THE BRITISH MUSEUM

Technical Research Bulletin

VOLUME 2 2008

Wooden Egyptian archery bows in the collections of the British Museum

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Summary The woods of 15 Egyptian wooden archery bows from the collections of the British Museum, ranging in date from the Neolithic period to the New Kingdom have been scientifically identified. The objects studied included bows from Asyut and from the tomb of Mentuhotep II at Deir el-Bahri. Microscopical examination of millimetre-sized samples revealed that all the bows were made from indigenous Egyptian woods. Acacia (*Acacia* sp.) and sidder (*Ziziphus spina-christi*) woods were preferentially selected, with seven bows of acacia and six of sidder. These woods have a high proportion of the properties needed for optimum functioning as archery bows, i.e. resilience, flexibility, elasticity and strength. Tamarisk wood (*Tamarix* sp.), a less suitable choice of timber for bows, was used for the remaining two artefacts.

Across Europe, the Mediterranean region and the Middle East, three main forms of bow have been recognized. The earliest form, the self bow, was made from a single piece of wood, often a long stave to allow additional draw length. The use of a single piece of wood reduced the risk of mechanical weakness or fracturing. The other two forms of bow were backed bows (made from two layers of wood glued together) and composite bows, the most sophisticated form, in which the wood was bonded to other materials such as antler, horn and sinew. With the exception of one, whose attribution as a bow is uncertain, the artefacts in this study are self bows.

INTRODUCTION

In Europe, evidence from the Late Upper Palaeolithic has shown that wooden bows and arrows were used extensively for hunting. By the third millennium BC, their use had extended to warfare, for which they made effective weapons [1]. Three main forms of bow have been recognized. The earliest form, the self bow, was made from a single piece of wood, often in the form of a long stave, to allow for added draw length. Maximizing the axial alignment of the wood grain reduced the risk of mechanical weakness or fracturing [2]. The other two forms were backed bows, which were made from two layers of wood glued together, and composite bows, the most sophisticated, which consisted of wood and other materials such as antler, horn and sinew bonded together.

Taking the European framework of archery practices as a model, there have been some technological studies of both self bows and composite bows (and their arrows) from Egyptian tombs such as that of Tutankhamun [3, 4]. The number of surviving Egyptian archery bows is relatively small and there is still a great deal of information to emerge from scientific identification of the wood selected for the manufacture of these artefacts. In addition, more research is needed into the technology of forming the wood to shape through an assessment of the types of sharp cutting tools used and the tool marks observed on the artefacts. The present contribution presents the results of a wood anatomical study of the majority of the Egyptian wooden self bows in the collections of the British Museum (BM). It represents a significant addition to the relatively small number of archery bow woods identified so far by scientific methods.

MATERIALS

Of the 15 bows studied, 14 have a recorded provenance: one is from the Faiyum, one from Beni Hasan, five from Asyut, and seven from Thebes. Of the Theban examples five have a more precise find spot, having been discovered at the temple-tomb of King Mentuhotep II at Deir el-Bahri. Only one specimen (EA 5429) is without a recorded provenance. Most of the bows are known to have been discovered in tombs, and some of the others come from a cemetery context (EA 47352 and 47548, from Hogarth's excavations at Asyut,

which focused on the clearance of tombs). This is entirely in accordance with the ancient Egyptian practice of providing weapons for the use of the dead, which was particularly prevalent from the First Intermediate Period to the Eighteenth Dynasty. Only the item from the Faiyum was found in a clearly domestic context – outside a grain silo – and, significantly, its identification as a bow is somewhat doubtful. The following chronological periods have been specified for the bows: Neolithic, Sixth Dynasty(?), Eleventh Dynasty, Twelfth Dynasty, Eighteenth Dynasty, Late Old Kingdom to Middle Kingdom, and New Kingdom. Two bows (EA 47352 and 47548) from Asyut had no recorded date, but probably belong to the years between the Sixth and Twelfth Dynasties, since most of the finds from D.G. Hogarth's excavations at the site fell within that time range.

The bows examined were:

- EA 58699 (1927,0312.13): part of a wooden bow or threshing-stick in fair condition; length: 37.8 cm (incomplete); Neolithic period; excavated 1924–1926 at a settlement site on the north eastern edge of the Faiyum (K site, silo 14). Donated by G. Caton-Thompson for the British School of Archaeology in Egypt [5].
- EA 47352 (1907,0511.644): wooden bow in poor condition (both ends damaged); length: 112.2 cm; excavated by D.G. Hogarth at Asyut, but precise find spot not recorded. No date recorded, but probably Late Old Kingdom to Middle Kingdom.
- EA 47548 (1907,0511.643): wooden bow in incomplete condition (one end missing); length: 142.5 cm; excavated by D.G. Hogarth at Asyut, but precise find spot not recorded. No date recorded, but probably Late Old Kingdom to Middle Kingdom.
- EA 47569 (1907,0511.469): wooden bow in fair condition; length: 161.5 cm; perhaps Sixth Dynasty; excavated by D.G. Hogarth at Asyut in tomb 19 (coffin no. 2). The bow was found together with seven arrows (also EA 47569).
- EA 47570 (1907,0511.477): wooden bow in good condition; length: 169.1 cm; Twelfth Dynasty; excavated by D.G. Hogarth at Asyut in tomb 9. The bow, together with 13 arrows (also EA 47570; Figure 1), was found on the lid of the coffin of a man named Ankhef, whose tomb was discovered undisturbed. The style of the coffin (EA 46631: 1907,0511.542) indicates that the burial dates to the early Twelfth Dynasty, about 1950 BC [6].
- EA 47572 (1907,0511.492): tip of wooden bow with gut string wound round; also five fragments of gut bowstring, fair condition (incomplete); length: 21.0 cm (maximum); perhaps Sixth Dynasty; excavated by D.G. Hogarth at Asyut.
- EA 47629 (1907,1015.4): shaft of a wooden bow tapering to a point at one end bearing impressions of string; fair condition (two repaired fragments); length: 47.7 cm (incomplete); Eleventh Dynasty; excavated by the Egypt Exploration Fund in 1907 at Deir el-Bahri, from the burial chamber of the temple-tomb of King Mentuhotep II [7].
- EA 47630 (1907,1015.5): shaft of a wooden bow tapering to a point at one end with impressions of string; fair condition; length: 31 cm (incomplete); Eleventh Dynasty; excavated by the Egypt Exploration Fund in 1907 at Deir el-Bahri, from the burial chamber of the temple-tomb of King Mentuhotep II [7].
- EA 49462 (1910,1210.35): wooden bow fragment in fair condition; length: 48 cm (incomplete); Eleventh Dynasty; excavated by the Egypt Exploration Fund at Deir el-Bahri, from the burial chamber of the temple-tomb of King Mentuhotep II.
- EA 49463 (1910,1210.36): wooden bow fragments in

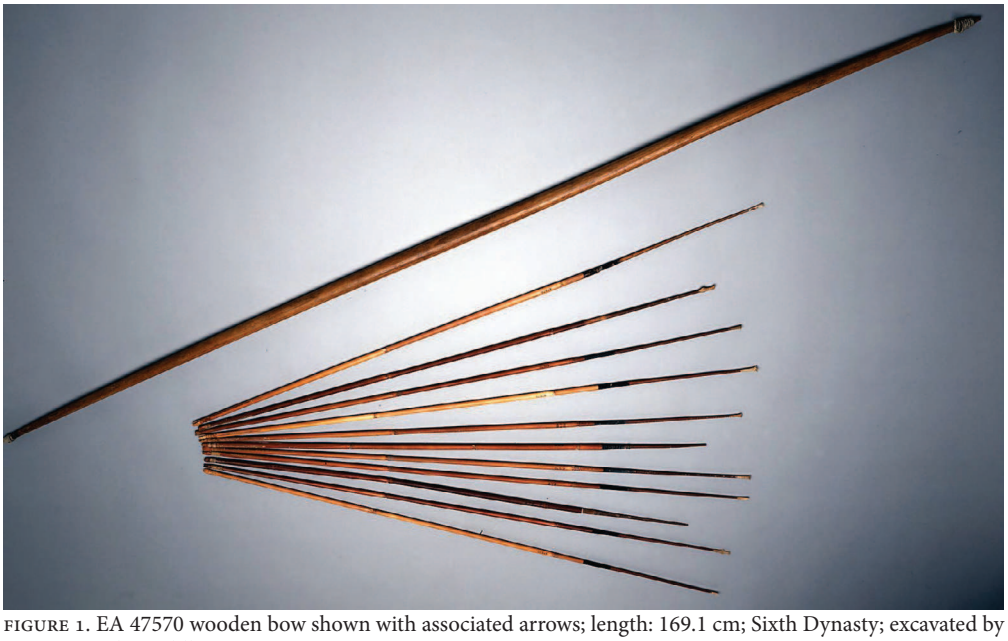

FIGURE 1. EA 47570 wooden bow shown with associated arrows; length: 169.1 cm; Sixth Dynasty; excavated by D.G. Hogarth, Middle Egypt, Asyut

fair condition; length: 55.5 cm (incomplete); Eleventh Dynasty; excavated by the Egypt Exploration Fund at Deir el-Bahri, from the burial chamber of the temple-tomb of King Mentuhotep II.

- EA 49465 (1910,1210.38): wooden bow fragment in fair condition; length: 33.6 cm (incomplete); Eleventh Dynasty; excavated by the Egypt Exploration Fund at Deir el-Bahri, from the burial chamber of the temple-tomb of King Mentuhotep II [7].
- EA 5429 (1839,0921.883): wooden bow in fair condition; length: 172.5 cm; inscribed in ink: 'The Troop commander …'; probably Eighteenth Dynasty; find spot unrecorded. Purchased as part of the Anastasi collection 1839 [8, 9].
- EA 41583 (1905,0516.14): wooden bow in good condition; length: 174.3 cm; Middle Kingdom; excavated by John Garstang at Beni Hasan, but exact find spot not recorded; date not recorded, but probably Middle Kingdom.
- EA 5431: wooden bow in good condition; length: 149.3 cm; probably New Kingdom; from Thebes. Purchased at the sale of the Henry Salt collection, Sotheby's, 1835 (lot 412).
- EA 5430: wooden bow in good condition; length: 108.8 cm; probably New Kingdom; from Thebes. Purchased at the sale of the Henry Salt collection, Sotheby's, 1835 (lot 1063) [8].

METHODS

Small samples, 2 × 2 × 2 mm, were removed from the bows. Standard procedures were followed for the optical microscopical examination and identification of these wood samples [10]. Comparisons were made with thin sections of wood in the scientific reference collections at the BM. Characteristic features of cell anatomy revealed in transverse, radial longitudinal and tangential longitudinal sections were described according to the standards of the International Association of Wood Anatomists (IAWA) [11]. The full details of these identifications to taxon can be found in the appendix.

DISCUSSION

Table 1 shows the results of the wood identifications. Of the 15 bows examined, seven were made of *Acacia* sp. (acacia) wood; six were made from *Ziziphus spina-christi* (sidder/Christ's thorn) and two from *Tamarix* sp. (tamarisk).

The earliest example of what may be part of a wooden bow (EA 58699) is Neolithic in date. Excavated from silo 14 of a granary at K site in the Faiyum (Middle Egypt), its context lends some support to the alternative theory that this may be a threshing-stick. Unfortunately, its incomplete condition creates difficulties in differentiating a bow form from a threshing-stick form. The wood used was *Tamarix* sp., Figure 2. The species of *Tamarix* present in Egypt, the Sahara and adjacent regions are virtually impossible to separate reliably on the basis of their wood anatomy. Neumann *et al*. have suggested a separation into a *T. aphylla* type (including *T. aphylla* and *T. passerinoides*), which shows very broad rays, sometimes exceeding 20 cells, and a second *Tamarix* type that includes several species with narrower rays [12]. In this study, *Tamarix* has been identified to genus level only, as species-level identification is largely irrelevant in terms of the wood's suitability (or otherwise) for bow making; for other studies the separation might be more useful.

Tamarisk is unlikely to have been the first choice of timber for a bow. It does not have the main properties needed in woods used for bows, which are density, flexibility, elasticity

TABLE 1. Wood identifications from 15 Egyptian self bows

Accession number, period and find spot (where known)	*Acacia* sp. (acacia)	*Tamarix* sp. (tamarisk)	*Ziziphus spina-christi* (sidder/Christ's thorn)
58699 Neolithic; Faiyum		×	
47352 Late Old–Middle Kingdom; Asyut		×	
47548 Late Old–Middle Kingdom; Asyut	×		
47569 Sixth Dynasty(?); Asyut	×		
47570 Twelfth Dynasty; Asyut	×		
47572 Sixth Dynasty(?); Asyut	×		
47629 Eleventh Dynasty; Deir el-Bahri			×
47630 Eleventh Dynasty; Deir el-Bahri			×
49462 Eleventh Dynasty; Deir el-Bahri	×?		
49463 Eleventh Dynasty; Deir el-Bahri			×
49465 Eleventh Dynasty; Deir el-Bahri			×
5429 Eighteenth Dynasty			×
41583 Middle Kingdom; Beni Hasan	×		
5431 Probably New Kingdom; Thebes	×		
5430 Probably New Kingdom; Thebes			×

FIGURE 2. Transverse thin section of *Tamarix aphylla* (tamarisk) wood

and durability after seasoning [2]. It also shows little resistance to attack by fungi and insects. With appropriate tools to hand, tamarisk timber would, however, have been easy to work and would have been readily obtainable from the vegetation of the Nile bank. Its properties include medium bending and compression strength, moderate hardness and a coarse and fibrous texture, properties that make tamarisk a more suitable wood for a threshing-stick than a bow, suggesting that this object is more likely to have been a threshing-stick.

Four of the five bows from Asyut were made of *Acacia* sp. wood, Figure 3. Although there are regional geographical distributions among acacias, microscopical separation of the different species of *Acacia* is extremely difficult on account of their anatomical similarities. Some are large trees and are characteristic of the Nile banks, such as *Acacia nilotica*. Others are small trees or shrubs and are characteristic of savanna, semi-desert or desert vegetation, such as *A. tortilis* subsp. *raddiana, A. tortilis*, and further south, *A. seyal* and *A. senegal*. These differences in tree size and shape have an impact on the wood available for the bowyer. The wood from shrubby acacia species is seldom straight-growing, of great length or girth, although it may be very hard, heavy and durable. This kind of acacia timber would have been most suitable for use as dowels or pegs in connective carpentry. Acacia species which yielded longer lengths of flexible but sufficiently dense wood were more likely to have been used to make these ancient Egyptian self bows. Such properties would have made acacia a favoured choice for Egyptian self bows over a wide chronological time span as we see from these further examples: EA 49462 of the Eleventh Dynasty from Deir el-Bahri, EA 41583 of Middle Kingdom period from Beni Hasan and EA 5431, which is New Kingdom in date. Meiggs [13], McLeod [4], Western and McLeod [14], and Gale *et al.* [15] all record the use of *Acacia* for several First Intermediate Period (or Sixth Dynasty) and Ninth or Tenth Dynasty self bows (or bow fragments). The fifth wooden bow from Asyut, EA 47352, has a length of 112.2 cm, but both ends have been damaged so there is some uncertainty as to whether this is actually a bow. Although this bow was made of *Tamarix* sp., and it has been noted above that tamarisk is not a prime bow wood, Western and McLeod have recorded its use for a self bow from the First Intermediate Period [14].

The site of Beni Hasan has not only yielded a Middle Kingdom wooden self bow in good condition (EA 41583), but has also provided depictions of bow manufacture and use. In the tomb of the nomarch Amenehat (BH2) at Beni Hasan, bowyers are engaged in bow making and the stages of manufacture are clearly illustrated [16]. In the tomb of the nomarch Khety (BH17) a desert hunting scene is depicted [17] in which, as Geoffrey Killen observes: the power and effectiveness of a typical self bow are ruthlessly displayed [18].

The five self bows of the Eleventh Dynasty found at Deir el-Bahri, Upper Egypt (EA 47629, 47630, 49462, 49463, 49465) were excavated from the burial chamber of the tomb of King Mentuhotep II. With the exception of EA 49462, which has a tentative identification of acacia, all were manufactured from *Ziziphus spina-christi* (sidder) wood, Figure 4. At first glance, it is tempting to infer from this result some form of regional specialization or workshop preference. Looking more closely, however, it can be seen that there may be other reasons for the preferential selection of sidder wood that transcend time periods or individual bowyer's preferences. These reasons relate to the wood properties of

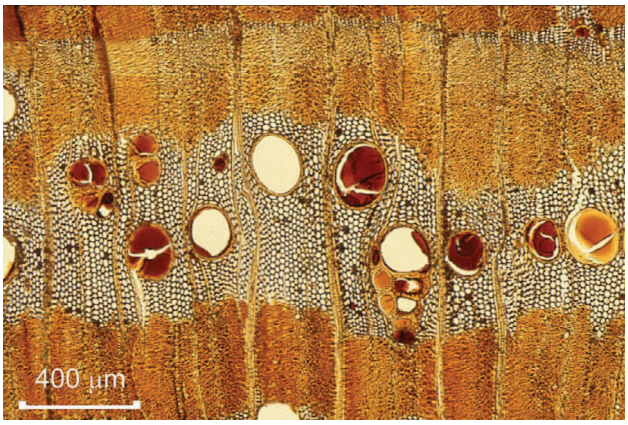

FIGURE 3. Transverse thin section of *Acacia tortilis* subsp. *raddiana* (acacia) wood

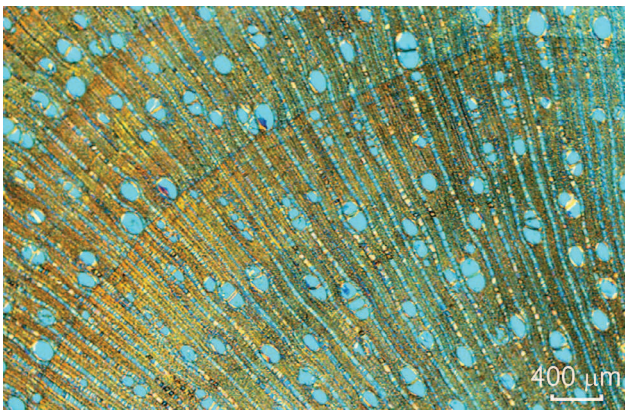

FIGURE 4. Transverse thin section of *Ziziphus spina-christi* (sidder, Christ's thorn) wood

sidder. The wood is hard, dense and durable and is highly suitable for tool handles, furniture components, dowels and pegs. Being slightly less flexible than acacia, it would have taken second place to acacia as a raw material for bows. Nevertheless, it was a valued timber not just for bows but, in many periods, for high-quality Egyptian woodworking. Sidder is similar to acacia in that it can occur as large trees, such as *Z. spina-christi*, but also as smaller trees or bushes, offering short lengths of timber. *Ziziphus* wood was readily available from Nile terrace vegetation, on wadi slopes, in oases and adjacent to arable or fallow land. Western and McLeod record the use of sidder for a self bow (fragment) from the First Intermediate Period [14], while Gale *et al.* list an Eighteenth Dynasty bow also made from *Ziziphus* wood [15]. It has already been noted that the Eighteenth Dynasty self bow EA 5429 is made from sidder wood, as is EA 5430, which has no provenance or date.

McLeod has drawn attention to the possible difficulties that arise from archaeologists' attributions of particular types of wood to such artefacts, rather than scientific anatomical identifications of the wood [4]. This is particularly relevant in the publication of four self bows from the British Museum collections which he cites: i.e. EA 47569 and 47570 from Sixth Dynasty Asyut, EA 5429 from the Eighteenth Dynasty and EA 41583 from Middle Kingdom Beni Hasan. McLeod suggests the identification of acacia for these self bows "may be archaeologists' identification rather than botanical certifications" [4; p. 52]. The results of the scientific identification of these self bows in Table 1 confirm that, with the exception of EA 5429, which is made of *Ziziphus*, three are indeed acacia (EA 47569, 47570 and 41583).

In Europe there were many woods traditionally used for bows, including yew (*Taxus baccata*), cornel (*Cornus mascula*), laburnum (*Laburnum anagyroides*), elder (*Sambucus nigra*), hazel (*Corylus avellana*), ash (*Fraxinus excelsior* and *F. ornus*), elm (*Ulmus campestris*) and juniper (*Juniperus communis* and *J. oxycedrus*). The softwood yew was considered to provide the best bow wood [19, 20]. Although Gale *et al.* have listed bows among the range of uses to which yew wood was usually put in Egypt [15], and have recorded that yew wood may have been imported there during the Sixth to Twelfth Dynasties for coffin components and in the Eighteenth Dynasty for a statuette head, there appear to be no published records as yet for the use of yew wood for Egyptian self bows. None of the species listed above which were in common use by European bowyers have yet been identified from ancient Egyptian self bows. The present study has highlighted the use of the indigenous Egyptian timbers acacia, sidder and tamarisk for bow making. The only non-indigenous taxon used for Egyptian bows that has been published so far is *Ceratonia siliqua* (carob), identified by Royal Botanic Gardens, Kew for a Middle Kingdom bow [15]. Although there is still some debate on the subject, carob trees are generally regarded as native to the maquis woodland of the Mediterranean region (including the Levant) [21]. They were not indigenous to Egypt, but may have been planted there in gardens or occurred spontaneously in the form of feral derivatives of the fruit crop that evolved and spread around the western Mediterranean under domestication [22]. At present, carob trees are found in the Mediterranean region of northern Egypt and in Sinai [23]. The choice to exploit carob timber for bows and other artefacts would have been a sound one; it is strong, hard and of good quality.

There has been much discussion and speculation in the literature on ancient Egypt (e.g. Gale *et al.* [15]) about the different roles played by indigenous and imported timbers for many different types of artefacts and structures. In every period, and for a variety of complex reasons, such a selection of woods has been made. Selection not only maximized the use of the properties of the woods themselves (which were well understood by the Egyptian craftsman), but also reflected cultural preferences over time. Selection was, therefore, not merely functional, but aesthetic and economic. Archery bows, although primarily utilitarian items, were not just used for hunting or warfare but also in ceremonial events and were placed as funerary offerings in tombs to serve the individual in the afterlife. This may have had significant bearing on the choice of woods for the bows, depending on whether they were intended for active use or symbolic representation. These results suggest that most of the bows could, however, have been used (i.e. those made of acacia and sidder); the tamarisk examples could fall into the non-utilitarian category.

CONCLUSIONS

This study has added a significant number of wood identifications to the current state of published knowledge on the subject. Furthermore, it has underlined the need to pursue the scientific identification of ancient Egyptian archery bow woods, not just for self bows, but for composite bows as well, in order to understand a number of key technological issues. Not until now have we been in a position to confirm the observations of Western and McLeod [14], i.e. that

acacia and sidder woods seem to have been preferentially selected. These woods showed a satisfactory number of the required properties for manufacturing bows, including resilience, flexibility, elasticity and strength. Tamarisk wood appears to have been used less frequently. As Geoffrey Killen observes: an understanding of the physical properties needed to satisfy the design specification of any product made from a resistant type material is essential [18]. Egyptian carpenters and bowyers understood the complex properties of the woods they worked. It is understandable, then, that tamarisk was rarely used in self bow manufacture, while the acacia and sidder were recognized as superior timbers that could be worked into effective self bows.

APPENDIX: DIAGNOSTIC ANATOMICAL CHARACTERISTICS OF THE THREE TAXA IDENTIFIED IN THIS STUDY

Acacia *sp. (acacia) including* A. mellifera *(shrub or tree),* A. laeta *(shrub or tree),* A. asak *(shrub or tree),* A. tortilis *(tree),* A. tortilis *subsp.* tortilis *(tree),* A. tortilis *subsp.* raddiana *(tree),* A. nilotica *(tree),* A. nilotica *subsp.* nilotica *(tree),* A. nilotica *subsp.* tomentosa *(tree),* A. pachyceras *var.* najdensis *(tree),* A. oerfota *var.* oerfota *(shrub),* A. seyal *(tree),* A. ehrenbergiana *(shrub),* A. etbaica *(shrub or small tree) [23], family Fabaceae, subfamily Mimosoideae*

Growth ring boundaries sometimes distinct; wood diffuse-porous; vessels in multiples; vessels mostly in short (2–3 vessels) radial rows; vessel outline rounded; simple perforation plates; vestured intervessel pits with oval to slit-like, often coalescent apertures; vessel-ray pits with distinct borders; fibres non-septate; fibres of medium wall thickness or very thick-walled; fibre pits simple to minutely bordered; axial parenchyma present in bands much wider than rays; axial parenchyma bands marginal (or seemingly marginal); diffuse apotracheal parenchyma present; diffuse; paratracheal axial parenchyma vasicentric, aliform, confluent or unilateral; multiseriate rays 3–5 seriate and 5–10 seriate; homocellular rays with procumbent cells; sheath cells present; some prismatic crystals present in chambered axial parenchyma cells.

Tamarix *sp. (tamarisk), including* T. aphylla *(tree or large shrub),* T. tetragyna *(shrub),* T. nilotica *(shrub or tree),* T. amplexicaulis *(shrub),* T. passerinoides *(shrub),* T. macrocarpa *(shrub) [24], family Tamaricaceae*

Growth ring boundaries indistinct; wood diffuse-porous; vessel clusters common; vessel outline rounded; simple perforation plates; alternate intervessel pits; minute intervessel pits; vessel-ray pits with distinct borders; scanty deposits present in heartwood vessels; a few vascular or vasicentric tracheids present; fibres of medium wall thickness; simple to minutely bordered fibre pits mainly restricted to radial walls; fibres non-septate; paratracheal axial parenchyma present in vasicentric or confluent distribution; fusiform axial parenchyma; multiseriate rays 5–20 cells in width; heterocellular rays with procumbent, square and upright cells mixed throughout the ray; storied structure present (vessels and axial parenchyma); occasional prismatic crystals in non-chambered cells in rays.

Ziziphus spina-christi *(Christ's thorn or sidder) [24], family Rhamnaceae*

Distinct growth ring boundaries; wood diffuse-porous; vessels mostly in short (2–3 vessels) radial rows; vessel outline rounded; simple perforation plates; alternate intervessel pits; vessel-ray pits with distinct borders; vessel-ray pits similar to intervessel pits; deposits present in heartwood vessels; fibres of medium wall thickness or very thick-walled; simple to minutely bordered fibre pits mainly restricted to radial walls; non-septate fibres; fibres arranged in regular radial rows; banded axial parenchyma; axial parenchyma bands marginal (or seemingly marginal); diffuse apotracheal axial parenchyma present; paratracheal axial parenchyma scanty or vasicentric; axial parenchyma as strands; rays exclusively uniseriate or multiseriate (1–3 cells wide); heterocellular rays with procumbent, square and upright cells mixed throughout the ray; occasional prismatic crystals in ray cells.

ACKNOWLEDGEMENTS

The authors are grateful to Geoffrey Killen for his valuable comments and suggestions.

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