on the industry's status see A. Dunn, “Historical and Archaeological Indicators of Economic Change in Middle Byzantine Boeotia and their Problems,” *Ἐπετηρίς τῆς Ἐταιρείας Βοιωτικῶν Μελετῶν* 2 (1995) 755–774, and “The Rise and Fall of Towns, Loci of Maritime Traffic, and Silk Production: The Problem of Thisvi-Kastorion,” in E. Jeffreys (ed.), *Byzantine Style, Religion and Civilization: In Honour of Sir Steven Runciman* (Cambridge 2006) 38–71; E. de Rosen, “The Silk Industry of Middle Byzantine Boeotia,” *Diogenes* 7 (2019) 30–48.

¹⁵ *Ep.* 71, P. L. Leone, *Ioannis Tzetzae Epistulae* (Leipzig 1972) 102.11. On

used a κερκίς. This detail, certainly concerned with professionals weaving for customers, accords with that of Psellos. Earlier in the letter Tzetzes applies κερκίς to the tools Milesian women used in producing bedspreads (στρωμνῶν), as he learned from Homer,¹⁶ which shows that he assumes that both weaving practices relied upon a κερκίς. κερκίς is often translated as “shuttle.”¹⁷ According to Susan Edmunds’ in-depth study of Homeric weaving, this is inexact, as the shuttle is a typical tool for the horizontal, treadle-operated loom, while Homeric weaving is based on the warp-weighted loom. A better translation would be a “pin beater” that could have been used to beat the weft into place, strum the warp (to address the unevenness between threads or separate those stuck together), or act as a warp separator to create sheds in motif weaving. A Homeric pin beater was generally stick-like or pointed at one end or both, although this could have varied depending on the specific task to be performed.¹⁸ From Psellos and Tzetzes’ texts we do not clearly know the functions of the pin beater, but it appears that this accessory tool of the Homeric warp-weighted loom had persisted into Byzantine weaving.

Michael Choniates, the metropolitan of Athens ca. 1175–1204, provides similar hints about weaving practice. In a letter dated 1183–1185 he expresses his disappointment in Demetrios Drimys, who has opted for life in Constantinople over the governing post of Hellas and the Peloponnese. Among his accusations against Constantinopolitan citizens, Michael in-

the dating of this letter see M. Grünbart, “Prosopographische Beiträge zum Briefcorpus des Ioannes Tzetzes,” *JÖB* 46 (1996) 202.

¹⁶ Leone, *Ioannis Tzetzae Epistulae* 102.3 (*Ep.* 71)..

¹⁷ In the case of Psellos see A. Kaldellis, *Mothers and Sons, Fathers and Daughters: The Byzantine Family of Michael Psellos* (Notre Dame 2006) 184.

¹⁸ S. Edmunds, “Picturing Homeric Weaving,” in *Donum natalicium digitaliter confectum Gregorio Nagy* (Washington 2012), <https://chs.harvard.edu/CHS/article/display/4365>, §40–§51.

cludes their exploitation of Thebans and Corinthians in terms of textile production: “Theban and Corinthian fingers make clothes at the loom not for you.”¹⁹ He must be referring to professional weavers whose products were exported to Constantinople. The specification of fingers as the agent of weaving corroborates the testimony of Psellos, who emphasized the importance of finger movements in weaving. This feature aligns closely with weaving on looms with simple or no shedding or patterning devices, in which case the weaver relies on the fingers to open sheds and insert wefts. For more advanced looms with sophisticated shedding or patterning devices such as treadle looms and drawlooms, the remarkable finger movement is replaced by the operation of these devices, which are associated more with hands than fingers.²⁰ Hence it seems that Byzantine weaving was mainly on looms of primitive types.

The next textual record comes from Eustathios of Thessalonike (ca. 1115–1195/6). Urging monastics not to resume the secular life, he gives examples of those who suffer in the mundane world. Among them are “men who weave a loom that is worth little and painstakingly take away coins that can be easily counted through earning of everyday toil.”²¹ This proves the use of a type of loom that could be cheaply built and was accessible to persons of little means who had to work as professionals for daily hire. The scene he describes must have been so common, presumably around Thessalonike, that it would easily impress his monastic audience. So we may deduce that low-cost looms were widely available in Byzantium.

¹⁹ Ph. Kolovou, *Michaelis Choniatae Epistulae* (Berlin 2001) 69–70: οὐ τὰς ἀμπεχόνας ὑμῖν ἰστουργοῦσι Θηβαῖοι καὶ Κορίνθιοι δάκτυλοι.

²⁰ E. Brody, *The Book of Looms: A History of the Handloom from Ancient Times to the Present* (London 1979) 102–137; Geijer, *Textile Art* 77–78, 96–101.

²¹ K. Metzler, *Eustathii Thessalonicensis De emendanda vita monachica* (Berlin 2006) 46.1–3 (§38): ἄνδρας, τοὺς μὲν ἰστὸν ὑφαίνοντας ὀλίγου τιμώμενον καὶ μόγις δι’ ἡμέρας ἀποφερομένους κέρδος τοῦ καμάτου νούμμου εὐαριθμήτους.

Finally, we should note a record outside of our period but often cited in the scholarship.²² This biblical commentary by Theodoret of Cyrrihus (ca. 393–ca. 458/466) presumably reflects practice in fifth-century Syria.²³ Taking the weaving of wool textiles as an example, Theodoret says that weaving began with placing the warps on the looms like strings.²⁴ The insertion of the weft involved the use of pin beaters (ταῖς δὲ κερκίσι), which separated the warp threads after loosening and tightening some of them (literally “the threads having been put into place”).²⁵ According to Edmunds (n.18 above), the pin beaters here could only have functioned as warp separators to pick temporary sheds for pattern weaving. Theodoret continues that the inserted weft was beaten (πιλοῦσαι, literally “compressed”) with certain instruments made for this purpose.²⁶ These unspecified instruments must have been a type of weft beater, but clearly different from the pin beaters mentioned above; otherwise Theodoret would have referred to them also as κερκίδες. In what follows (617D–620B) he expresses his admiration for wool or silk textiles with diverse colors and

²² This is the only textual record Anna Muthesius analyzed in detail in her study of Byzantine silk weaving: *Byzantine Silk Weaving AD 400 to AD 1200* (Vienna 1997) 23–24, and in *Economic History* 157. Cf. J. Ball, “The Missing Link: Filling the Gap in the Evolution of Medieval Domestic Looms,” in J. Alchermes et al. (eds.), *Αναθέματα Εορτικά: Studies in Honor of Thomas F. Mathews* (Mainz 2009) 39. Cf. Schorta, *Monochrome Seidengeewebe* 26.

²³ The passages Theodoret comments on come from the Book of Job. These were illuminated in many surviving manuscripts, see below.

²⁴ *PG* 83.617C: εἶτα γυναικῶν χεῖρες λαβοῦσαι, τὰ λεπτὰ νήθουσι νήματα, καὶ ταῦτα πρότερον, οἷόν τινος χορδᾶς, κατὰ τάξιν ἐν τοῖς ἰστοῖς διατεῖναι, ἐμβάλλουσι μὲν τὴν κρόκην, ταῖς δὲ κερκίσι τοὺς στήμονας διακρίναι, καὶ τῶν ἐμβεβλημένων μηρίνων, τὰς μὲν χαλῶσαι, τὰς δὲ τεινοῦσαι.

²⁵ Anna Muthesius’ claim (in *Economic History* 157) that these sentences clearly indicate shed sticks and draw loops is certainly an overinterpretation.

²⁶ *PG* 83.617D: εἶτα τοῖς εἰς τοῦτο συντεθημένοις ὀργάνοις οἷον ὠθοῦσαι καὶ πιλοῦσαι τὴν κρόκην, οὕτως ἀποτελοῦσι τὸ ὕφασμα.

motifs—that is, he assumes that the weaving process described could be employed at least for wool and silk textiles.

To conclude on our textual sources, Theophylact attests from the provincial perspective of Bulgaria that Byzantines generally wove on vertical looms, working from the bottom upward. Psellos shows that in Constantinople, artisans working on cheap textiles used pin beaters and exacting finger movements in weaving. According to Tzetzes, pin beaters were also counted among the weaving implements of the Theban silk weavers. Michael Choniates says that Thebans and Corinthians also wove typically with fingers, which, as in the case of Psellos, may point to the use of primitive looms. Near Thessalonike, Eustathios implies that weavers for daily hire were commonly seen with cheap looms. From Theodoret it appears that in early-Byzantine Syria the pin beater was used for shedding, while weft beating was performed by another tool. Throughout, the weaving practice seems to have been identical for different textile materials. Most of these authors refer to professional weaving, except for Theophylact and Theodoret whose descriptions seem to concern more general contexts.

2. *Pictorial representations*

Two types of illuminated manuscripts often contain scenes of weaving: copies of the Book of Job and of John of Damascus' homily on the Birth of Christ. Of the fifteen illustrated Job manuscripts, at least half include images of weaving on a loom. These were intended to visualize the occasion when God explained his greatness to Job by saying “who gave women skill in weaving or knowledge of embroidery?”²⁷ Six of these miniatures (*figs.* 1–6), dated eleventh to thirteenth century, will be

²⁷ Job 38:36, Τίς δὲ ἔδωκεν γυναῖξιν ὑφάσματος σοφίαν ἢ ποικιλικὴν ἐπιστήμην; transl. A. Pietersma et al. (eds.), *A New English Translation of the Septuagint* (Oxford 2007) 694. For an investigation on Byzantine weaving imagery from the perspective of women see Meyer, *An Obscure Portrait* 153–161.

our focus here.²⁸ The provenances of these manuscripts remain unclear, apart from tentative attributions of *Vat.Pal.gr.* 230 to a provincial origin and *Vat.gr.* 1231 to Cyprus.²⁹ Comparative analysis of the Job illustrations in question has shown that the imagery is typically adapted to contemporary interests.³⁰ All the loom depictions include more or less unique details (see below). Hence we can assume that they were not rigid copies of their sources but incorporated realistic elements from their times. As to the Birth images, we will examine two, fol. 100^r in *Taphou* 14 of Jerusalem's Patriarchal Library (*fig.* 7) and fol. 397^v in codex 14 of the Esphigmenou monastery (*fig.* 8). The former is attributed to the eleventh or twelfth century,³¹ the latter to Constantinople between 1066 and 1081.³² Each illustrates the Achaeans consulting the oracle at Delphi and receiving the prophecy about the coming of Christ: the priestess Xanthippe is prophesying to them after being interrupted while weaving a fine purple priestly cloth on the loom.³³ *Taphou* 14's loom in particular must have been realistic for the illustrator's time, for it is not only an unprecedented object in

²⁸ *Vat.Pal.gr.* 230, fol. 218^r (late XI/early XII) (*fig.* 1); *Vat.gr.* 1231, fol. 410^r (early XII) (*fig.* 2); *Vat.gr.* 751, fol. 146^r (before 1200) (*fig.* 3); *Par.gr.* 134, fol. 184^v (XIII) (*fig.* 4); Oxford, Bodleian Library, *Barocci* 201, fol. 220^v (last quarter XII/early XIII) (*fig.* 5); Jerusalem, Patriarchal Library, *Taphou* 5, fol. 234^v (late XIII) (*fig.* 6). For the dating of these manuscripts see S. Papadaki-Oekland, *Byzantine Illuminated Manuscripts of the Book of Job* (Athens 2009) 350–353, 368, 359–361, 381–382, 388, 395; J. Andrews, “The Book of Job,” in V. Tsamakda (ed.), *A Companion to Byzantine Illustrated Manuscripts* (Boston 2017) 238–245.

²⁹ Papadaki-Oekland, *Byzantine Illuminated Manuscripts* 360–361, 368.

³⁰ Papadaki-Oekland, *Byzantine Illuminated Manuscripts* 352–353, 361, 381–382, 388; Andrews, in *A Companion* 237–238, 240.

³¹ B. Kotter, *Die Schriften des Johannes von Damaskos* V (Berlin 1988) 313.

³² G. Galavaris, *The Illustrations of the Liturgical Homilies of Gregory Nazianzenus* (Princeton 1969) 225–226.

³³ Kotter, *Die Schriften* V 333–334.

the illustrator's antecedents but unparalleled in its detail.³⁴

A conspicuous feature of the looms as depicted is that all are two-bar vertical looms, simple-structured, and apparently requiring only modest investment. Also, the fabrics are constructed from the bottom upward. Moreover, when the action of weaving is clearly portrayed (*figs.* 2, 3, 4, 5, 6, 8), there is always a subtle use of fingers on the warps and wefts. All these features fit well with what we have seen in the written descriptions.

On the other hand, we can also see details about Byzantine weaving practice that are not attested in textual records. First, the two horizontal beams of the depicted looms are either fixed (*figs.* 3, 4, 5, 6, 8) or designed to be detachable or rotatable (*figs.* 2, 7). The latter arrangement would have allowed the upper beam to release additional lengths of warps and the lower beam (cloth beam) to fold the woven fabric. In this way the loom could accommodate a textile longer than its height. Second, in *fig.* 6 a comb-shaped tool is lying below the loom. In a weaving context it must have been used to beat the weft threads firmly into place. However, because of its distinctive shape, it is undoubtedly not the pin beater mentioned in written records but a different weaving implement, possibly the unspecified weft beater implied by Theodoret. We will refer to it as a weaving comb. The presence of the weaving comb suggests that it could replace the pin beater as the primary tool for weft beating. Third, in *figs.* 3 and 6 we see depictions of spools (or bobbins), i.e. cylinders wound with weft threads. In the first, a spool is held by the weaver in one hand; in the second, multiple spools with various colors hang in front of the woven fabric by their weft threads, which are partially inserted between the warps. Fourth, the textile in *fig.* 6 must be of inferior quality: the weaving comb is crude with widely spaced teeth,

³⁴ K. Weitzmann, *Greek Mythology in Byzantine Art* (Princeton 1984) 61–65.

precluding it from beating high-grade textiles which were usually densely woven.³⁵ By contrast, the textile in *fig. 2* must be a luxury piece, for it has border medallions in horizontal rows, a distinguishing feature of extant top-end Byzantine silk textiles.³⁶ The same applies to the textile in *fig. 7*, with its wide band of pseudo-Kufic inscriptions, a decoration found only in high-end products.³⁷ Fifth, the loom in *fig. 3* has a clear heddle stick and a shed stick. Each would have controlled an alternate group of warp threads. When operated in turn, they could create openings between the warp groups back and forth (i.e. the natural shed and the counter shed). These devices increased the speed of weaving textile structures with no patterns (i.e. ground weave).³⁸ In *fig. 2* we see two parallel cavities on the loom's vertical beams. Similar heddle and shed sticks were likely installed at some point, and the cavities were the sockets used to fix them. They were probably removed for the convenience of pattern weaving when they were not in use. Finally, the loom in *fig. 3* also has a pair of triangular structures attached to its vertical beams. These must have been incorporated to stabilize the loom, as it lacks the pedestals that most of its depicted counterparts have (*figs. 2, 5, 6, 7, 8*).

³⁵ Galliker, *Middle Byzantine Silk* 134; cf. Leone, *Ioannis Tzetzae Epistulae* 102 (*Ep.* 71).

³⁶ The enclosed figures are hard to discern in the miniature, but to judge from the motifs frequent from the tenth century on, they may be a griffin, lion, elephant, and tree: Muthesius, *Byzantine Silk Weaving* 179 (M48), 182 (M55), 183 (M58), 185 (M65), 191 (M85).

³⁷ Pseudo-Kufic inscriptions in top-standard fabrics: Weigand, in *Eis μνήμην* 509–514; Muthesius, in *Studies* 94–95; H. C. Evans and W. D. Wixom, *The Glory of Byzantium: Art and Culture of the Middle Byzantine Era* (New York 1997) 505–507. They also decorated the arm-band, turban, shield, helmet, or greaves of aristocrats: Parani, *Reconstructing the Reality of Images* 54, 95, 121–122, 149–150, 326–327, 329.

³⁸ Geijer, *Textile Art* 20–21; F. Zhao et al. (eds.), *A World of Looms: Weaving Technology and Textile Arts* (Hangzhou 2019) 13.

Beyond these details, the images are hardly informative. The Job text does not provide any specification on the weaving context. In the Birth text, a weaving priestess in the Delphian sanctuary was certainly anachronistic in the illustrator's time; it is unclear if the depiction was appropriated from a real-life scene or an imaginary combination of realistic elements. That all the depicted weavers are women is also not explanatory, since both the Job and the Birth texts required the illustrators to present female weavers, an unspecified woman in the one case and a priestess in the other. Thus these miniatures alone do not constitute compelling evidence for understanding the gender aspect of Byzantine weaving.

In sum, the pictorial evidence presents the two-bar vertical loom as the dominant type of weaving apparatus in Byzantium. Minor tools or loom structures may also have been involved, including movable beams, weaving combs, spools, heddle and shed sticks, and props. Combined, these could produce textiles of various lengths, materials, and patterns. Apart from pin beaters, which remain unattested in the extant images, the pictorial evidence corroborates what we have observed in the written evidence.

3. *Ethnographic studies*

Many ethnic groups worldwide have traditionally woven on the two-bar vertical loom similar to the Byzantine type we have examined.³⁹ Among them, the Berber loom in North Africa, especially Morocco, and the Turkish loom can serve as suitable references. Having received considerable coverage in the

³⁹ Zhao et al., *A World of Looms* 52 (Japan), 61 (Korea), 102 (India), 140 (Congo), 172 (Bolivia), 259 (Egypt). Further examples can be found in America, Greece, Palestine, and Syria: G. Reichard, *Weaving a Navajo Blanket* (New York 2013); G. Aikaterinides, "Σύγχρονες εκφορσσεις λαϊκής τέχνης στον Τυρό," *Χρονικά των Τσακώνων* 16 (2002) 50, 57; G. Crowfoot, "The Vertical Loom in Palestine and Syria," *PEQ* 73 (1941) 141–151. For North Africa and Turkey see in what follows.

scholarship, these constitute well-understood examples to draw upon.⁴⁰

The Berber and Turkish looms share striking similarities to the proposed Byzantine type. Structurally, both are two-bar vertical looms. Most of the attested accessory components of the Byzantine loom, including a pair of heddle and shed sticks, the weaving comb, movable horizontal beams, and external stabilizing structures are commonly used for Berber and Turkish looms.⁴¹ Furthermore, the reliance on finger movements as indicated in Byzantine sources also characterizes Berber and Turkish weaving.⁴² And like their Byzantine counterpart, these looms can produce textiles of various materials and qualities.⁴³ And if we consider the surviving

⁴⁰ Our discussion will focus on flat woven textiles (often known as kilims) rather than carpets, as the latter are barely attested in Byzantium. This needs clarification because carpets feature a furry surface called pile, the production of which requires an additional set of tools and techniques.

⁴¹ Berber loom: C. Becker, *Amazigh Arts in Morocco: Women Shaping Berber Identity* (Austin 2006) 22; C. Spring and J. Hudson, *North African Textiles* (London 1995) 36–37; C. McCreary, *The Traditional Moroccan Loom* (Santa Rosa 1975) 10–18; J. Picton and J. Mack, *African Textiles: Looms, Weaving and Design* (London 1979) 62–67; M. Naji, “Gender and Materiality in-the-Making: The Manufacture of Sirwan Femininities through Weaving in Southern Morocco,” *Journal of Material Culture* 14 (2009) 49; S. Forelli and J. Harries, “Traditional Berber Weaving in Central Morocco,” *Textile Museum Journal* 4 (1977) 49–52; F. Sorber, “Weaving Techniques and Tools,” in N. Paydar et al. (eds.), *The Fabric of Moroccan Life* (Washington 2002) 139–140. Turkish loom: P. Davies, *Antique Kilims of Anatolia* (New York 2000) 27–29; H. Böhmer, “Traditional Tools Used in Rural Carpets and Kilim Weaving in Turkey,” in N. Maarouf (ed.), *Traditional Carpets and Kilims in the Muslim World* (Istanbul 2002) 219–220.

⁴² Berber weaving: McCreary, *Traditional Moroccan Loom* 11, 49–50; Naji, *Journal of Material Culture* 14 (2009) 59–61. Turkish: Davies, *Antique Kilims* 32.

⁴³ On the Berber loom, Forelli and Harries, *Textile Museum Journal* 4 (1977) 43–48. I. Reswick, *Traditional Textiles of Tunisia and Related North African Weavings* (Los Angeles 1985) 23–30, 131–146; Spring and Hudson, *North African Textiles* 27–32; B. Pickering, W. Pickering, and R. Yohe, *Moroccan*

Byzantine silk textiles to be representative, Byzantine textiles were predominantly weft-faced like those from Berber and Turkish looms.⁴⁴ These points demonstrate that the Byzantine loom that we have reconstructed could have been feasible in practice.

Based on Berber and Turkish models, ethnographic studies can help clarify some aspects of Byzantine weaving practice that remain obscure or lack historical testimonies. Regarding the accessory tools, the weaving comb's essential role as the weft beater for Berber and Turkish looms proves that it must have been equally fundamental for performing the same task in Byzantium. In contrast, although well attested in Byzantine textual sources, the pin beater is not an evident part in these other weaving practices: weft beating, a major function of the pin beater, is done exclusively by the weaving comb. And strumming the warp and opening sheds for motif creation, the remaining functions of the pin beater, do not seem to necessitate a specific tool. In the rare cases when pin-shaped objects are mentioned in the ethnographic literature, they are always subsidiary tools. In Berber weaving, a pin beater-like object is used "to correct motifs."⁴⁵ In Turkish weaving, the tool on occasion substitutes for the weaver's fingers to pick the sheds in weaving textiles with complex designs.⁴⁶ In a similar weaving practice in Palestine and Syria, it corrects the occasional

Carpets (London 1994) 19–22; Sorber, in *The Fabric* 139.

⁴⁴ For the Byzantine case see Muthesius, *Byzantine Silk Weaving* 163–203, and in *Economic History* 157; Galliker, *Middle Byzantine Silk* 222–223. For the Berber case, Picton and Mack, *African Textiles* 54–55. For the Turkish case, W. Blazier, "Structure and Technique," in G. Bosch (ed.), *Anatolian Tribal Weaving* (Hollywood 1981) 6; Davies, *Antique Kilims* 31–32; W. Ziemba, A. Akatay, and S. Schwartz, *Turkish Flat Weaves: An Introduction to the Weaving and Culture of Anatolia* (London 1979) 22.

⁴⁵ Naji, *Journal of Material Culture* 14 (2009) 49, where the tool is called a needle.

⁴⁶ Davies, *Antique Kilims* 29, where the tool is described as a small stick.

uneven threads left after applying the weaving comb.⁴⁷ Admittedly, the use of a pin-shaped tool can be essential in some weaving practices. Weaving on body-tensioned looms in insular southeast Asia (Bali) and Peru (Chincheró) often includes a pin-shaped tool for creating sheds in pattern weaving.⁴⁸ In the Kashmir region, the weavers of the *kani pashmina* shawls on horizontal looms use such a tool both for shed opening and as a spool. Thus, after it creates the sheds, it also guides the threads wound on it through the sheds.⁴⁹ However, what makes the tool more indispensable is these weaving practices' need for a specific weft beater in pattern weaving, a function that the tool also performs but that is quite well fulfilled by the weaving comb in Berber and Turkish weaving. This reasoning would lead us to conclude that the pin beater in Byzantium probably enjoyed only sporadic use, as in the Berber and Turkish cases, a conclusion consistent with its non-occurrence in the MS. depictions we have examined. Thus the pin beater's mention in Byzantine written records may be more of a rhetorical trope than historical reality. As to Theodoret's explicit mention of pin beaters as warp separators, we can interpret this as reflecting a difference peculiar to the early Byzantine period. Alternatively, Theodoret could be describing an uncommon weaving scene when pin beaters were in use. The latter interpretation is more likely, as the textiles he had in mind were intricately patterned, including imagery of men, hunters, worshippers, trees, and many other things (*PG* 83.617D): this would have made pin beaters, one of the primary functions of which is to open temporary sheds in pattern weaving, far more desirable.

The existing scholarship adopts a skeptical stance on the

⁴⁷ Crowfoot, *PEQ* 73 (1941) 144–146, where the tool is described as a pin.

⁴⁸ Zhao, *A World of Looms* 242–243, 279.

⁴⁹ Zhao, *A World of Looms* 104.

ability of primitive looms like the two-bar vertical loom to produce patterns.⁵⁰ Nevertheless, we have seen in the miniatures pattern repeats of elaborate medallions and pseudo-Kufic inscriptions woven on such looms. Ethnographic studies have also suggested that Berber and Turkish looms can produce densely woven and intricately patterned textiles.⁵¹ Although experiments will still be necessary to confirm Berber and Turkish looms' ability to reproduce the surviving Byzantine textiles, our ethnographic knowledge would help contextualize Byzantine weavers' training process, an aspect unrecorded in historical sources. To master the techniques of weaving in both cultures takes many years. Traditionally, weavers start learning from childhood by observing their relatives and neighbors weaving and through occasional practice. Their subsequent career revolves around a set of patterns that they need to practice repeatedly until they can memorize exactly their weaving steps, e.g. the number of warp threads to be taken up or missed, and to reproduce them with dexterity. Although no written aids are extant on this process, in the Berber case weavers sometimes use rhythmic sentences that they murmur while counting the warp threads to assist their memory in pattern creation.⁵² The pattern design of skilled weavers comes from their own experimentation in combining the patterns they have mastered, which can end up being highly complex.⁵³ Such pattern-oriented training may help explain how Byzantine weavers

⁵⁰ Muthesius, *Byzantine Silk Weaving* 23, 40 n.6, and in *Economic History* 155; Galliker, *Middle Byzantine Silk* 225, 308; cf. Parani, *Reconstructing the Reality of Images* 204.

⁵¹ Berber: Sorber, in *The Fabric* 139; Spring and Hudson, *North African Textiles* 36. Turkish: Davies, *Antique Kilims* 50.

⁵² Reswick, *Traditional Textiles* 74.

⁵³ For the Berber case see Forelli and Harries, *Textile Museum Journal* 4 (1977) 52–59; Reswick, *Traditional Textiles* 68–79. For the Turkish case, Davies, *Antique Kilims* 47–51.

could create elaborate repeating patterns on looms without pattern-producing devices.

Another suggestion we can make based on ethnographic studies concerns the organization of weaving activities. In Berber and Turkish weaving, group work is necessary. Preparing the warp threads, installing them onto the loom, and folding the finished fabrics all need to be done by multiple persons. Moreover, working in shifts would also be preferred in order to ensure stable output.⁵⁴ For a textile of substantial width, multiple weavers may also work together.⁵⁵ We may expect Byzantine weavers, especially professionals, also to have worked in groups or with the aid of stand-by assistants.

To conclude the insights from ethnographic studies: the similarities between the proposed Byzantine weaving practice and Berber and Turkish weaving supports the validity of our reconstruction. Berber and Turkish models also suggest that the weaving comb might have been much more critical than the pin beater in Byzantine weaving. In addition, to produce patterned textiles Byzantine weavers possibly went through a lengthy and demanding training process. Finally, they probably worked in a group setting.

4. *Archaeological finds*

The archaeological evidence is not straightforward, since the finds are subject to various interpretations reflecting different assumptions about weaving practice.⁵⁶ However, our examina-

⁵⁴ McCreary, *Traditional Moroccan Loom* 10, 20–21, 31, 57, 64–65; Becker, *Amazigh Arts* 22–23; Naji, *Journal of Material Culture* 14 (2009) 52, 57; Davies, *Antique Kilims* 27–29.

⁵⁵ Reswick, *Traditional Textiles* 71; Davies, *Antique Kilims* 50.

⁵⁶ For a methodological assessment of looms' archaeological remains in medieval Europe see R. Windler, "Mittelalterliche Webstühle und Weberwerkstätten – Archäologische Befunde und Funde," in W. Melzer (ed.), *Archäologie und mittelalterliches Handwerk – eine Standortbestimmung* (Soest 2008) 201–215.

tion has established a largely consistent and detailed picture, allowing us to seek confirmation among the archaeological remains. Current scholarship has brought up several types of material evidence that may be relevant to Byzantine weaving practice. A frequently-mentioned example is loom weights, which have been found, for example, in Central Greece (Kato Vassiliki, Isthmia, Thebes) and Anatolia (Amorium and Boğazköy).⁵⁷ They have often been taken as a sign of weaving activities because they were key components of the warp-weighted loom, the dominant loom type in Greece and adjacent areas in antiquity.⁵⁸ They were hung on the lower ends of the warps to create tension. However, the evidence we have surveyed indicates that the warp-weighted loom was no longer in use in the Byzantine period. Theophylact of Ohrid clearly states that Byzantines wove upwards, whereas weaving on the warp-weighted loom typically goes downward.⁵⁹ Moreover, the pictorial sources consistently show looms with no loom weights. So it is reasonable to conclude that the weights found in a Byzantine context may have been used for other purposes than weaving. As speculated by some scholars, they could have been

⁵⁷ A. Paliouras, *Βυζαντινή Αιτωλοακαρνανία* (Athens 2004) 414–415; M. Veikou, *Byzantine Epirus: A Topography of Transformation* (Leiden 2012) 229–230, 439–440; T. Gregory and P. Kardulias, “Geophysical and Surface Surveys in the Byzantine Fortress at Isthmia 1985–1986,” *Hesperia* 59 (1990) 471; D. Blackman, “Archaeology in Greece 2001–2002,” *AR* 48 (2001/2) 53; C. S. Lightfoot, “The Amorium Project: The 1996 Excavation Season,” *DOP* 52 (1998) 328, and “The Amorium Project: The 1997 Study Season,” and *DOP* 53 (1999) 344; B. Böhlendorf-Arslan, “Das bewegliche Inventar eines mittelbyzantinischen Dorfes: Kleinfunde aus Boğazköy,” in *Byzantine Small Finds in Archaeological Contexts* (Istanbul 2012) 363.

⁵⁸ M. Hoffmann, *The Warp-Weighted Loom: Studies in the History and Technology of an Ancient Implement* (Oslo 1964) 297–321; Broudy, *The Book of Looms* 23–28; Zhao, *A World of Looms* 157–158.

⁵⁹ Broudy, *The Book of Looms* 25; Geijer, *Textile Art* 30–32.

weights for fishing nets or wine bottle stoppers.⁶⁰

Another archaeological find that has attracted scholarly attention is the pits that allegedly were substructures of looms. They have been discovered in an eleventh-century domestic setting in Cappadocia (Selime) and in Christian monastic contexts of the late first millennium in Upper Egypt (especially western Thebes).⁶¹ Jennifer Ball has argued that those found in Selime were the remains of horizontal looms.⁶² Whatever the cogency of her identification, the archaeological context suggests that the pits were installed during the settlement's Turkish period and should not be regarded as typical Byzantine looms. More relevant are those in Egypt. Pits of this type, of longitudinal shape, set parallel to a wall, with crossbars at the bottom, and predominantly found in a Christian monastic context, can be traced back to the Byzantine period, which implies that their use remained consistent thereafter.⁶³ Herbert Winlock first proposed that the pits found in the Monastery of Epiphanius (eight) and the Monastery of Cyriacus (one) at Thebes were used to accommodate horizontal treadle looms.⁶⁴ His

⁶⁰ Veikou, *Byzantine Epirus* 299; Lightfoot, *DOP* 53 (1999) 344. For an overview of such debates in Bronze Age archaeology see L. Rahmstorf, "An Introduction to the Investigation of Archaeological Textile Tools," in E. Strand et al. (eds.), *Tools, Textiles and Contexts: Investigating Textile Production in the Aegean and Eastern Mediterranean Bronze Age* (Oxford 2015) 7–9.

⁶¹ For those in Selime see Ball, in *Αναθέματα Εορτικά* 38–44. For those around Thebes, E. Wipszycka, "Resources and Economic Activities of the Egyptian Monastic Communities (4th–8th Century)," *JJwP* 41 (2011) 174–177; J. Sigl, "Egyptian Pit-looms from the Late First Millennium AD – Attempts in Reconstruction from the Archaeological Evidence," in M. Mossakowska-Gaubert (ed.), *Egyptian Textiles and their Production: 'Word' and 'Object'* (Lincoln 2020) 30–33.

⁶² Ball, in *Αναθέματα Εορτικά* 43–44.

⁶³ For details see Sigl, in *Egyptian Textiles* 30–33.

⁶⁴ H. Winlock and W. Crum, *The Monastery of Epiphanius at Thebes I* (New York 1926) 68–70.

identification is widely questioned because of the pits' narrow width and has been disproved by reconstructing experiments.⁶⁵ Recently, Johanna Sigl examined all relevant features of 53 such loom pits in Upper Egypt. After eliminating the possibility of alternative loom types, she reasonably concluded that the looms installed on these pits had to be vertical given the archaeological remains of the looms' fixtures, including scorings on the adjacent walls and the crossbars in the pits.⁶⁶ Her conclusion is well in line with what we have observed from other sources, pointing to the prevailing use of the same type of loom in Byzantine weaving. The remains of the fixtures she studied merit particular attention. On the one hand, the scorings on the walls, which she identified as tethering points to fix the looms' vertical beams, could have accommodated the triangular structures we see on the loom in *fig. 3*. Alternatively, as in Berber weaving, the scorings may only reflect binding the vertical beams' upper ends.⁶⁷ Both designs could have been adopted as loom fixtures in Byzantium. On the other hand, pits, which Sigl implied may have been used to accommodate weavers' feet and the crossbars bound to the looms, are not attested either in Byzantine historical sources or in Berber and Turkish practices. Thus, Sigl's study complements our previous reconstruction by suggesting that the two-bar vertical loom

⁶⁵ L. White (review of A. P. Usher, *A History of Mechanical Inventions*), *Isis* 46 (1955) 292; R. Forbes, *Studies in Ancient Technology* IV (Leiden 1964) 219; Wild, *AJA* 91 (1987) 459; G. Vogelsang-Eastwood, *The Development and Spread of Compound Weave Textiles with Particular Reference to Weft-faced Compound Weave Textiles in Wool from Egypt* I (diss. Manchester 1990) 423–425; Muthesius, *Byzantine Silk Weaving* 23; J. Sigl, "Pits with Crossbars – Investigations on Loom-remains from Coptic Egypt," in K. Endreffy et al. (eds.), *Proceedings of the Fourth Central European Conference of Young Egyptologists* (Budapest 2007) 358–363.

⁶⁶ Sigl, in *Egyptian Textiles* 27–29.

⁶⁷ McCreary, *Traditional Moroccan Loom* 12.

used in Byzantium, at least in the monastic context, could also have included a pit as its substructure.

Our examination of the pictorial and ethnographic evidence shows that the weaving comb must have been indispensable as the weft beater for the two-bar vertical loom. However, its material remains have not been sufficiently discussed in the scholarship. Wooden weaving combs have been found in Egypt and dated roughly to the Byzantine era.⁶⁸ In Central Greece, copper toothed bars have been discovered in Corinth, Spata (Attica), Athens, and Thebes, generally attributed to the Byzantine period; five have been more precisely dated to around the twelfth century, among which those from Spata and Athens might be attributed to either monastic or domestic contexts while those from Thebes to a professional one.⁶⁹ All the toothed bars are punctured at a few points, where wooden handles must have been riveted. Generally speaking, these weaving combs were, or were intended to be, of a T shape, consisting of a handle and a toothed bar. This design would have made it very suitable for beating downward between fixed vertical warps, as in weaving on two-bar vertical looms. However, the weaving comb could not have been effective on a

⁶⁸ For those dated to the seventh and eighth centuries see O. Wulff, *Altchristlicher und mittelalterliche byzantinische und italienische Bildwerke I* (Berlin 1909) 98. For those attributed roughly to late Roman times, W. Petrie, *Tools and Weapons: Illustrated by the Egyptian Collection in University College, London* (London 1917) 54. The contexts of these finds were not specifically documented.

⁶⁹ Corinth and Spata: G. Davidson, *Corinth XII The Minor Objects* (Princeton 1952) 173, pl. 78; D. Papanikola-Bakirtze, *Καθημερινή Ζωή στο Βυζάντιο* (Athens 2002) 364–365. Athens: V. Papaeuthymiou, “Το Ασκληπιείο των Αθηνών κατά τους χριστιανικούς χρόνους,” *ArchEph* 151 (2012) 114–115. The two found in Thebes, now in the Archaeological Museum of Thebes, were documented by the responsible archaeologist Giannis Vaxevanis: unpublished Museum records, put online by the Ephorate of Euboean Antiquities, cf. https://www.medievalroutes.gr/el/sylloges/antikeimena/4297_el/ (hereafter EEA); see below on their context.

warp-weighted loom, since the warps' lower ends were not fixed. Instead, the pin beater was the most appropriate weft beater, as it did not require the warps to be held firmly in place to function properly.⁷⁰ As to weaving on a horizontal loom, pictorial and archaeological evidence from the Latin West suggests that the typical weft beater was a reed.⁷¹ Ethnographic studies show that a weaving comb could be used as the weft beater of a much more primitive horizontal ground loom as used in a nomadic setting in Anatolia,⁷² but such use is rarely documented and certainly not indispensable even for that loom type.⁷³ In any case, as both textual and pictorial sources point to the predominance of vertical looms, we may reasonably assume that the remains of weaving combs found in Byzantium indicate weaving on two-bar vertical looms.

On the other hand, the archaeological finds can provide further insights into the textile materials produced on two-bar vertical looms when examined in context. The two copper toothed bars from Thebes came from a site called Agia Triada.⁷⁴ Coins from the site suggest that its Byzantine flourish-

⁷⁰ Cf. L. Wilson, *The Clothing of the Ancient Romans* (Baltimore 1938) 22–23.

⁷¹ D. Carroll, "Dating the Foot-Powered Loom: The Coptic Evidence," *AJA* 89 (1985) 169; Wild, *AJA* 91 (1987) 459–460; Windler, in *Archäologie und mittelalterliches Handwerk* 207. In illuminated Job manuscripts postdating the group examined above, we find representations of reeds with horizontal looms. The earliest of these is *Par.gr.* 135, fol. 222^v, where we see a reed similar to those of the Latin West, e.g. the one depicted in Trinity College Library, 0.9.34, fol. 32b. As *Par.gr.* 135 is attributed to the Peloponnese in the 1360s, the artist was most likely portraying an already westernized weaving practice. Cf. Ball, in *Αναθέματα Εορτικά* 40.

⁷² Ziemba, Akatay, and Schwartz, *Turkish Flat Weaves* 89.

⁷³ For example, weaving on looms of the same type in North Africa uses a piece of wood as the weft beater; no weaving comb has been reported: Reswick, *Traditional Textiles* 54–63; Spring and Hudson, *North African Textiles* 35–36; Picton and Mack, *African Textiles* 59.

⁷⁴ This is indicated in *ArchDelt* 42 (1987) 118, and documented by Vaxevanis' records and EEA.

ing was in the second half of the twelfth century,⁷⁵ coinciding with the apogee of the prominent silk industry in Thebes (see n.14). The part of the site excavated contained at least fifty interconnected basins and wells, most about one meter in diameter and sometimes coated with mortar, pointing to use in processing fabrics or hides.⁷⁶ When functioning at full capacity, such a large industrial complex could have produced a considerable output that is unlikely to have gone unattested in other evidence. Therefore, as has been widely accepted,⁷⁷ the site was probably a workshop for silk processing. In this case, the copper toothed bars must have been components of the weaving combs used by professionals for silk weaving. In support of this, we should note that one of these toothed bars has a design distinguishing it from its counterparts from the same period: it is square and has shorter and denser teeth,⁷⁸ indicating use in weaving fine textiles like silk. Silk textiles from Thebes ranked among the empire's best silks at that time: they were widely used in the imperial court and desired by

⁷⁵ Around half of the coins dated before 1204 came from the reign of Manuel Komnenos (1143–1185): M. Galane-Krikou, “Θήβα: 10^{ος}–14^{ος} αιώνας. Η νομισματική μαρτυρία από την Αγία Τριάδα,” *Byzantina Symmeikta* 11 (1997) 140.

⁷⁶ *ArchDelt* 41 (1986) 27; 42 (1987) 117–118; 43 (1988) 97; Ch. Koilakou, “Βυζαντινά εργαστήρια (βαφής;) στη Θήβα,” *Τεχνολογία* 3 (1991) 23–24, and “Βιοτεχνικές εγκαταστάσεις βυζαντινής εποχής στη Θήβα,” in *Αρχαιολογικά τεκμήρια βιοτεχνικών εγκαταστάσεων κατά τη Βυζαντινή εποχή* (Athens 2004) 223–227. For the remains of tannery workshops see R. Thomson and Q. Mould, *Leather Tanneries: The Archaeological Evidence* (London 2011).

⁷⁷ *ArchDelt* 41 (1986) 27; Koilakou, in *Αρχαιολογικά* 226–227, and in *Εγκυκλοπαίδεια*.

⁷⁸ Photograph of the copper toothed bar from Athens: Papaeuthymiou, *Αρχαιολογικής Εφημερίς* 151 (2012) 114. Those from Spata and Corinth: Papanikola-Bakirtze, *Καθημερινή Ζωή* 364–365. Those from Thebes: Vaxevanis' records and EEA.

sovereigns both East and West.⁷⁹ This reasoning would lead us to conclude that the two-bar vertical loom may also have been used to weave high-end silk textiles. This consistency between the weaving practices of different textile materials appears to agree with what Theodoret implies about the early Byzantine period. The only detectable particularity for weaving delicate textiles seems to have been the use of weaving combs with unique designs.

To conclude on the archaeological evidence, the finds of typical loom pits, so far identified only in Upper Egypt and mainly in a monastic context, and of weaving combs add to a coherent picture comprising textual, pictorial, and ethnographic evidence, suggesting that the two-bar vertical loom was the most common Byzantine weaving apparatus. These finds are far more compelling evidence about Byzantine weaving than loom weights. On the other hand, the analysis of the copper toothed bars from Thebes seems to confirm that even the high-end silk textiles could have been produced on the two-bar vertical loom.

5. Conclusion

Our synthesis of the limited textual, pictorial, ethnographic, and archaeological evidence allows us to propose the following tentative reconstruction: at least in the eleventh to thirteenth centuries, Byzantines wove primarily on two-bar vertical looms in a practice resembling Berber and Turkish weaving. In comparison with pin beaters, weaving combs seem to have played a much more prominent role. Such simple-structure looms could accommodate textiles of different materials, sizes, and qualities. To meet different weaving needs, minor modifications can also

⁷⁹ This can be concluded from Niketas Choniates' reports on the Norman raid of Thebes ca. 1147 and the emir of Ankara's request from Alexios III in 1195: I.-A. van Dieten, *Nicetae Choniatae Historia* (Berlin 1975) 74, 461, 475; transl. H. Magoulias, *O City of Byzantium, Annals of Niketas Choniates* (Detroit 1984) 44, 253, 261.

be detected in the designs of horizontal beams (movable or immovable), fixtures (pedestals, adjustments to fix one or both ends of the vertical beams), substructures (with or without loom pits), weaving combs (with toothed bars of various gauges), and other accessories (with or without pin beaters, heddle and shed sticks). We should also expect that the Byzantine weavers who used such looms underwent arduous training focused on motif creation, and worked in group settings. Beyond this general picture, although sometimes we do have evidence attributed to more specified contexts, information about context remains too fragmentary to establish clear differences in domestic, professional, and monastic settings or between Constantinople and provinces. To reach tenable conclusions on this aspect, more informative testimonies will be needed.⁸⁰

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Figure 1



Figure 4



Figure 5



Figure 8



Figure 2



Figure 3



Figure 6



Figure 7

Figures 1–8: Miniatures of weaving scenes

Figure 1: https://digi.vatlib.it/view/MSS_Pal.gr.230: fol. 218r

Figure 2: https://digi.vatlib.it/view/MSS_Vat.gr.1231: fol. 410r

Figure 3: https://digi.vatlib.it/view/MSS_Vat.gr.751: fol. 146r

Figure 4: <https://commons.wikimedia.org/wiki/>

File:/%D0%96%D0%B5%D0%BD%D1%89%D0%B8%D0%BD%

D1%8B_%D0%BA%D0%BE%D1%82%D0%BE%D1%80%D1%8B%D0%B5_%D0%BF%D1%80%D1%8F%D0%B4%D1%83%D1%82_%D0%B8_%D1%82%D0%BA%D1%83%D1%82.jpg

Figure 5: <https://digital.bodleian.ox.ac.uk/objects/89eed297-6c50-4f88-99e8-a0ec9e071c3b/surfaces/ccec4292-de2e-4fc0-9a25-fd803a3548e7> (fol. 220^v).

Figure 6: Papadaki-Oekland, *Byzantine Illuminated Manuscripts* 253, fig. 297

Figure 7: A. Walker, “Meaningful Mingling: Classicizing Imagery and Islamicizing Script in a Byzantine Bowl,” *The Art Bulletin* 90 (2008) 45, fig. 23

Figure 8: S. Pelekanidis et al., *The Treasures of Mount Athos: Illuminated Manuscripts II The Monasteries of Iveron, St. Panteleimon, Esphigmenou, and Chilandari* (Athens 1975) 233, fig. 370