



Igbo-Ukwu Textiles: AMS Dating and Fiber Analysis

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Abstract Thurstan Shaw’s excavations at Igbo-Ukwu revealed many artifacts and technologies that remain astonishing, unique, and incompletely understood, both within Africa and more broadly, even after 50 years. Among these are the textiles recovered primarily from Igbo Isaiah, where fragments were preserved by contact with the bronze artifacts gathered in what has been interpreted as a shrine. In the 1960s, an analysis of 20 textile samples was unable to identify the plant fibers used to weave the fabric. In this article, we report the results of new fiber identifications based on the SEM study of two Igbo-Ukwu fabric samples curated by the British Museum. The combination of bast fibers from one or more species of the fig tree (*Ficus* genus) and leaf fibers from *Raphia* sp. provides evidence of a complex indigenous weaving technology that has largely disappeared from Africa. An AMS date on one of the samples provides an important new element to our understanding of the culture and chronology of Igbo-Ukwu. A final section positions the Igbo-Ukwu cloth within the known history of textiles in Africa, emphasizing sub-Saharan West Africa over the past two millennia.

Résumé Les fouilles de Thurstan Shaw à Igbo-Ukwu ont révélé de nombreux artefacts et technologies qui restent étonnants, uniques et incomplètement compris, à la fois en Afrique et plus largement, même après 50 ans. Parmi ceux-ci figurent les textiles récupérés principalement d’Igbo Isaiah, où des fragments ont été préservés par contact avec les artefacts en bronze déposés dans ce qui a été interprété comme un sanctuaire. L’analyse dans les années 1960 de 20 échantillons de textiles n’a pas permis d’identifier la source des fibres végétales utilisés. Dans cet article, nous rapportons les résultats de nouvelles identifications de fibres basées sur l’étude SEM de deux échantillons de tissu dans les collections du British Museum. La combinaison de fibres libériennes d’une ou plusieurs espèces de figuier (genre *Ficus*) et de fibres de feuilles de *Raphia* sp. témoigne d’une technologie de tissage indigène complexe qui a largement disparu d’Afrique. Une date AMS sur l’un des échantillons fournit un nouvel élément important pour notre compréhension de la culture et de la chronologie d’Igbo-Ukwu. Une dernière section positionne le tissu Igbo Ukwu dans l’histoire connue du textile en Afrique, en mettant l’accent sur l’Afrique de l’Ouest subsaharienne au cours des deux derniers millénaires.

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Introduction: The Textile Fragments Excavated by Thurstan Shaw and Early Analysis by the Shirley Institute

Most of the excavated textile fragments published in *Igbo Ukwu* (Shaw, 1970) originated in Igbo Isaiah, with a handful from Igbo Richard (Table 1; see McIntosh, this issue, for plans and an overview of the Igbo-Ukwu site). Shaw's 1960 excavations at Igbo Isaiah, which were prompted by earlier finds of numerous bronze objects during the digging of a water cistern in 1938, revealed a mass of bronze, copper, ceramic, and glass artifacts resting in situ 40–60 cm below the surface. These had been protected from disturbance by an overlying compound wall that was removed just before excavation began (Fig. 1). The 1938 finds are presumed to have come from cistern digging and disturbance to the east of the protective wall. The similarity of the 1938 and 1960 finds led to the conclusion that all these objects had originally been gathered together in a single context, which Shaw suggested was a storehouse or shrine for ritual or ceremonial objects and regalia. The recovery of textiles in association with a number of these objects indicates that they were wrapped or otherwise covered by cloth, and that the contact with the bronze objects preserved the fabric.

Shaw sent twenty-four samples to the Shirley Institute in Manchester for analysis. Of these, twenty-one were samples of woven cloth. Three were yarn or fabric without discernable weaving. Although Shaw (1970, p. 240–243) lists all of these as textiles, Emery

(1966, p. xvi) suggests that the term “textile,” originating from the Latin “*texere*” (to weave), be reserved for woven fabrics. The Shirley Institute identified two main types of fibers: bast and leaf or grass (Shaw, 1970, p. 242). Bast fibers are derived from the inner bark of trees. Some plants, such as flax and hemp, also have bast fibers, which can be extracted from the outermost part of the stem (Emery, 1966, p. 5). The Shirley Institute analysts could not identify the plant species used but suggested that they were likely of African rather than European origin. The bast fiber textiles were all undyed, plain/tabby woven of 2-ply, Z-twist yarns composed of two single S-twist components (Figs. 2–3). The twist is more pronounced in one system (probably the warp, where the twist could be maintained under tension) than the other. Both closely woven and more open, gauzelike weaves were present, but close weaves predominated (Table 1). Coarse and fine weaves were mentioned but not defined for some samples. All the woven leaf/grass fiber textiles identified by the Shirley Institute were also plain weaves but used single, flat strands with no twist (Fig. 4). Closely woven samples predominate again (Table 1). The Shirley Institute descriptions do not address whether some of the woven samples may have been more like mats than cloth (e.g., Shaw, 1970, plates 495, 497, and 499), both of which share a common structure of interlaced warp and weft fibers. The main differentiation between the two is the flexibility or pliability of cloth made possible by the use of fine gauge, pliable fibers, or yarns (Emery, 1966: 208–210).

Table 1 Excavated bast (left) and leaf/grass (right) textile samples analyzed by the Shirley Institute. IS samples were excavated from Igbo Isaiah, IR samples from Igbo Richard

<i>BAST Fiber—2-ply, Z twist yarns composed of 2 S-twist components</i>			<i>LEAF OR GRASS fiber—single flat strand</i>		
Plain/tabby close weave	Analyst comments	Plain open weave	Plain/tabby close weave	Analyst comments	Plain open weave
<i>IS25a</i>	Coarse, fine	<i>IS172a</i>	<i>IS88, 340</i>		<i>IS153</i>
<i>IS118</i>		<i>IS291</i>	<i>IS113</i>	v.coarse	
<i>IS152a</i>	coarse		<i>IS423</i>		
<i>IS280</i>			<i>IS359</i>	Badly decayed	
<i>IS352a</i>					
<i>IS359a</i>			<i>IR339</i>		
<i>IS385a</i>			<i>IR471</i>	Heavy Cu coating	
<i>IS420</i>			<i>IR472</i>	Badly decayed	
<i>IR474</i>			<i>IR475</i>		

Samples in italics were associated with bronze objects. (Data from Shaw, 1970, p. 240–242)

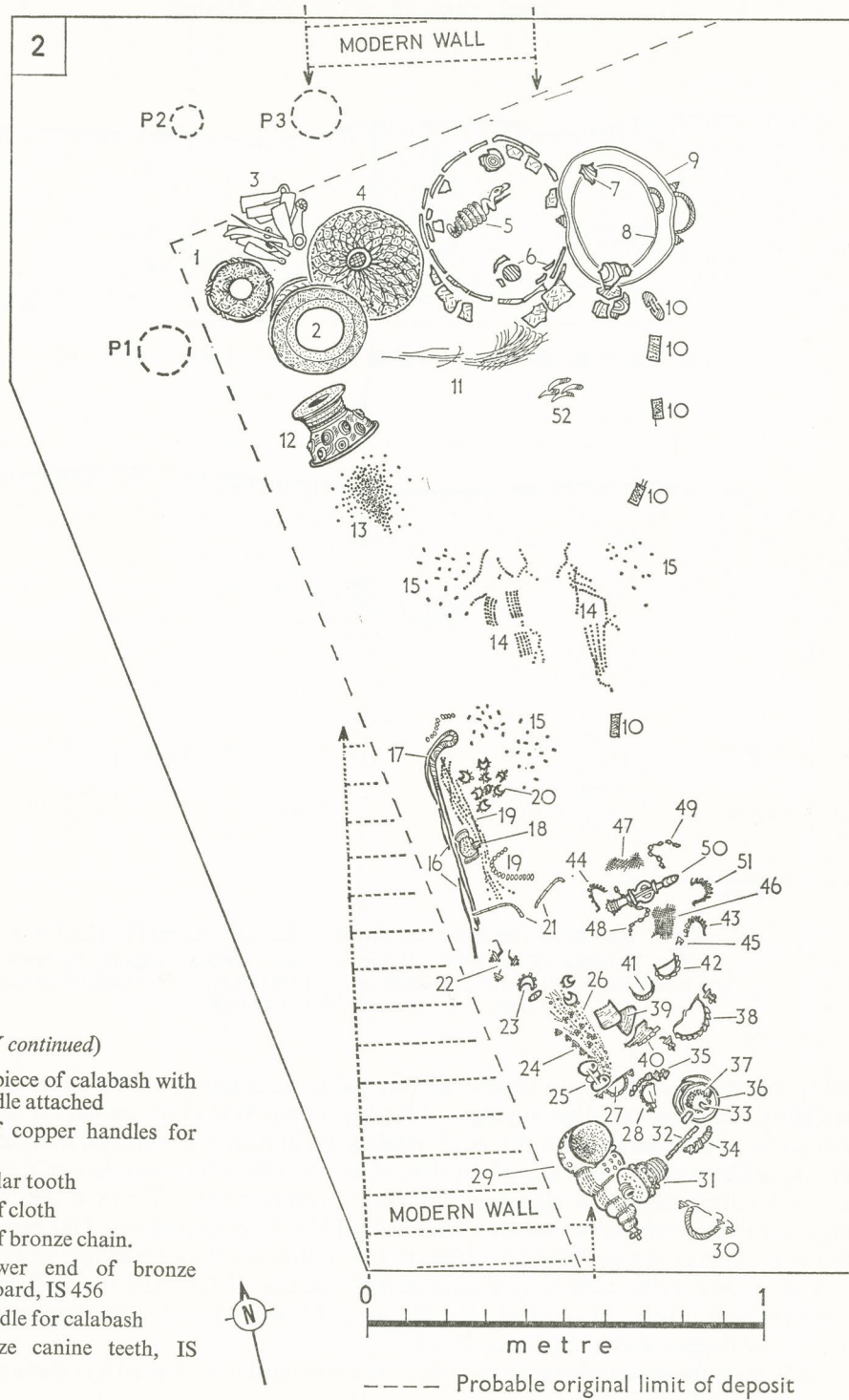


Fig. 1 Plan of excavated objects in the Igbo Isaiah ritual deposit or shrine. The modern wall was removed before excavation. The area to the east was disturbed by digging in 1938

that produced a large number of bronze, glass, and pottery artifacts. Reproduced with permission from Shaw (1970, Fig. 6, p. 55), courtesy of P. J. Smith and the Thurstan Shaw Estate

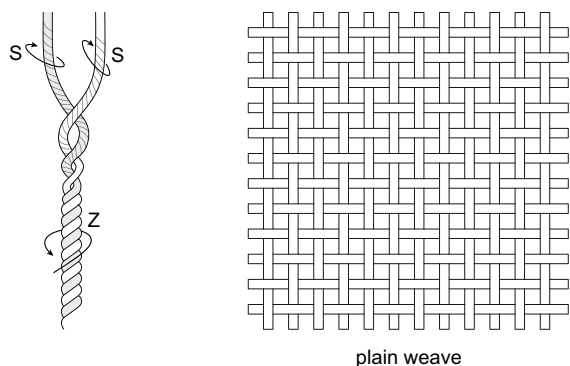


Fig. 2 Schematic showing two S-twist fibers plied together by Z-twist (left) and plain or tabby weave (right)

In the intervening five decades since the publication of *Igbo Ukwu*, a re-study of these textile samples has not been possible because their whereabouts are unknown.

New Analyses: The British Museum Samples

The two Igbo-Ukwu samples analyzed in this paper (AF1979,18.104 and 105) were not recovered by Shaw but were dug up in 1938 by Isaiah Anozie (owner of the Igbo Isaiah compound). They were subsequently acquired by district officer

Frank Carpenter in 1939 and donated to the British Museum (Fig. 5). Shaw (1970, p. 41–42) recounts how numerous bronzes from earlier digging around Igbo Isaiah were recovered by colonial administrators and district personnel, then deposited in the British Museum or Nigerian museums. He gathered information on these and published them as part of the Igbo Isaiah assemblage (Shaw, 1970). The two textile samples in our study were almost certainly directly associated with textiles later excavated from Igbo Isaiah. Shaw encountered pieces of fabric associated with a broken bronze sword scabbard on the edge of the area dug up by Isaiah Anozie 20 years earlier. Anozie had also recovered a broken bronze scabbard, and Shaw (1970, p. 61, plate 355) demonstrated that the two pieces fit together. A textile fragment associated with the copper chain overlying the excavated scabbard half closely matches our 4-cm² sample from AF1979,18.104, including the finished edge (Shaw, 1970, Plates 67, 499, 500; cp. Figure 6). Together, these provide strong evidence that our textiles were originally associated with bronze and copper artifacts from the Igbo Isaiah ritual deposit.

Sample Description and SEM Analysis and Results

Optical microscopy was used to evaluate and describe yarn diameter and thread counts. Our samples are finely

Fig. 3 a Close-weave and b open-weave bast textile fragments from Igbo Isaiah (15×). Reproduced from Shaw (1970, pl. 497 [sample IS 118], pl. 501 [sample IS 172]), courtesy of P. J. Smith and the Thurstan Shaw Estate

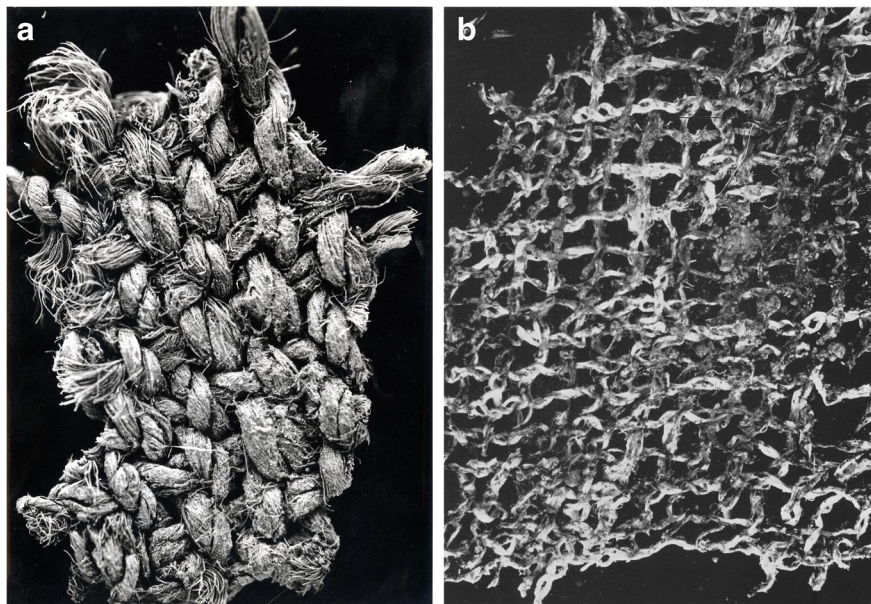




Fig. 4 Close-weave leaf/grass fiber textile fragment from Igbo Isaiah (15 \times). Reproduced with permission from Shaw (1970, pl. 495 [sample IS 88]), courtesy of P. J. Smith and the Thurstan Shaw Estate

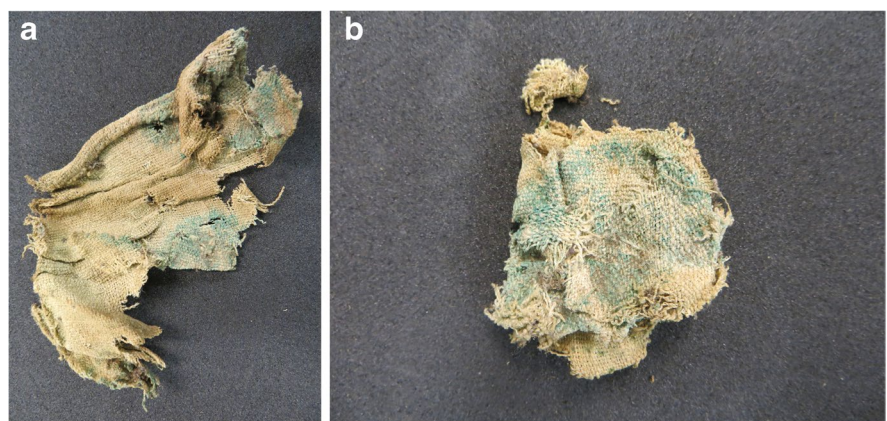
woven plain weave cloth, with yarn diameters between 0.3 mm and 0.4 mm and a thread count with one system averaging 24/cm (presumably the warp, with the twist maintained by tension) and the other system 16/

cm (Fig. 7). The yarns in the latter system have far less twist and generally larger diameters. The finished edge on AF1979,18.104 is exceptionally finely worked.

In addition, variable pressure scanning electron microscopy (VP SEM) was used to examine the textile fragments and identify the source of the fibers used. The model of VP SEM used (Hitachi S-3700 N) has a large chamber, so it was not necessary to sample the textile fragments; the examination was entirely non-invasive and non-destructive. Each textile fragment was placed uncoated and unmodified into the VP SEM chamber and examined at magnifications ranging from $\times 15$ to $\times 705$. The data bars on each SEM image provide further details about the parameters used. Many of the fibers were highly degraded or covered with detrital particles or had been affected by insect burrowing and nesting. Some had become disentangled or had metal corrosion products adhering to them. Despite their condition, sufficient key characteristics could be discerned to enable identification. Different types of fibers could be seen in both fragments. Bundles of bast fibers from the inner bark of fig trees (*Ficus* sp.) were extensively used (Fig. 8), as were fibers from young leaves of raffia palms (*Raphia* sp.; Fig. 9).

Ficus species are particularly abundant in moist tropical forest (van Noort et al., 2007, p. 644). Our samples most closely match reference collection specimens from three of the numerous *Ficus* species found in Nigeria: *F. platyphylla*, *F. thonningii*, and *F. sycamorus*, though *F. sycamorus* is found only in drier savanna habitats (Fern, 2022). Fig tree bast fibers require a complex extractive process, involving the removal of large bark strips from the tree, planing

Fig. 5 **a** British Museum textile 1979,18.104 (scale unknown, but partly unfolded, the fragment measures 72 \times 112 mm); **b** British Museum textile 1979,18.105 (scale unknown, but partly unfolded, the fragment measures 59 \times 75 mm). Both photos: J. Hudson, copyright The Trustees of the British Museum



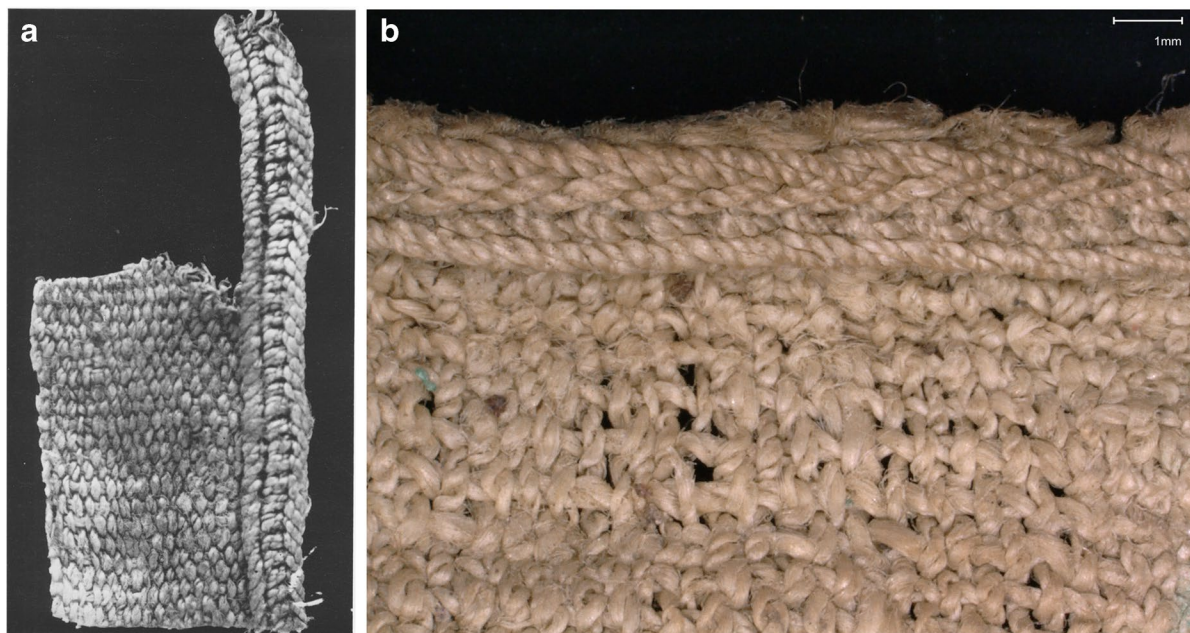


Fig. 6 **a** Textile associated with copper chain overlying the broken sword scabbard in Igbo Isaiah. Reproduced from Shaw (1970, pl. 500 [sample IS 152], courtesy of P. J. Smith and the

Thurstan Shaw Estate; **b** Finished edge of 1979,1.104. magnified. Image by C. R. Cartwright, copyright The Trustees of the British Museum

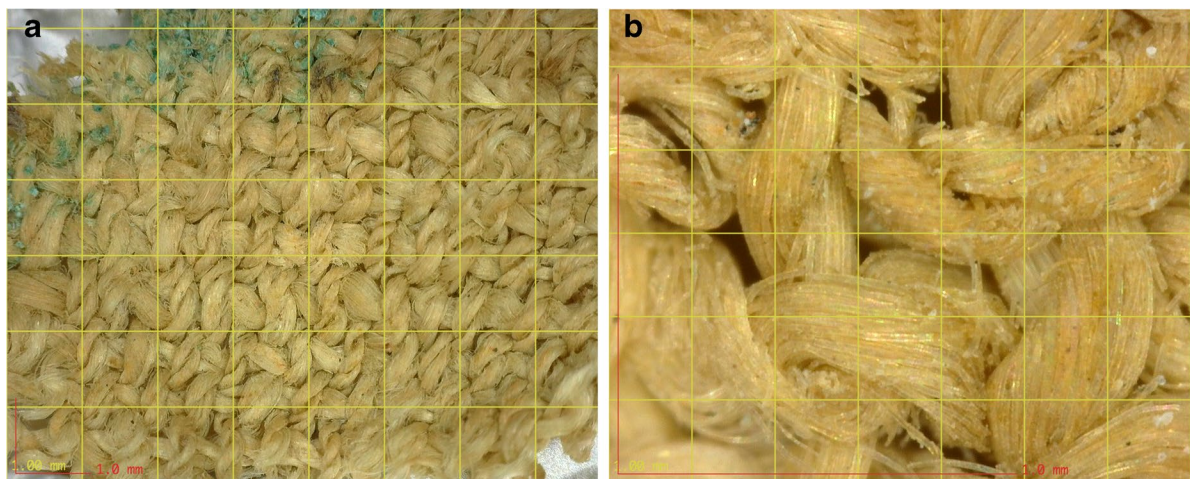


Fig. 7 **a** BM sample AF1979,18.104 showing oxidized copper alloy particles and tighter twist in the vertically oriented strands here with an average of 24 warp \times 16 weft/cm (\times 40)

and yarn diameter of 0.3–0.4 mm; **b** same fabric (250 \times). Images by S. K. McIntosh using a Dino-lite optical microscope

off the outer bark, processing the inner bark in water to soften the fibers, and separating the fibers into strands that may be twisted and/or plied before weaving to create the textile (Picton & Mack, 1979, p. 32).

At least 11 *Raphia* species are present in Nigeria. Comparisons with reference collection specimens revealed close matches of the raffia palm fibers in our textiles with those from *R. longiflora*, *R. sudanica* (synonym

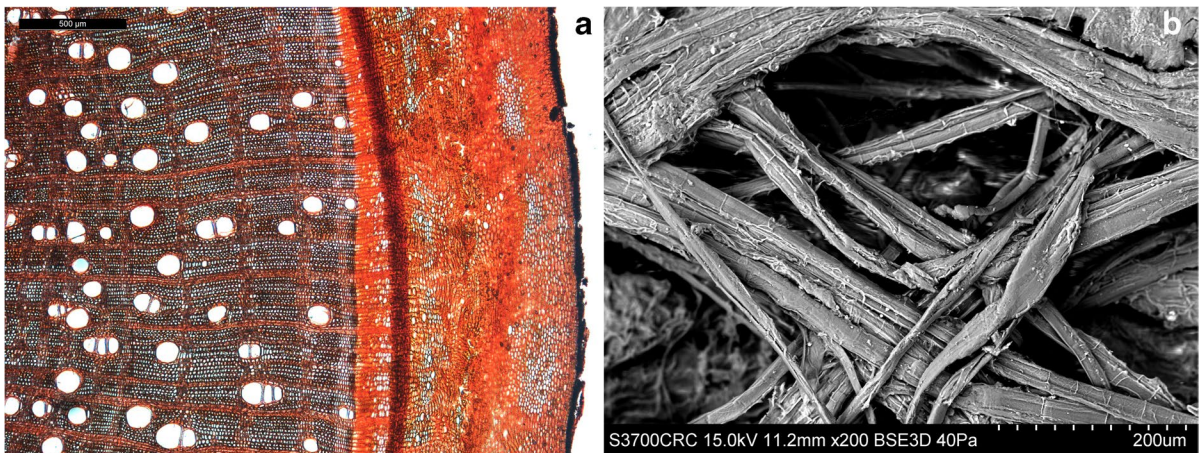


Fig. 8 *Ficus* bast fibers: **a** Transverse section of *Ficus* wood with bright orange stain showing area of bark containing bast fibers; **b** SEM image of *Ficus* bast fibers, showing diagnostic

characteristics. Images by C. R. Cartwright, copyright The Trustees of the British Museum

R. humilis), and *R. hookeri*. *Raphia* fibers are extracted by peeling off the epidermis of a young leaf, drying it, and then separating it into strands using fingers or a comb (Nicklin, 1980; Picton & Mack, 1979, p. 32–33, 37). Both *Ficus* and *Raphia* fibers can be quite long (one or more meters), so draft spinning to combine short fibers into thread, as wool and cotton require, is not necessary (Nicklin, 1980). Strands can be combined by tying, weaving, or splicing—adding individual fiber strips either continuously or end-to-end while plying and twisting them (Gleba & Harris, 2019; Kriger, 2006, p. 24). In the British Museum samples, the *Ficus* fibers were twisted and plied. *Raphia* fibers were woven flat and unplied.

The two main types of fiber identified by the Shirley Institute—bast and leaf or grass fiber—are

given some specificity by the SEM analysis. Our samples did not involve grass fibers, so our discussion focuses on bast and raffia cloth. Without new analyses, we cannot know whether all the bast fibers in Igbo-Ukwu textiles are from *Ficus* trees and all the leaf fibers are from *Raphia*. However, the similarity of multiple samples, noted by the Shirley Institute (Shaw, 1970, p. 240–2), makes this a good possibility. Textiles woven from *Raphia* leaf fibers have a large distribution ethnographically and historically in Nigeria and throughout the forest zone (Nicklin, 1980, p. 134). In the late nineteenth and twentieth centuries, raffia cloth production was important in parts of Nigeria and throughout the Congo basin, where the leaf fibers were woven flat, unspun, without twist (Loir, 1935; Nicklin, 1980; Schaedler, 1987, p. 334–8, 366–395). The Igbo-Ukwu leaf fiber textiles are evidence of the antiquity of this technology.

Textiles woven of twisted and plied bast fibers from trees are, by contrast, relatively rare in ethnographic and historical accounts. Exceptionally, Olfert Dapper reported in the seventeenth century that the bark of some trees was woven into cloth in Madagascar, and he describes the processing of the inner bark to extract the fibers. The quality of the bast textile was so good, according to Dapper, that it could be mistaken for European linen and was much more durable than cotton (Dapper, 1671, cited in Schaedler, 1987, p. 33, 45). The ethnographer Ralph Linton (1933, cited in Picton & Mack, 1979, p. 32) provided additional details on the

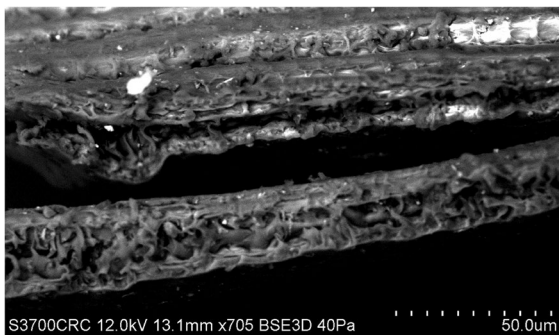


Fig. 9 SEM image of *Raphia* leaf fibers, showing diagnostic characteristics. *Raphia* fibers are visible under the *Ficus* bast fibers in Fig. 8b in the lower left corner. Image by C. R. Cartwright, copyright The Trustees of the British Museum

chaîne opératoire for processing tree bast fibers for both cordage and weaving in Madagascar. Among the 35 species of *Ficus* listed in *Useful Plants of West Tropical Africa* (Dalziel, 1955), only one is specifically identified as a source of fiber for woven cloth in Africa (Table 2). Historically, *Ficus* was far more commonly used across tropical Africa and Madagascar to make felted bark cloth, which is created by wetting and pounding stripped panels of the soft inner bark to consolidate the bast fibers (Burt, 1995; Picton & Mack, 1979, p. 42–46).

Picton and Mack note that bast fibers from a very large number of plant species, particularly of the genus *Hibiscus*, are used in West Africa for netting and cordage, but few plants yield fibers “fine enough to be spun for use in weaving cloth” (1979, p. 31). While raffia and bast fibers are still used to weave some ritual cloth in localities in Nigeria, they have declined in favor of cotton and other imported fibers (Aronson, 1982; Nicklin, 1980, p. 155; Picton & Mack, 1979, p. 32; Schaedler, 1987, p. 35).

Dating the Igbo-Ukwu Textiles

The chronology of the Igbo-Ukwu textiles is of great interest, both for understanding the age of the technology and for dating the use of the Igbo Isaiah shrine or repository. Until now, Igbo Isaiah has been dated on the basis of stylistic similarities to pottery and some of the bronzes from Igbo Richard and Igbo Jonah (Shaw, 1970, p. 258–259). Nevertheless, it is not uncommon to see claims in the literature that Igbo Isaiah and its textiles date to the ninth century CE (Bolland, 1991, p. 48; Kriger, 2006, p. 28; Picton & Mack, 1979, p. 31; Schaedler, 1987, p. 293). The original radiocarbon analysis of samples from Igbo Richard and Igbo Jonah was completed in the 1960s when standard deviations for individual dates often ranged between ± 100 and ± 150 years or more. Claiming precision to a

particular century could hardly be justified, let alone pinpointing a particular calendar year at the center of the standard deviation range (e.g., Hartle, 1980, p. 198). After initially proposing a ninth-century date, Shaw adopted an interpretation of calendar dates in the eighth–eleventh century CE range (1 sigma) for four of the radiocarbon results, consistent with early efforts at dendrochronological calibration and due attention to the standard deviation (Shaw, 1970, p. 260–261; 1975; 1977, p. 90–92). Regardless, the claim for a ninth-century date for Igbo-Ukwu has proven extremely durable in the literature, even as recent calibration curves have expanded the range of possible calendar dates to the seventh–thirteenth century CE (2 sigma) for four of the five original radiocarbon dates for Igbo Richard and Igbo Jonah (Fig. 10). Only one of these was a direct date on an artifact—the wood from the presumed stool from Igbo Richard. Had the stool been fashioned from the heartwood of a long-lived tree, such as *Chlorophora excelsis* (Yoruba: *iroko* [“the wood of kings”]), the date could be centuries older than the burial itself. Shaw (1975, p. 505–506) considered this possibility but noted that the wood sample was from the outside of the stool, so probably not very much older than the burial itself. The dates for Igbo Jonah were on composite samples of charcoal from two pit features (Shaw, 1975, p. 506). Charcoal samples originally submitted from Igbo Isaiah by Shaw were destroyed by defective lab apparatus (Shaw, 1970, p. 260). One can easily appreciate the scientific value of another direct date on an artifact, especially one from Igbo Isaiah.

The BM textile sample Af1979,18.105 was submitted to Beta Analytic for AMS analysis in the expectation that high-precision dating of a short-lived sample would provide important chronological insights. The sample was pretreated with heated acid and alkali to remove any insect or other contamination. The sample produced a date of 940 ± 30 BP (1027–1180 cal

Table 2 *Ficus* species used for cloth in Africa (from Dalziel, 1955, p. 279–283)

Species	Ethnographic uses
<i>F. glumosa</i>	Bark used for cloth—upper Ubangi
<i>F. natalensis</i>	In Uganda, furnishes a very good bark cloth
<i>F. platyphylla</i>	In upper Nile Land (Sudan?), fiber is extracted for cordage or for weaving into fabrics
<i>F. thonningii</i>	Blume. Bast is made into bark cloth, esp. in E.Africa and Togo. Used for cloth in Baoulé and upper Ubangi. (Process described is for felted bark cloth.)
<i>F. vogeliana</i> miq	Used for bark cloth in Cameroon. Var. <i>textilis</i> cultivated in Ivory Coast for bark cloth

CE at 2 sigma) which likely dates the final use of the shrine (Fig. 10). While the new date places the creation of the textile in the eleventh-twelfth century CE, the bronze and other objects in the shrine may have been in use for some time before being wrapped or covered with cloth for the last time.

Igbo-Ukwu in the History of African Textile Technology

The various technologies used in textile production—such as fiber extraction, strand manipulation by twisting and plying, and interweaving two sets of strands at right angles to each other—likely have deep histories in Africa, as elsewhere. Many of the interlacing techniques for basketry and mats are very similar to those for woven cloth; the salient difference is the relative rigidity of basketry and mat fibers (Emery, 1966; Picton & Mack, 1979, p. 17). Miller (2007, p. 69) outlines the shared steps in the *chaîne opératoire* for fibers, basketry, mats, and woven cloth. In Eurasia, fired clay impressions of cordage, woven mats, baskets, and possibly cloth, plus spun and dyed flax fibers, have extended the documented antiquity of these related technologies back to the Upper Paleolithic (Bar-Yosef et al., 2011; Soffer et al., 2000). Between 8300 and 6100 cal BCE,

foraging groups left traces of a variety of baskets, mats, cordage, and rope in the arid Takarkori rockshelter in southwest Libya (di Lernia et al., 2012). The archaeological and historical record for loomed cloth in Africa begins in Pre-Dynastic Egypt, where preserved flax textiles attest to a well-developed weaving technology in bast fibers from plant stems (Vogelsang-Eastwood, 2000). The earliest textile finds from the Levant and Egypt are all woven from bast fibers (Gleba & Harris, 2019), and this now includes oak bast fiber from Çatalhöyük textiles (Rast-Eicher et al., 2021). Subsequently, in Egypt, wool, goat hair, and palm fiber were added to the repertoire, and cotton is attested by the first century CE (Bender Jorgensen, 2017). In Nubia, cotton becomes common in the Meroitic period in the third century CE (Kriger, 2005, p. 91), and over 80% of the textiles dating to the first four centuries CE at Qsar Ibrim are cotton (Bender Jorgensen, 2017, p. 236).

The known history of woven cloth in sub-Saharan West Africa has largely featured wool and cotton, which we review briefly here to provide a larger context for the dated cloth at Igbo Ukwu. Magnavita's (2020) summary of the limited direct archaeological evidence for woven cloth in the Sahara and West Africa suggests that from the Classic to Late Garamantian period (CE 1–700) through to the early medieval period, wool and cotton were the primary materials used, with evidence

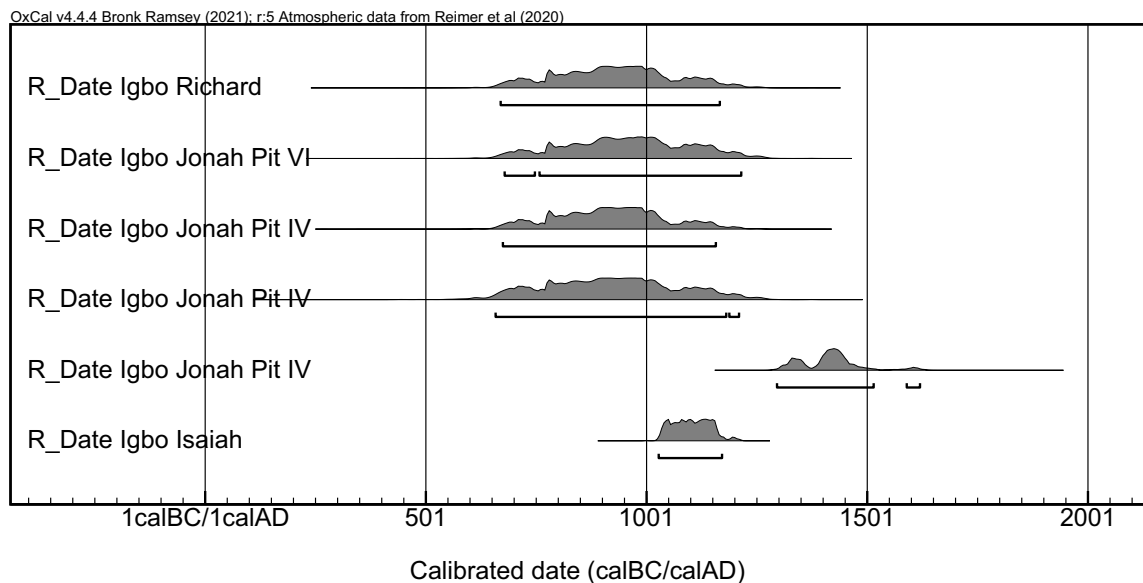


Fig. 10 Calibration curves for the five original, low precision radiocarbon dates for Igbo Richard and Igbo Jonah, plus the new date (Beta 541404) on the textile from Igbo Isaiah

for wool preceding that for cotton. These materials both have short fibers that must be spun to incorporate them into yarn for weaving. Fragments of wool plain-weave textiles have been found in second-century CE graves near Jarma (Magnavita, 2020, p. 197). Several Islamic burials in the Air mountains have cotton and wool tunics dated between the seventh and tenth centuries CE; these were presumably produced in North Africa and acquired by mobile desert populations (Magnavita, 2020, p. 191–192). At the site of Kissi in Burkina Faso, fragments of a possible textile woven from animal hair or wool from a burial dated to the first to fourth century CE may similarly be attributed to mobility and/or exchange (Magnavita, 2020, p. 196).

The widespread appearance of ceramic spindle whorls in the final centuries of the first millennium CE in the Sudanic region of sub-Saharan West Africa is commonly considered an indicator of the development of local wool and/or cotton cloth production, although perishable materials such as bone or dried clay may possibly have been used to weight spindles earlier. Al-Bakri described the thriving production and trade of cotton cloth involving several towns on the middle Senegal River in the eleventh century (Levtzion & Hopkins, 1981, p. 78). Arab authors writing in the eleventh and twelfth centuries describe the prestige function of cloth in the polities of Kawkaw and Ghana, where it was worn only by kings and elites, and also its role as an important trade item. Al-Idrisi specifies that in the towns of the Wanqara and Kawkaw, merchants wore shirts and cloaks; nobles and other elites wore waist-wrappers (Levtzion & Hopkins, 1981, p. 111, 113). Several other chroniclers report that non-elites and rural populations wore either minimal clothing or skins (Levtzion & Hopkins 1981, p. 83, 98–99, 212). Ibn Battuta notes the gendered nature of clothing in the Mali court. The Mansa and male courtiers were richly attired, but the female slaves and daughters of Mansa Suleyman wore no clothes (Levtzion & Hopkins, 1981, p. 295–297).

Possibly contemporary with these historical reports were the communal cave burials of hundreds of individuals of the Tellem culture who were clothed when entombed, indicating the widespread availability of cloth in the remote region of the Bandiagara plateau in Mali. Three dates on human bones from one of the earliest of these caves (cave C) calibrate to sometime between the eleventh and thirteenth centuries CE (Bedaux, 1972; Huizinga et al., 1967). Recent AMS

dating of other human bones from cave C produced dates primarily in the fourteenth–sixteenth centuries CE (Maurer et al., 2017; Table 2), raising questions about the chronology of the bulk of the textiles in cave C, since none of these were directly dated. The most common clothing items were cotton tunics and caps woven on narrow strip looms—a technology still widespread in West Africa (Bolland, 1991; Kriger, 1990, p. 38; Lamb and Lamb, 1980). These were presumably worn by males. Items likely worn by females included fiber and/or cotton pubic aprons (*cache-sexe*) and woven belts (Bedaux & Bolland, 1989). A gendered pattern of men clothed in tunics and headgear and women wearing pubic aprons and belts was common in the late nineteenth century in parts of West Africa (e.g., Binger, 1892).

Compared to the historical and archaeological evidence for cotton and wool, the evidence for tree bast textiles is notably sparse and comes primarily from the forest zone, with one exception. Mat and probable textile fragments composed of *Hibiscus* bast fibers were recovered from the Sahelian site of Tongo Maaré Diabal and dated c. 800 CE (Gestrich & MacDonald, 2018). The small number of fortuitously preserved textile fragments from forest sites, plus ethnographic and historical information, confirm that the forest is a textile province in which tree bast and leaf fibers have been prominent. We imagine that the early development of cordage and basketry in the forest would have exploited these materials (though we have no actual evidence), providing the backdrop to the development of woven cloth. The area of the Nok culture in north-central Nigeria offers copious evidence of fibers and cordage in the first millennium BCE. Terracotta statuary documents an extravagant use of fibers and cordage for personal adornment around the neck, at the waist, and for pubic aprons (see Breunig, 2014; Chesi & Merzeder, 2006). A few statuettes depict what appear to be woven fiber bags, but there is virtually no evidence for textiles used as clothing (T. Maennel, pers. comm.). The source of the fibers is unknown, but tree and grass possibilities would have been widely available. Dalziel (1955) records a large number of trees and vines that yield bast fiber for cordage; these are common, for example, among the Malvaceae (e.g., numerous species of *Hibiscus*, *Sida*, and *Urena*) and Moraceae (e.g., many species of *Ficus*). In the Aracaceae family, numerous genera in addition to *Raphia* have species exploited for cordage and fiber for mats and baskets.

Direct archaeological evidence for textiles in the forest zone comes from just three sites, all now referable to the eleventh–fourteenth centuries. Of these, only Igbo-Ukwu has produced numerous fragments. Willett has reported bast textile fragments associated with two Ife heads (Willett et al., 2004, Appendix 2). Like the Igbo-Ukwu bast textiles, these are Z-twist yarns composed of 2 single S-twist components. Connah recovered six textile fragments from the Clerks' Quarters site in Benin City, associated with the compacted deposit of at least 41 human skeletons in a very deep pit. Two dates on associated charcoal calibrate to somewhere between the late eleventh and mid-fourteenth century (Connah, 1975, p. 182). Two of the textile fragments are woven of “some flat grass or straw-like material, possibly obtained from the leaves of the *Raphia* palm” (Greeves, 1975, p. 236). One fragment (Connah, 1975, plate 45) is a plain weave of flat fibers, with five fibers/cm in one system and nine fibers/cm in the other. Two fine, Z-twist 2-ply strands of a different, unidentified fiber are spaced 0.8 cm apart in the fabric. The other four fragments were tentatively identified as cotton, but the fibers were opaque and brittle, preventing definitive identification. For these fragments, Z-twist yarn was used; when plied, Z on S-twist was used. The plain weave fabric has 10 warp×10 weft/cm. Two of the fabrics include an open, lace-like structure (Connah, 1975, plates 47, 48). Another fragment had supplementary threads woven in to make brocaded patterns (Connah, 1975, plate 46). These, like the Igbo-Ukwu textiles, attest to a high level of craftsmanship.

Historical and ethnographic documentation of bast fiber textiles in Nigeria is meager. Boser-Sarivaxévanis (1975, p. 324) pronounced the technology on its way to extinction and practiced only in very circumscribed locations, such as among the Yoruba-speaking Owe of Kabba. Among the Igbo, she claimed that only a few old women still knew how to weave tree bast fiber cloth. She was able to identify one species exploited for weaving, *Conopharyngia* (= *Tabernaemontana*) *pachysiphon* (Family Apocynaceae), from which a cloth resembling linen could be woven. Requiring much more labor than cotton, this textile was worn only by wealthy individuals or used as a burial shroud (Boser-Sarivaxévanis, 1975, p. 325–327).

Raphia textile production is better represented in the literature, particularly for those areas in central Africa where it remained dominant into the twentieth century (Schaedler, 1987, p. 366–395). In Nigeria, by

contrast, historical and ethnographic accounts have tended to focus on cotton strip weaving by men on horizontal treadle looms (Kriger, 1990; but see Nicklin, 1980). Although cotton cloth has attracted the lion's share of historical attention, it almost certainly was a latecomer to the forest (Kriger, 2005), preceded by a textile economy based on bast and raffia fibers.

Textile specialists have suggested that early forest zone textiles were likely produced on a vertical, single-heddle loom, which had a wide distribution in the lower Niger basin and along the Guinea coast historically, and continuing southeast into the Congo basin for the production of *Raphia* cloth (Boser-Sarivaxévanis, 1975; Kriger, 1990, p. 28–29, 38; Picton & Mack, 1979, p. 67–97). Schaedler (1987, p. 448) theorizes that this type of loom was indigenous in sub-Saharan Africa and may have considerable time depth. Once the technology for extracting fibers for cordage, mats, and basketry was developed, the interweaving process with passive strands (the warp) fixed more or less in place, while the weft is active, moving over and under the passive set, was fully familiar. Any desire for fabrics more flexible than baskets or mats would lead to the production of finer fibers, the weaving of which would be facilitated by tying the passive strands (the warp) to a loom support that holds them under tension (Miller, 2007, p. 77–78). This could be oriented horizontally (as in the ground loom used in parts of northern Nigeria and Cameroon) or vertically (Idiens, 1980, p. 5–6). Claims for a Near Eastern origin for the single heddle loom in sub-Saharan Africa (e.g., Boser-Sarivaxévanis, 1972, p. 206; 1975, p. 333–334) have not received much support in the literature in recent decades. An indigenous transition to loomed textiles from mats and basketry in sub-Saharan Africa is readily theorized via shared structural elements. By the time of the Igbo-Ukwu textiles, the techniques for extracting fibers from *Ficus* tree bast were highly developed, producing plied yarns of very small diameter and permitting the weaving of dense, close-woven cloth.

Early Forest Textiles: Use and Significance

Many key questions about these early forest textiles remain frustratingly out of reach. The context at all three sites suggests their use in ritual contexts—wrapping ritual or sacred objects at Igbo Isaiah and Ile-Ife, and in death and burial assemblages at Igbo Richard

and Clerks' Quarters feature 21 in Benin City. However, we can only speculate about what different meanings and significance might have been attached to *Ficus* vs *Raphia* cloths, or possibly cotton in the case of Benin City. Whether textiles were used for clothing, and if so, what type and by whom, is equally elusive, beyond the depiction in Ife brass statues of royal/elite men and women wearing wrappers. The altar stand from Igbo Isaiah depicts a male and a female with what appear to be fiber necklaces, waist belts, and cache-sexe (Shaw, 1970, plates 206, 207). Shaw (1977, p. 50–51) suggested that paired holes in the copper crown and pectoral in the Igbo Richard burial served for the attachment of fabric. A fragment of probable *Raphia* fabric was associated with the crown (IR339; Shaw, 1970, p. 242). The only other textiles associated with the body itself were bast textile strips 1.8 cm wide that had been wrapped around a copper wristlet (IR223, IR 474; Shaw, 1970, p. 163, 242, plate 317). The artist's reconstruction shows the corpse attired in a full-length robe (Shaw, 1970, frontispiece), which is perhaps the most speculative aspect of the scene.

Given the extraordinarily diverse symbolism and complex social significance of different kinds, colors, and patterns of cloth in Nigeria today (e.g., Asakitikpi, 2007; Renne, 1995), we must imagine that indigenous cloth woven centuries ago was equally imbued with powerful meanings. Possibilities range from status, rank, and prestige to ritual uses related to life events (birth, circumcision, marriage, death), healing, and protection from spiritual forces. Although we could find almost no published ethnographic references to the local meanings of tree bast textiles, various ethnic groups in Nigeria today attribute spiritual qualities and powers to certain tree species. For example, Agbaje-Williams (2005) has identified two dozen trees used for religious purposes in Yoruba communities. *Ficus vogelii* is prominent among them, along with *Chlorophora excelsa* (Yoruba: *iroko*; Igbo: *oji*) and *Ceiba pentandra* (kapok; Igbo: *akpu*). These spiritual powers are aggregated in sacred groves. It may be that early tree bast cloth or fiber provided a way to incorporate a tree's spiritual power into flexible fabrics that could literally envelope people and things with healing or protective powers, mediating between individuals and spirits. Wrapping with cord or twine made from these powerful fibers may have also been ritually salient. Skeuomorphs of cord/twine wrapping

are frequent elements in the iconography of the Igbo Isaiah bronzes pictured in Shaw (1970): the roped pot (plate 196); the snail shells (plates 211–218); the bowls, which are themselves skeuomorphs of calabashes with netting (plates 220, 221); the canine teeth (plate 279); and even the serpent ornament (plate 332). At a distance of more than eight centuries, we can only speculate.

Equally remote is the question of the gendered nature of weaving in the deep past, although various arguments have been advanced (see Asakitikpi, 2006 for an overview). In Nigeria, women primarily weave on the vertical broadloom and men on the narrow strip treadle loom, but this is not uniformly the case. Among the Ibibio, *Raphia* weaving on the vertical broadloom is done by men, as it is throughout the Congo basin (Loir, 1935; Nicklin, 1980; Picton & Mack, 1979). Because weavers are responsive to shifting economic and social forces, they can and do switch loom types and adapt to a variety of new contingencies (see examples in Aronson, 1982; Nicklin, 1980). Textile researchers, anthropologists, and historians have documented some of the changes in weaving production and organization over the past two or three centuries of exceptionally dynamic economic and cultural circumstances. It is likely that the first centuries of the second millennium were also a time of change in the forest zone, necessitating caution when thinking about any potential relation of loom type and gender of weavers so many centuries ago.

Summary

The analysis of the two British Museum textile samples from Igbo Isaiah has resulted in three significant findings. First, a description of the fabric structure documents, for the first time, the diameter of the yarns (0.3–0.4 mm) and the density of the weave (24 warp × 16 weft/cm) in a fineweave sample. This was likely executed on a vertical, single-heddle broadloom and with a high level of craftsmanship and mastery. Second, the fibers in the samples have been identified as primarily *Ficus* tree bast with *Raphia* leaf elements as well. These textiles represent a well-developed weaving tradition in the Nigerian forest that has all but disappeared in Africa. Third, a radiocarbon date of the eleventh-twelfth century (calibrated) is the first

direct date for Igbo Isaiah, displacing earlier claims of a ninth-century date for the textiles. Importantly, the textiles do not date the objects at Igbo Isaiah, which may have been in use for some time before being wrapped or covered with the cloth for the last time.

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Declarations

Conflict of Interest The authors declare no competing interests.

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