
MARINA DARAGAN,  LEONID LEONTYEV, MILJANA RADIVOJEVIĆ, 
LUISE ØRSTED BRANDT,  INA VANDEN BERGHE  AND MARGARITA GLEBA 

THE PERISHABLE MATERIAL CULTURE OF THE PONTIC STEPPE SCYTHIANS: SCIENTIFIC INVESTIGATION OF A FOURTH-CENTURY BC KURGAN BURIAL AT BULHAKOVO, UKRAINE

Summary. Using the organic artefacts from the fourth-century BC grave at Bulhakovo in southern Ukraine, this article discusses the economics of the perishable material culture of the Scythians of the Pontic Steppe region. Thanks to the survival of organic materials (wood, leather, textiles), the burial provides important information about the complex networks of production and exchange that existed in European Scythia. Scientific analyses produced new data regarding materials and techniques used for the production of wooden, leather and textile objects, providing an opportunity for a more nuanced discussion of their production and consumption.

INTRODUCTION

The Scythians were part of a diverse group of nomadic peoples of varied genetic origins that shared a similar material culture, economic structure, lifestyle and ideology and that inhabited the vast Eurasian Steppe (Alekseev 2003; Parzinger 2004; Cunliffe 2019; Simpson and Pankova 2020).¹ In the modern historiographic tradition, Scythia is associated with the steppe corridor between the Danube and the Don rivers, including the Crimea (Olhovskij 1991; Alekseev 2012). Therefore, for the purpose of this article, Scythians are understood to be the nomads inhabiting the Pontic Steppe north of the Black Sea, as originally defined by the ancient Greek ‘father of history’ Herodotus. Herodotus declared the Scythians as one of the four great civilizations of his time, due to the major and often devastating effect these horse-riding warriors had on the course

¹ The problems of terminology have been extensively discussed elsewhere (see in particular Alekseev 2003; 2012; Parzinger 2004; Ivantchik 2018). Recent archaeogenetic studies indicate that Scythian-related individuals did not belong to a genetically homogeneous population (overview and relevant bibliography in Olalde and Posth 2020). Like the terms ‘Celtic’ and ‘Viking’, we chose to use the term ‘Scythian’ to refer to a broader cultural phenomenon rather than ethnicity or genetic background.

of history and the contemporary sedentary civilizations they interacted with, such as the Assyrians, Persians, Macedonians and Greeks. For some four centuries (*c.* 700–300 BC), Scythians served as the mobile bridge linking these sedentary empires and states of Europe and Asia. In the fourth century BC, the Scythian culture witnessed its economic peak, manifested in the quantity and quality of archaeological finds and documented by the written sources.

The Scythians left no written records, so everything we know about them is either based on the archaeological record or filtered through the ancient Greek, Persian and Roman accounts. The ancient written sources are outsiders' perspectives that are biased and often anachronistic, but still dominate Scythian studies without due critical analysis. Meanwhile, Scythian archaeology has disproportionately focused on the spectacular gold objects from elite graves that have come to characterize the Scythian material culture in the archaeological literature and popular imagination, reinforced particularly through large blockbuster exhibitions (e.g. Tolochko and Murzin 1991; Reeder 1999; Aruz *et al.* 2000; Menghin and Parzinger 2007; Roberts 2021).

Besides these prestige objects, however, Scythians were in much greater need of a stable supply of basic subsistence products, such as food, clothing, tools and weapons. Nonetheless, Scythian economy – their relationship with the (available) natural and cultural resources, as expressed principally through their exploitation, production, distribution and consumption – has mostly been investigated using traditional typological and contextual analyses of material culture and ancient written sources (Gavriliuk 2013). Exotic luxury items, such as Greek transport amphorae and fine-ware pottery and gold items in Greek style, as well as weapons, all of which constitute frequent finds in Scythian elite burials, have been intensively studied from a typological and stylistic point of view (e.g. Monakhov 2003; Polin 2014; Treister 2019).

Yet we know next to nothing about the production of the much more essential subsistence products: food, textiles, leather, bone and wood items. The degree to which the Scythians were directly engaged with any of these technologies also continues to be debated (Grakov 1954; Gavriliuk 2013; Pankov 2014; Bruyako and Sekerskaya 2016). Even in the case of metal artefacts, although they have been studied archaeologically and metallographically (Shramko and Solntsev 1991; Pankov 2014; Daragan and Romanenko 2021), we still do not know where the raw materials for the iron, bronze, silver, and gold items originated.

The lacuna in our knowledge is partly due to poor preservation of organics in this region. In contrast to the much better preserved Scytho-Siberian finds (e.g. Rudenko 1970; Simpson and Pankova 2017), the perishable material culture of the European Scythians is less known. However, wooden, bone, leather and textile artefacts have been recovered from numerous burials excavated across southern Ukraine. Many of the currently available scientific methods can help with answering important questions regarding their characterization, provenance and dating. As a case in point, we present here the results of recent multidisciplinary investigations of the wooden, leather and textile objects found in a Scythian kurgan burial dated to the second quarter of the fourth century BC at Bulhakovo. The kurgan was one of many hundreds excavated by the newly formed expeditions of the Institute of Archaeology of then Ukrainian Soviet Socialist Republic in the 1960s and 1970s in the wake of the large-scale construction of water reservoirs and irrigation systems in southern Ukraine.

Recent re-examination of the burial in preparation for the full publication of the cemetery (only partly published in Grebennikov 1996 and 2008) using some of the latest scientific methods produced new data regarding materials and techniques used for the production of the perishable

objects recovered. These data provide an opportunity for a start of a more nuanced discussion of their provenance and hence the economic networks that enabled their circulation in the Pontic Steppe region.

BURIAL CONTEXT

In 1971, the Ingulian archaeological expedition of the Institute of Archaeology, National Academy of Sciences of Ukraine, excavated Kurgan No. 5 near the village Bulhakovo, located on the left bank of the Ingulets river (Fig. 1). The kurgan, 0.8 m in height and 22 m in diameter, was constructed over the central Burial 1. Three other, secondary burials (Burials 2–4) were present in the mound. Burials 1, 3 and 4 had been looted in ancient times, but Burial 2 survived undisturbed. Burial 2 is a catacomb with a deep rectangular entrance and a rectangular chamber which contained two skeletons. The entrance of the catacomb was tightly sealed by a pile of stones. Soon after the burial, a part of the catacomb arch collapsed over it, likely creating a microclimate favourable for the preservation of otherwise perishable artefacts.

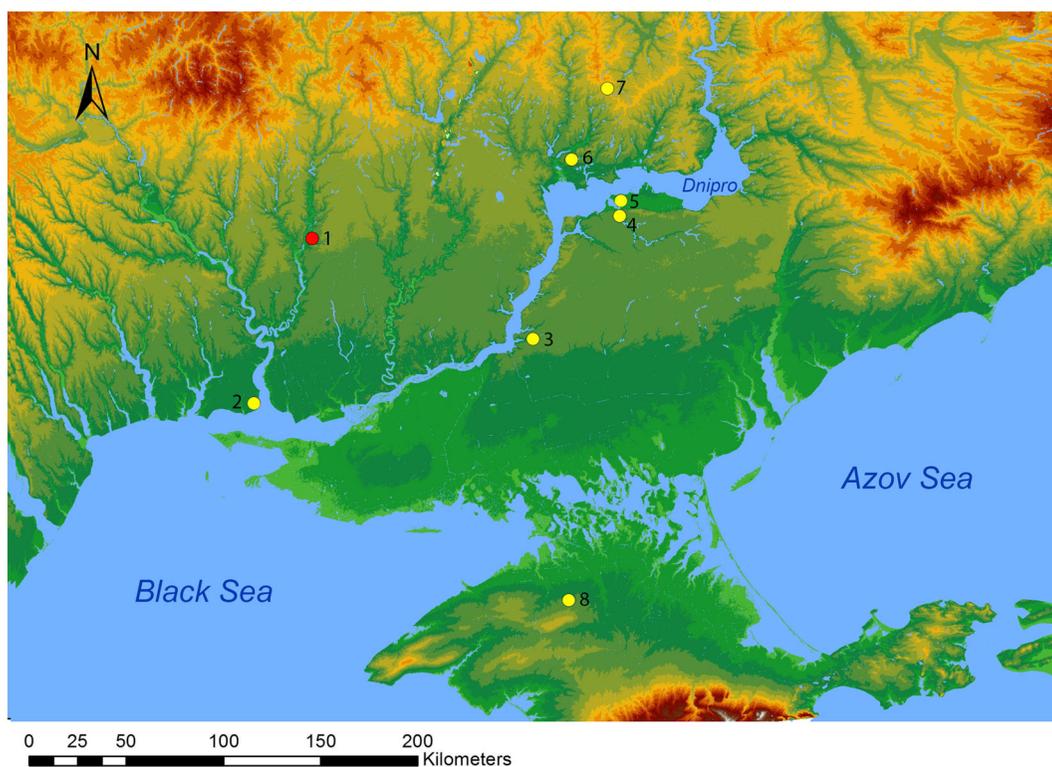


FIGURE 1

Map of sites mentioned in text. 1 - Bulhakovo; 2 - Olbia; 3 - Kairy; 4 - Ilyinka; 5 - Kamyanske Horodyshche; 6 - Tovsta Mohyla; 7 - Olexandropil; 8 - Frunze (image: M. Daragan).

Burial 2 is a double deposition, with the dead buried side by side, in an extended supine position with their heads pointing west (Fig. 2a and b). One of the buried individuals (hereafter Individual 1) lay directly next to the north wall. The second (Individual 2) was immediately to the south of the first. While the skeletal remains were in an extremely poor state of preservation, the funerary equipment, including perishable wood, leather and textile items, was relatively well preserved, although unfortunately not all of them were recovered and some have been lost since. The majority of the extant finds are currently curated at the Institute of Archaeology in Kyiv, Ukraine, and the State Hermitage, Russia, while one object is in the Mykolai Historical Museum, Ukraine. The following description of the context is based on the excavation report (Shaposhnikova 1971) and a thorough re-examination of surviving materials.

The buried individuals were placed on a thick grass mattress covered with an animal skin, observed during the excavations but not preserved. They were clad in garments made of leather and fabric, fragments of which were also noted by the excavators. Individual 2 wore leather boots (Fig. 3). Near the western wall of the burial chamber, there were two large wooden trays with handles (Fig. 4a), each containing animal bones and an iron knife with the remains of its bone handle. Between them were a small wooden bowl placed on wooden planks and another small closed wooden vessel with two handles, covered with a disk-shaped wooden object, which appears to be a reused mirror box half (Fig. 4b-c). Above the head of Individual 1 were two Attic black-figure *kantharoi* and a bronze mirror with an iron handle. Along the north wall of the burial,

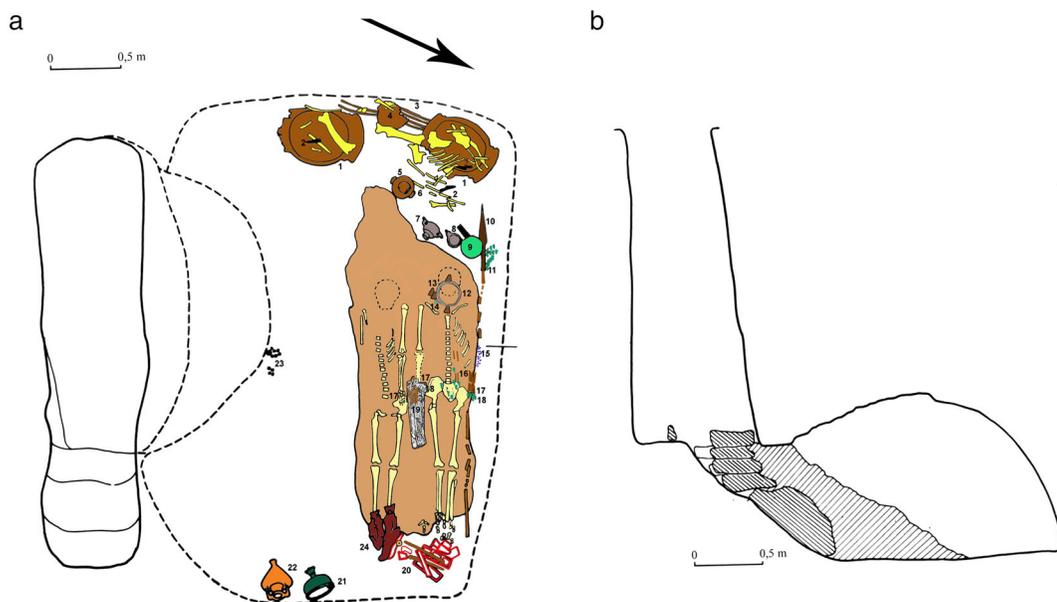


FIGURE 2

a. Bulhakovo Kurgan 5, Burial 2. 1 - wooden dishes with knives and animal bones; 2 - iron knives; 3 - wooden sticks; 4 - wooden bowl; 5 - wooden vessel; 6 - wooden mirror case; 7, 8 - Attic ceramic *kantharoi*; 9 - bronze mirror; 10 - spear; 11 - bronze arrow heads; 12 - silver torque; 13 - wooden prism; 14 - bronze earring/temple ring; 15 - glass beads; 16 - arrows; 17 - bronze, silver and gold finger rings; 18 - iron and glass bead bracelets; 19 - leather quiver with arrows; 20 - wooden boxes, spindles, weaving tablets, comb, ceramic spindle; 21 - bronze cauldron; 22 - Greek transport amphora; 23 - silver plaques; 24 - leather boots (image: M. Daragan after Shaposhnikova 1971). b. Bulhakovo Kurgan 5, Burial 2. Section of burial shaft and chamber (image: M. Daragan after Shaposhnikova 1971).



FIGURE 3

Leather boots: a) original after conservation (image after Grebennikov 2008); b) reconstruction (image after Klochko 1992).



FIGURE 4
Wooden objects: a) tray (after Grebennikov 2008); b) vessel; c) mirror cover (images: M. Daragan).

next to Individual 1, lay a long spear with a mostly disintegrated wooden shaft and an iron spearhead. Between the north wall and the tip of the spear lay over a dozen bronze arrowheads. A silver torque (*hryvnia*) was found on the neck of Individual 1. Around it, four small cloth amulet bags were placed. They do not survive but their contents consisted of small black beetles, initially thought to be seeds, which likely had consumed the original contents of the bags. On the right side of Individual 1, in the area above the clavicle, a bronze earring/temporal ring with a bead was found.

Twelve bronze arrows were scattered across the chest and pelvis of Individual 1. On the outstretched left arm of Individual 1, among the phalanges of the fingers, one bronze and three gold rings were found, while the right hand had one gold ring on the middle finger, while the index, ring, and little fingers each had poorly preserved silver rings. There were two partially fused bracelets on

the right wrist. One bracelet is a band of white and yellow transparent glass beads (15 complete, the rest fragmentary) strung on a leather cord. The second bracelet is iron. The presumed hem of the left 'sleeve' of the Individual 1's 'dress' appears to have been trimmed with small spherical blue glass and bronze beads.

In contrast to the sumptuous adornment of Individual 1, Individual 2 had only a single bronze ring on the left hand. However, when clearing the chamber floor, at a distance of 0.5 m south of the pelvis of Individual 2, three silver and gold plaques and rings were found. These plaques and other small unidentifiable elements made of bone and wood were in proximity to the completely decayed right hand of Individual 2.

A leather quiver was placed between the two skeletons, near the left thigh of Individual 2 and overlapping the right wrist of Individual 1 (Fig. 5a-b). The quiver was recovered as a block, preserving its various components including arrows *in situ* and, to date, constitutes the most completely preserved leather quiver found in European Scythia (Daragan 2020). It is sewn of multiple leather pieces using animal sinew thread. The quiver contained 31 bronze and at least four iron trilobate socketed arrowheads of six types (Fig. 5c), which are now fused together. Many of their wooden shafts were preserved (Fig. 5d).

Under the quiver, and likely preserved by it, were extensive textile remains. At the feet of Individual 1, in the north-east corner of the burial chamber was a group of wooden objects scattered and damaged by the burial chamber collapse. They appear to have been stored in a wooden chest, one side of which survives and preserves a carved ornament, possibly a stag. The chest originally contained two wooden boxes. Box 1 has a complex tripartite construction and a leather lining, a fragment of which preserves an incomplete incised inscription in Greek letters (Fig. 6). It contained 19 rectangular wooden weaving tablets with holes in the corners, which were likely used for tablet weaving, iron needles, and a few seeds of millet. Box 2, which had disintegrated, had a painted lid decorated with a polychrome depiction of a woman (Fig. 7). The chest also contained a variety of other objects primarily connected with textile work: three wooden distaffs, a wooden comb, skeins of thread, a ceramic spindle whorl made of a Greek transport amphora sherd (Fig. 8), and a prism-shaped wooden object that appears to have been grated on all sides (Fig. 9) (Daragan *et al.* 2016; Mylnikov and Daragan 2016). All these objects may have been originally contents in Box 2.

In the south-east corner of the chamber, a Greek transport amphora of the Menda type was placed close to the entrance. Just north of the amphora, tilted towards the north-east, was a bronze cauldron with loop handles (height 36.7 cm, oval rim diameter 33.5 x 23 cm), which was filled with oxidized animal bones (Fig. 10).

The two trays and the cauldron containing animal bones along with the single Greek wine transport *amphora*, two Greek *kylikes*, and the wooden vessel are all likely remains of funerary food offerings. Very similar trays with knives and animal bones are found in numerous Scythian burials – both male and female – of southern Ukraine and the Crimea: they appear to be a *sine qua non* of Scythian burials of the second half of the fifth-fourth centuries BC (Olhovskij 1991, 118). Bronze cauldrons are known from numerous unlooted Scythian burials (Bidzilia and Polin 2012, 344–51, 353–5). Furthermore, the frequent finds of animal bones impregnated with bronze oxidation products in the looted Scythian burials indicate that such cauldrons were almost an obligatory accessory to the everyday life of not only the representatives of the Scythian nobility and royalty but also every prosperous Scythian (Polin 2014, 121). The animal bones, identified as bovid and ovicaprid during excavation, indicate that at least two species of animals were slaughtered for the funeral feast at Bulhakovo, although the bones do not survive so further analysis is impossible.

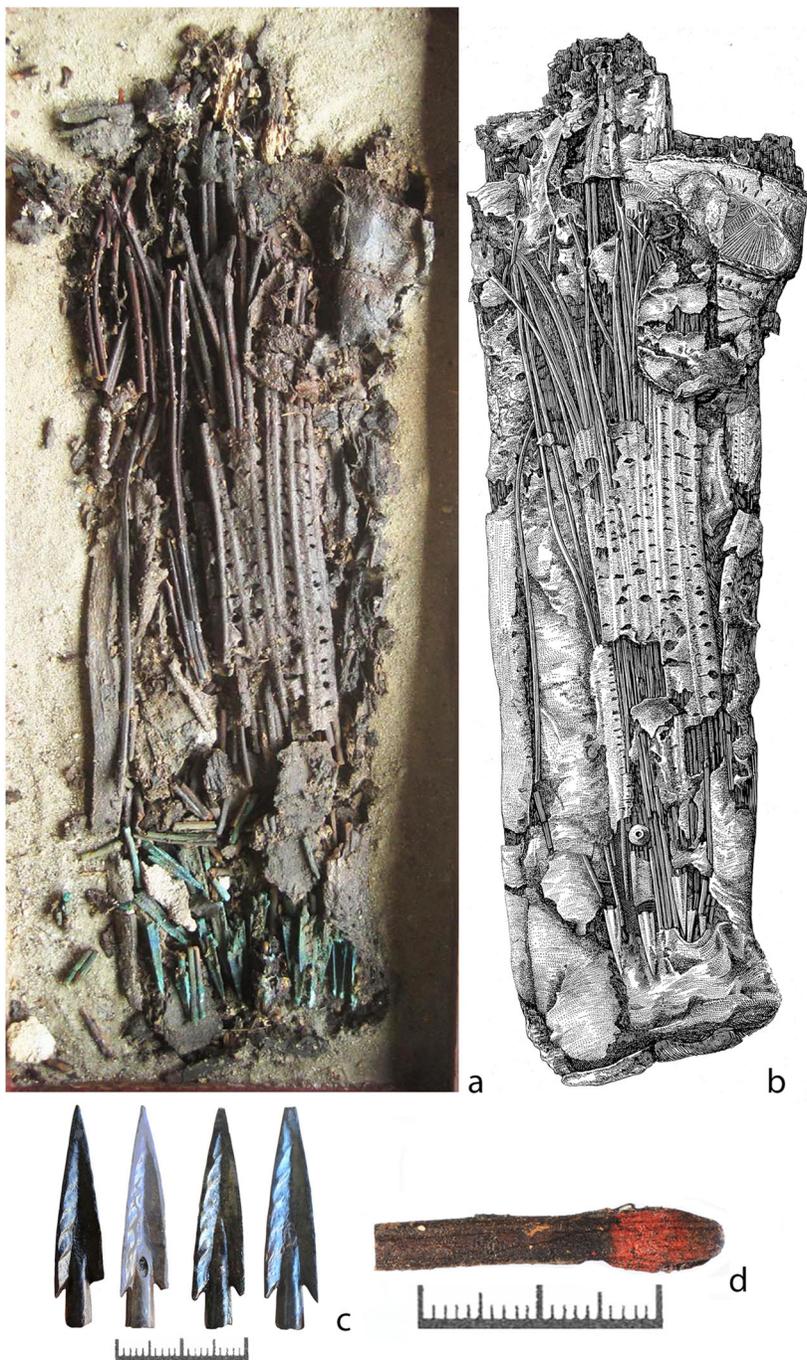


FIGURE 5

Leather quiver: a) *in situ* (image: M. Daragan); b) drawing (image: archive of S. Polin); c) bronze arrowhead with markings (image: M. Daragan); d) wooden arrow shaft with red pigment traces (image: M. Radivojevic).

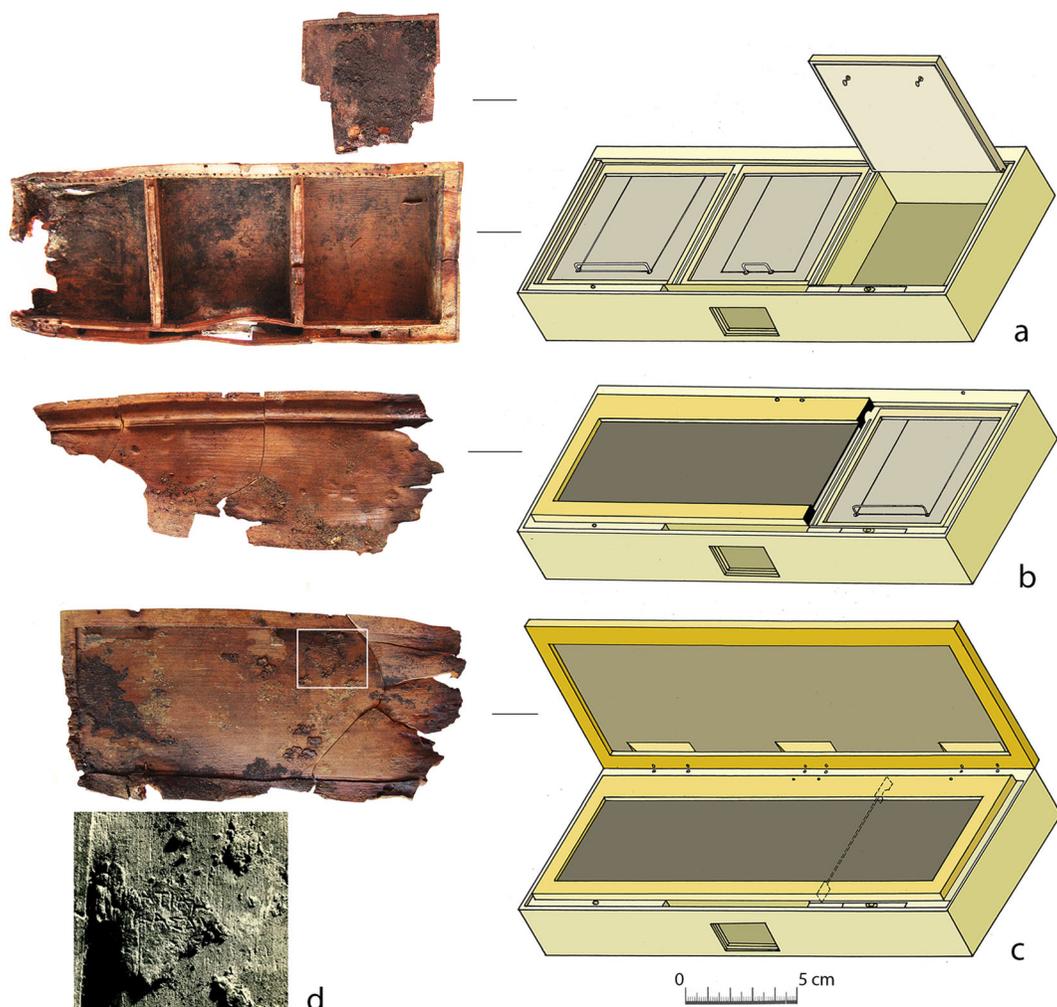


FIGURE 6

Wooden tripartite box and its reconstruction: a) box body with tripartite partitioning and a partition lid; b) inner lid; c) outer lid; d) inscription (images: M. Daragan; reconstruction: M. Daragan and O. Buravchuk; drawing: T. Menchinskaya).

Bovid and ovicaprid remains, together with horse bones, constitute the main food offerings in almost half of all Scythian burials (Gavriliuk 1987, 23; Anrukh and Sekerska 1999; Zhuravlev 2018, 680). Greek wine was popular with the Scythians and the richest Scythian kurgans can have as many as 20 Greek transport *amphorae* deposited in the catacombs (e.g. at Berdiansk, see Polin 2014, 263–8) and over 400 in the funeral feast (e.g. at Olexandropil, see Polin and Alekseev 2018, 320ff). The black-figure *kylikes* were likely used for drinking wine – a custom adopted from the Greeks as part of the overall wine consumption tradition.

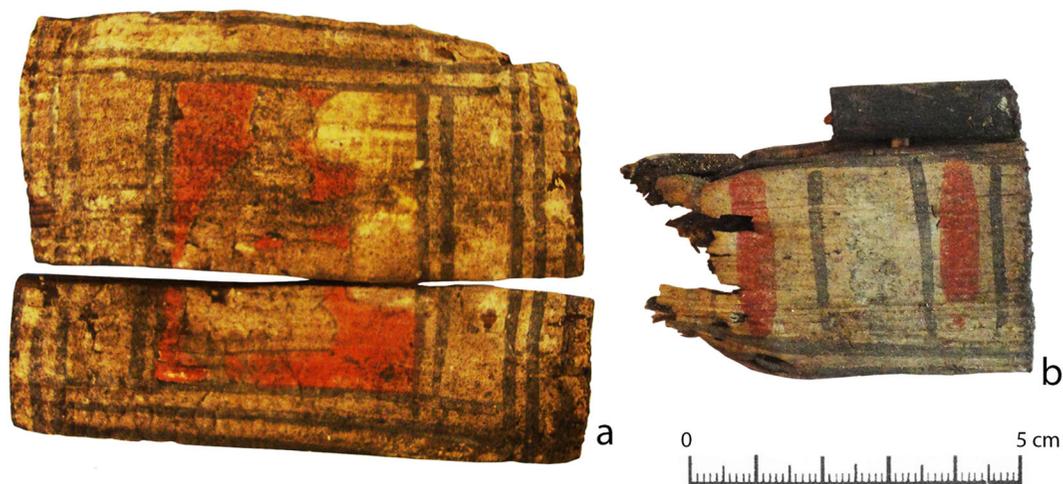


FIGURE 7
Wooden painted box: a) lid with painted woman; b) painted side (images: M. Daragan).

THE BURIED INDIVIDUALS

Since the skeletons were almost completely disintegrated, anthropological sexing of the remains was not possible. The sex of the buried people can be hypothesized on the basis of the accompanying burial gifts. As in many other cultures, among the Scythians, the weapons are generally associated with men, while jewellery, mirrors, and textile tools are common female attributes, although female Scythian burials with weapons are not uncommon (Olhovskij 1991, 109, 119). Nevertheless, considering the combination and association of the various objects in the Bulhakovo burial, the sexing of its occupants is not entirely straightforward.

Individual 1

Individual 1 at Bulhakovo had sumptuous personal ornaments (torque, temporal/ear ring, finger rings, bracelets in precious materials) and was associated with the bronze mirror and wooden boxes containing textile-making equipment. Torques are common in female burials and are predominantly found on children and young women. A single earring is somewhat unusual, as women most frequently wore two, but not unique, and is again mostly associated with children/young adults. The rings with round flat bezel and multiple rings are also typical female jewellery items, generally associated with higher status women (Petrenko 1978, 61). Mirrors have been found exclusively in association with women (Polin and Daragan 2019).

Textile equipment is also exclusively associated with female burials in Pontic Steppe Scythia (Daragan *et al.* 2016). The Bulhakovo box with its textile tools and other objects is not a unique example. A very similar set of at least 20 wooden weaving tablets was found in a small wooden box accompanying a Scythian woman buried in a late fifth-century BC burial near Frunze, the Crimea (Gavrilov 1993, 201–5; Daragan and Buravchuk 2013). The box also contained a wooden spindle, a lead spindle whorl, a bronze mirror, a Greek black-figure *kylix*, a wooden *pyxis*, and some other wooden objects. Examples of similar although more fragmented wooden distaffs,

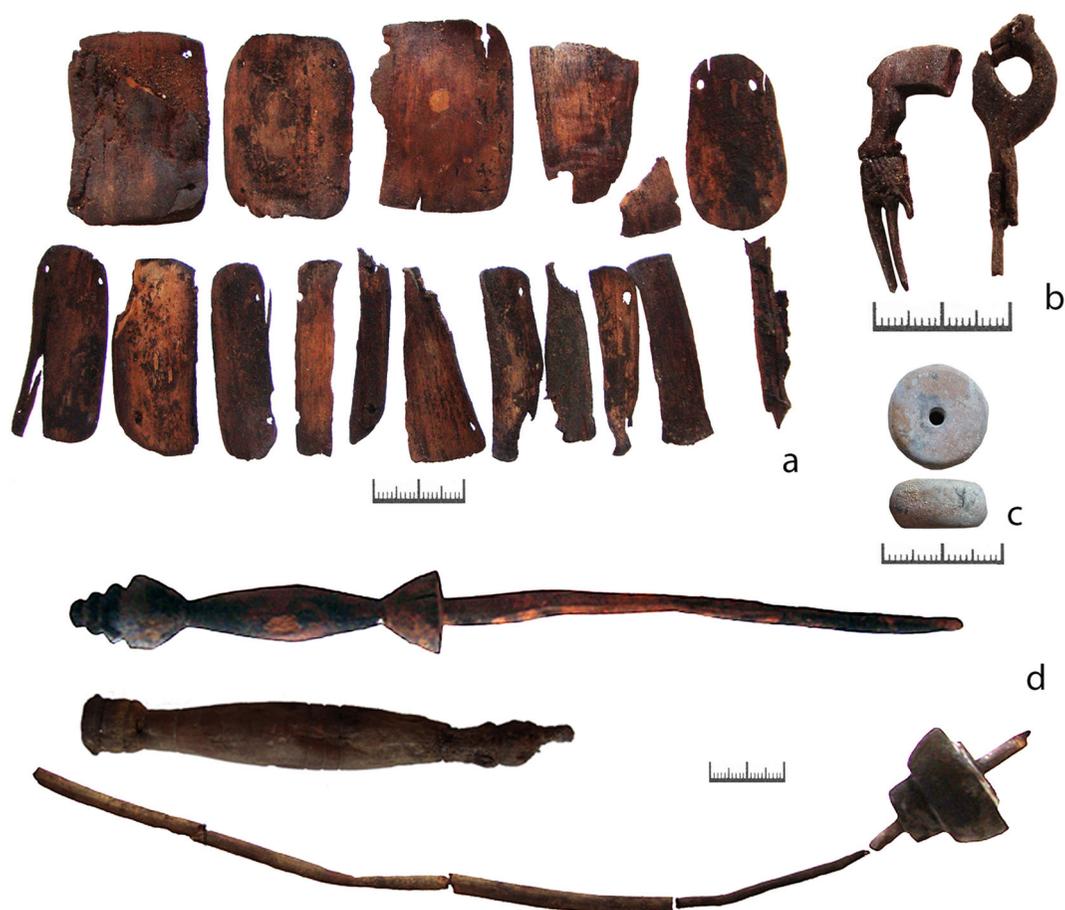


FIGURE 8

Textile tools: a) wooden tablets; b) wooden comb; c) ceramic spindle whorl; d) three wooden distaffs (images: M. Daragan).

tools used to keep the prepared fibre organized during spinning, are also known from other female Scythian burials.

The second wooden box associated with the textile tool set has a lid with a depiction of a crouching woman shown in profile painted in red, black and white paint (Fig. 7). Its iconography suggests that the owner of this object was more likely to be a woman.

Prism-shaped wooden objects grated on all sides similar to the one from Bulhakovo have been found exclusively in female Scythian burials. They may be associated with a custom of Scythian women, described by Herodotus, of cleaning their bodies by scrubbing them with shavings from aromatic woods (Pinchevska and Daragan 2019).

All these elements thus appear to indicate that the skeletal remains of Individual 1 most likely belonged to an adult female. They are, however, also associated with a spear and two sets of arrows. Both types of weapons are present in male and female Scythian burials; among the female burials with mirrors about 34% also contain weapons (Polin and Daragan 2019, 212).

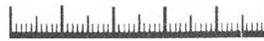


FIGURE 9
Prism-shaped wooden object (image: M. Daragan).



FIGURE 10
Bronze cauldron (images: O. Buravchuk).

Individual 2

The leather quiver with its arrows, placed between the two skeletons, is likely associated with Individual 2 because it was laid to the body's left. The left-sided position of a quiver is common in many other Scythian burials (Daragan 2020). Scythian, as well as Greek and Lydian (specifically the paintings from the Tatarli tumulus) iconography also shows quivers and *gorytoi* (arrow and bow containers) usually worn on the left side by the Scythians, a position facilitating quick arrow retrieval for a right-handed person (Daragan 2020, 153). The leather ankle boots preserved on the feet of Individual 2 are identical in shape to those worn by the male figures depicted on the objects of the Scythian toreutics found across the Pontic Steppe, for example on the famous gold beaker from Kul-Oba (Aleksiev 2012, 190–3). Nevertheless, leather fragments of similar boots are not found exclusively in male Scythian burials, and such footwear appears to have been worn by both sexes (Klochko 1992). Unfortunately, women are depicted in Scythian iconography exceedingly rarely, so we know very little about their dress from this source (Gleba 2008). These considerations, as well as the presence of only one finger ring and absence of other jewellery, suggest that Individual 2 can tentatively be identified as male.

Bronze cauldrons with loop handles are known from both male and female burials, for example an almost identical cauldron was found in the so-called queen's burial at Tovsta Mohyla (Mozolevskij 1979). It could thus have been intended for either or both individuals buried at Bulhakovo.

Double burials are not unusual in the Scythian sphere, although in other such cases, the second burial is usually in a different, often crouched position. The parallel positioning of the two individuals at Bulhakovo appears to indicate their 'equal' status. The few indicators of high status amidst otherwise relatively ordinary burial goods suggest that the couple interred in Burial 2 at Bulhakovo may have been members of the lower levels of the aristocracy.² Due to the fact that the other burials in the kurgan were looted, we cannot draw any further conclusions regarding the status and association of the people buried in it.

CHARACTERIZATION OF ORGANIC BURIAL GOODS

We used optical and scanning electron microscopy, mass spectrometry, liquid chromatography, and portable X-ray fluorescence to analyse the extant wood, leather, and textile artefacts from Bulhakovo (a detailed description of methods is presented in Supplementary Information). The results provide important information about the availability and choice of such materials used by the Scythians. See Supporting Information for details of methods.

Wood

Wood species identification was carried out on most of the extant items³ by observing the radial, tangential and transversal surfaces of objects in reflected light under the microscope (Table 1, Fig. 11). Apart from coniferous species, the species identified were mostly local to the Pontic

² For an overview of the current knowledge of the Scythian social organization, see Daragan and Polin 2022.

³ Of the multiple wooden objects excavated, one of the wooden trays, the bowl, and the spear shaft did not survive to undergo analysis.

TABLE 1
Wood species identification

Object	Element	Wood species
Tray	tray	<i>Rosaceae</i>
Closed vessel	vessel	alder (<i>Alnus</i> sp.) or birch (<i>Betula</i> sp.)
Tripartite box	box	maple (<i>Acer</i> sp.)
	cover	coniferous species
	internal covers	maple (<i>Acer</i> sp.), birch (<i>Betula</i> sp.)
Box with painted lid	sides	coniferous species
	lid	coniferous species
	rivets	willow (<i>Salix</i> sp.) or poplar (<i>Populus</i> sp.)
	lid	linden (<i>Tilia</i> sp.)
Mirror box lid	lid	linden (<i>Tilia</i> sp.)
Distaff 1	distaff	maple (<i>Acer</i> sp.)
Distaff 2	distaff	maple (<i>Acer</i> sp.)?
Distaff 3	distaff	alder (<i>Alnus</i> sp.)?
Tablets	tablets	maple (<i>Acer</i> sp.), alder (<i>Alnus</i> sp.)
Comb	comb	not identified
2 arrow shafts	arrow shaft	birch (<i>Betula</i> sp.)
2 arrow shafts	arrow shaft	poplar (<i>Populus</i> sp.) or European aspen (<i>Populus tremula</i>)
Prism-shaped object	prism-shaped object	maple (<i>Acer</i> sp.)

Steppe. Aspen, birch, maple, poplar, willow and alder were typical of the Polisia and forest-steppe of the north-east of Ukraine, and also grew near the rivers that traverse the Pontic Steppe (Sokolov *et al.* 1977; 1980; 1986). Coniferous species were common to the western forest (including the Carpathian Mountains) and north-west Polisia zones of Ukraine, as well as on the Crimean Peninsula. As these latter regions were outside the steppe region under the control of the nomadic Scythians, the wooden objects made of these species were likely exchange products with the neighbouring populations.

The technique of production is not evident in most wooden objects, and their current conservation state makes it difficult to identify any tool marks. However, some of the objects (such as the distaffs) appear to be lathe-turned. The choice of the wood species was likely conditioned by their availability as well as specific functional properties.

Leather

The animal skin on which the buried individuals were laid out did not survive but a sample of the leather boots was previously determined to be goat (*Capra hircus*) skin using optical microscopy (Plavan *et al.* 2012, 515). The microscopy of samples from the leather quiver was not successful due to highly degraded surface and absence of grain pattern, so seven samples from the different elements of the object were taken for species identification by Zooarchaeology by Mass Spectrometry (ZooMS). ZooMS is a method for species identification based on small differences in specific sequences (markers) of the protein collagen between animal species (Buckley *et al.* 2009). The combination of markers seen in the MS spectra make up the so-called ‘fingerprints’ of the sample which can be matched to a reference base of fingerprints from known animal species and thus identified. Analysis of two of the samples resulted in a positive identification of goat (*C. hircus*) (Table 2). One sample (MG26) could not be identified further than

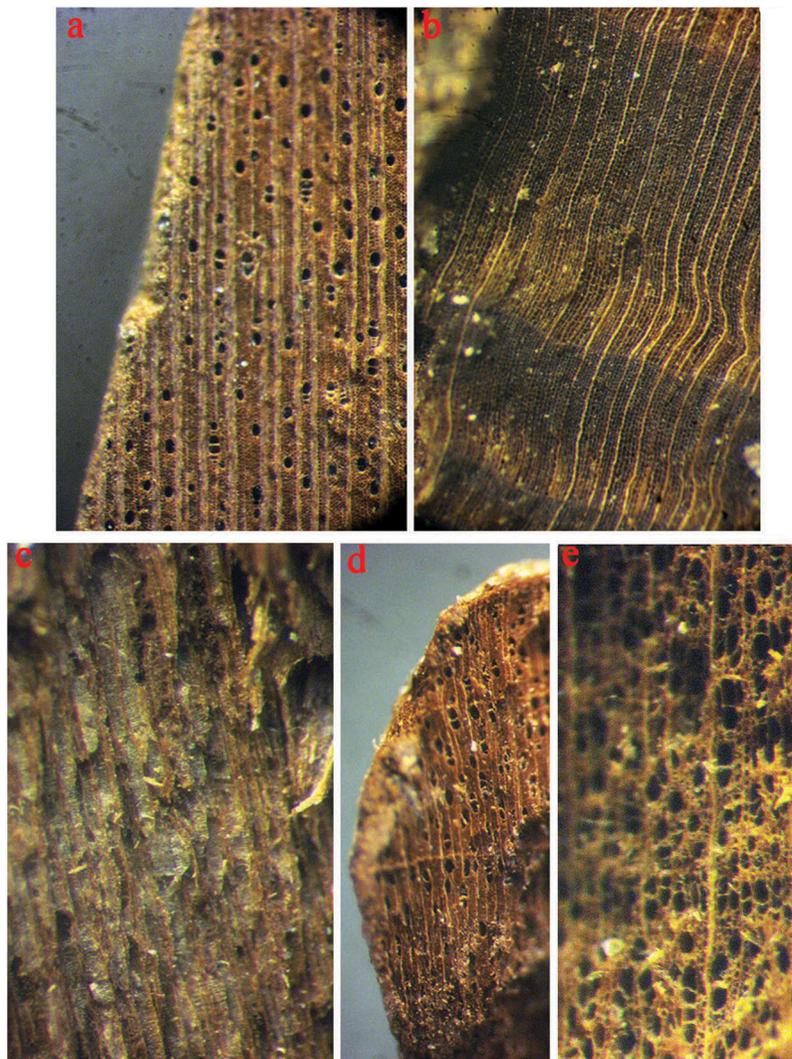


FIGURE 11

Select wood sections: a) Tripartite box - Maple (*Acer* sp.): vessels present; wood diffuse-porous; vessels in multiples, commonly single or short radial rows; perforation plates simple; tyloses in vessels absent; rays wider, up to 5–7 cells wide; aggregate rays absent; rays composed of a single procumbent cell type (homocellular); b) Lid of tripartite box - Coniferous species: vessels absent; growth ring boundaries distinct, gradual transition from earlywood to latewood; latewood zones generally narrow; wood mainly consists of early and late tracheids; no resin canals; c) Mirror cover - Linden (*Tilia* sp.): vessels present; wood diffuse-porous; vessels in multiples, commonly short radial rows and in clusters; vessel outline angular; perforation plates simple; helical thickenings present in vessel elements; tyloses in vessels absent; rays multiseriate up to 3–5 cells wide; aggregate rays absent; rays composed of a single procumbent cell type (homocellular); d) Distaff 3 - Alder (*Alnus* sp.): vessels present; wood diffuse-porous; vessels arranged in multiples, commonly short radial rows; vessel outline angular; perforation plates scalariform; rays exclusively uniseriate; aggregate rays may meet; rays composed of a single procumbent cell type (homocellular); e) Painted box - Poplar (*Populus* sp.): vessels present, wood diffuse-porous; vessels in multiples, commonly short radial rows; perforation plates simple; rays exclusively uniseriate; aggregate rays absent; rays composed of a single procumbent cell type (homocellular). (images: L. Leontyev).

TABLE 2
 Leather species identification of the quiver samples. *Identified as goat in (Spindler *et al.* 2020, 558). Markers are named according to both Buckley *et al.* (2009; 2014) and Brown *et al.* (2020)

ID	Element	(P1)	$\alpha 2(I)$ 988–1000 (A)	$\alpha 2(I)$ 494–508 (B)	$\alpha 2(I)$ 512–529 (C)	(P2)	$\alpha 2(I)$ 803–826 (D)	E	$\alpha 1(I)$ 602–634 (F)	$\alpha 2(I)$ 767–799 (G)	ZooMS ID
MG16	Upper front wall	1105.6	-	-	-	-	-	-	-	-	No ID
MG17	Back wall	-	-	-	-	-	-	-	-	-	No ID*
MG18	Front wall,	1105.6	1427.7	1580.8	1648.8	2131.1	-	2883.4	-	3093.5	Goat
	decorated part										
MG21	Upper front wall	1105.6	-	-	-	-	2115.1	-	-	-	Primate?
MG22	Front wall	-	-	-	-	-	-	-	-	-	No ID
MG26	Front wall	1105.6	1427.7	1580.8	1648.8	2131.1	-	2883.4	-	3077.5+3093.5	Goat/reindeer*
MG30	Lower back wall	1105.6	1427.7	1580.8	1648.8	2131.1	-	2883.4	-	3077.5+3093.5	Goat

goat or reindeer as marker A was absent. This sample and MG17 have however previously been identified as goat (Spindler *et al.* 2020, 588). Goat was also identified using ZooMS in the contemporaneous quivers from burials 2 and 3 in kurgan 4 at Ilyinka and Kurgan 1 at Kairy (Spindler *et al.* 2020).

Goat skin is very soft but also extremely durable and water resistant, making it a very suitable material for both the shoes and the quiver. The material was easily available as goats were among the domestic animals kept and bred by the pastoralist Scythians, as depicted on the exquisite gold pectoral from Tovsta Mohyla (Mozolevskij 1979; Cunliffe 2019, 348–9). Although not numerous and not always distinguishable from the sheep, goat bones have been found among the funeral feast remains from Olexandropil and other Scythian kurgans as well as at settlements (Zhuravlev 2018).

A possible identification of primate (*Hominoidea*) skin in sample MG21 seems feasible as human skin has in fact been identified in Scythian quivers previously (Spindler *et al.* 2020, 588), supporting the claim of Herodotus (*Histories* IV.64) that the Scythians used skin from their enemies to produce quivers.

Textiles and dyes

Extensive remains of layers of poorly preserved textiles and felt were preserved under the quiver (Gleba *et al.* 2020a and b). One of the textiles is a z/z plain weave or tabby with 20/30 threads/cm with striped decoration (Fig. 12a–b), while another appears to be a monochrome tabby of similar quality (Fig. 12c). Similar textiles have been recovered in other, contemporaneous Scythian burials (Gleba *et al.* 2020a and b). The third fabric is made of very fine wool z-twisted yarn and may be three-directional plaiting (Fig. 12d). Finally, there is a fragment of wool felt (Fig. 12e). Felt is common among the archaeological assemblages of Altai burials and continues to be the preferred textile of Eurasian nomads in modern times (Polosmak and Barkova 2005, 80, 92, 109–37, 143).

Dye analysis of the textiles and felt samples using liquid chromatography yielded alizarin, purpurin and an alizarin-like compound (Fig. 13), indicative of dyeing with common or dyer's madder (*Rubia tinctorum* L.), which was also found in several textiles from other Scythian burials excavated across southern Ukraine (Gleba *et al.* 2020a and b). Madder is native to Ukraine and was likely obtained locally.⁴

The layering, likely resulting from multiple folding, suggests that these were not garments that the deceased were wearing, but that textiles constituted burial gifts in their own right. The fact that they are preserved only under the leather quiver, suggests that their preservation was favoured by the microenvironment created underneath it, as is also the case in other contemporaneous burials (Gleba *et al.* 2020b). In all cases, where such layered textiles have survived, the fabrics are weft-dominant or weft-faced z/z-i tabbies of relatively similar quality and all dyed red, which suggests that this particular type of fabric constituted part of the Scythian burial kit. At the same time, the presence of parasitic insects (likely body lice) in the textiles from Bulhakovo (as well as in other burials) indicates that at least at some point during their lifetime, these textiles were in close proximity with a human body.

⁴ <http://www.plantsoftheworldonline.org/taxon/urn:lsid:ipni.org:names:765369-1> [accessed 09.02.2022].

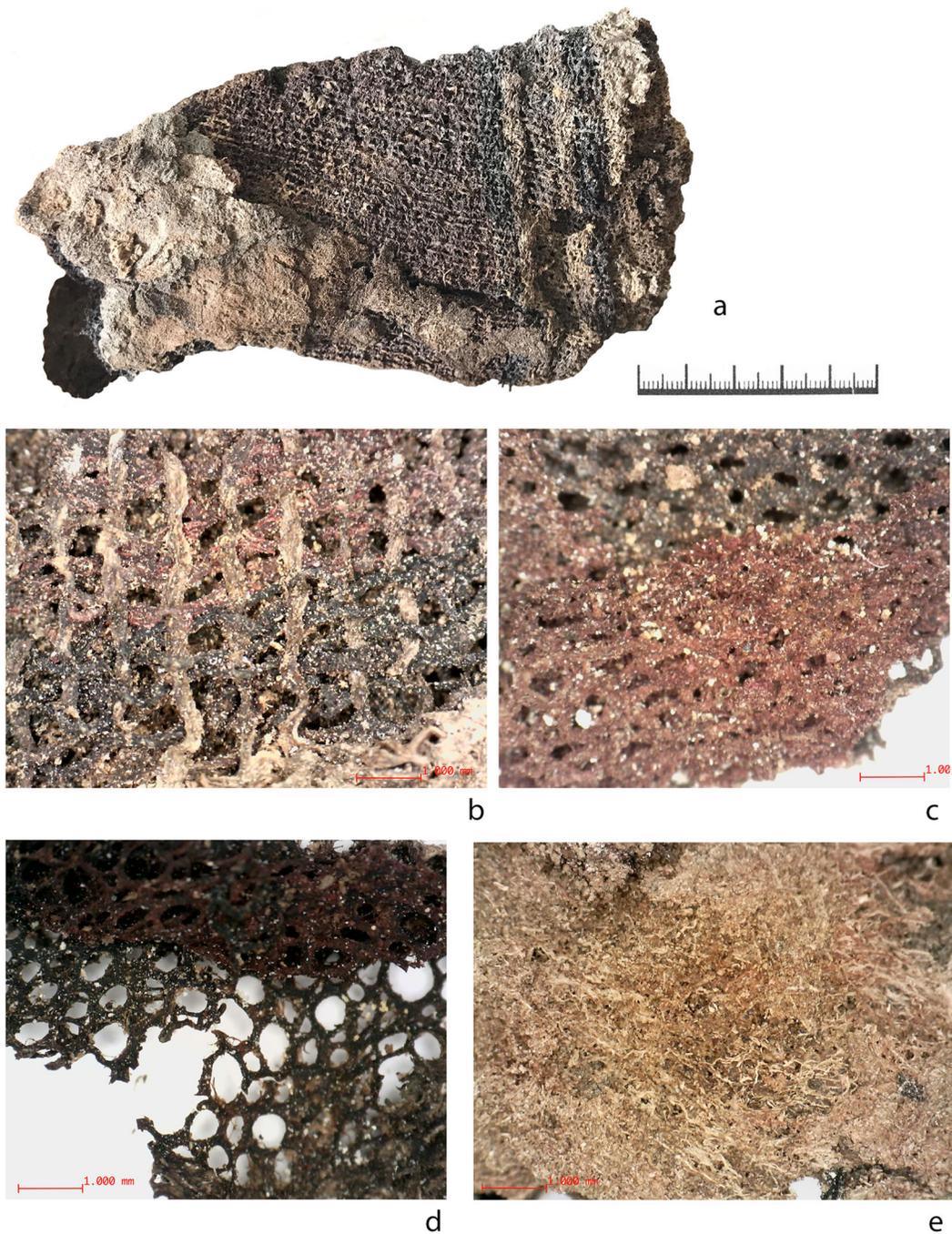


FIGURE 12

Textiles: a) fragment with stripes; b) striped tabby; c) monochrome tabby; d) three-directional plaiting; e) felt (images: M. Gleba).

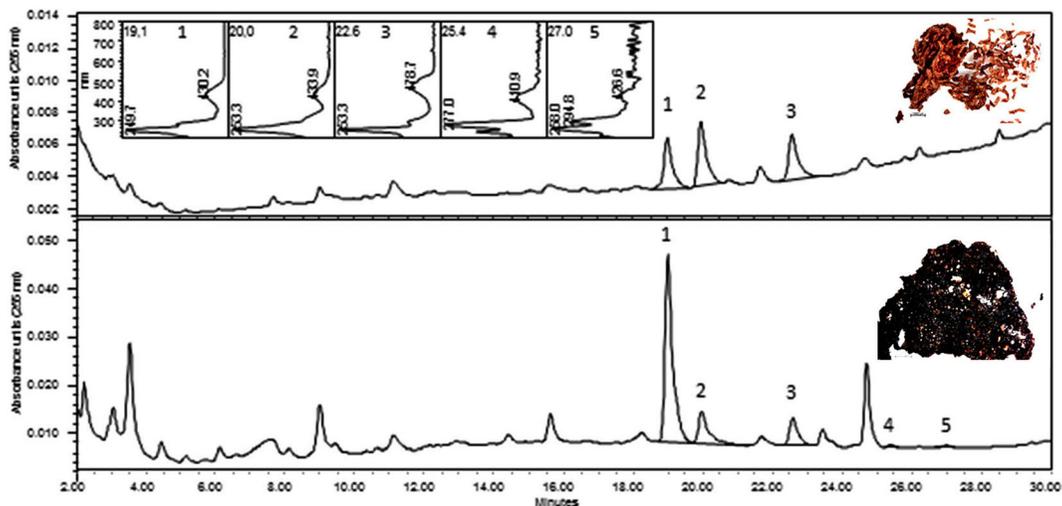


FIGURE 13

HPLC-DAD chromatogram at 255 nm wavelength of the red felt sample (top), and the black textile (bottom) from Bulhakovo Kurgan 5, Burial 2; Spectral data of detected anthraquinone compounds: alizarin (1), alizarin-like compound (2), purpurin (3), rubiadin (4) and nordamnacanthal (5).

Pigments

Many of the arrow shafts preserve paint markings in at least six patterns, possibly corresponding to the size types of arrowheads, although the fragmentary condition of the arrows does not allow confirmation of this (Fig. 5d). During the excavations, not only red, but also white, black and blue paint was observed on the shafts (Grebennikov 2008, 84). Today, only traces of the red colour are preserved. The portable X-ray Fluorescence (p-XRF) analysis of a wooden arrow with red pigment identified the presence of mercury (Hg) and sulphur (S) identifying the red pigment as cinnabar (Table 3), which is a common mineral used for decoration of various Scythian objects, including leather, bone and wood (Gleba *et al.* 2020a). Cinnabar-painted arrow shafts are known from several Scythian burials in Ukraine, for example Ilyinka Kurgan 4 Burial 3 (Gleba *et al.* 2020a, 162), and also in Russia (Simpson and Pankova 2017, 217 cat. 133, fig. 133).

Cinnabar is a naturally occurring mercury sulphide (HgS) and has been utilized for decorative purposes for millennia (Gliozzo 2021). Nonetheless, although the Carpathian mountains and the Donbas region of Ukraine have native sources of cinnabar, there is no evidence that either location was exploited during Scythian times. There are known quarries on the Crimean peninsula, but in this case, too, there are no data regarding their use in ancient times. Cinnabar could also have been procured from somewhere further afield, perhaps in the west where there are several known cinnabar mines in the Balkans (e.g. Gajić-Kvašćev *et al.* 2012), or the east, for example in the Caucasian region, Turkey, Central Asia or even China.⁵

⁵ <https://www.mindat.org/min-1052.html> [accessed 09.02.2022].

TABLE 3

p-XRF results table showing major elements present in the sample identified as cinnabar (average of three readings)

Object	P	S	K	Ca	Fe	Cu	Hg
	%	%	%	%	%	%	%
red-painted arrow	12.4	8.678.7	0.4	2.1	0.6	0.3	8.8

FROM BURIAL GOODS TO PRODUCTION AND EXCHANGE ECONOMY

It is often assumed that Scythians produced little of their material culture and obtained most of their non-animal-based subsistence and prestige goods through exchange with sedentary societies, since certain technologies (metallurgy in particular) necessitated infrastructures and operational sequences presumably incompatible with a nomadic lifestyle (e.g. Onaiko 1976; Gavriliuk 2013). This is undoubtedly true for the clearly Greek ceramic items, such as the Mendes transport amphora and the Attic *kylikes* found at Bulhakovo, and likely so for glass and for the gold objects executed in an unmistakably Hellenic style and hence assumed to have been produced by Greek craftspeople (Onaiko 1976; Alekseev 2012; Cunliffe 2019). Mirrors are also generally regarded as products of Greek artisans (particularly in Olbia) or as Scythian copies, although more recent studies suggest that they may have been manufactured by Scythian craftspeople (Olgovskij 1999, 68–9; Polin and Daragan 2019, 207).

Bronze arrowheads, on the other hand, are the quintessential Scythian artefact. Recent studies suggest that the arrowheads were cast in ceramic moulds using the lost-wax technique by Scythian specialists living in settlements, which appeared in the steppe from the second half of the fifth century BC, rather than being produced by nomadic Scythians, since the metallurgical process had to be carefully controlled and was highly specialized (Daragan 2017, 82; Daragan and Romanenko 2021). Some of the arrowheads carry markings, suggesting some degree of standardization, which is also indicated by the accompanying painted markings on the wooden arrow shafts. The large bronze cauldrons are generally regarded as Scythian products since they are found exclusively in Scythian contexts (Minasyan 2014, 190–3). Their local production is also mentioned by Herodotus (*Histories*, IV, 61). The metal production sites remain unknown, although one of them could have been Kamyanske Horodyshche, a fortified settlement in the lower Dnipro region, active between the end of the fifth and third centuries BC. Here evidence for the production of bronze cauldrons, as well as iron knives and spear heads, like the ones found in the Bulhakovo burial, has been found (Grakov 1954, 131; Gavriliuk 2013, 346–51).

Given the construction of the tripartite wooden box using exotic conifer wood, the Greek letters, and the iconography of a squatting bathing woman on the lid of the second wooden box, it is likely that they were produced in one of the (Crimean?) Greek centres. The lathe-turned distaffs may have been produced in the Greek settlements as well. The lathe appears to have been used in Greece (and by extension in its settlements across the Mediterranean basin) by the Archaic period, as documented by lathe-turned objects found at the Heraion of Samos (Kopcke 1967; Kyrieleis 1983). Of course, it cannot be excluded that the Scythians may have adopted the use of the lathe from their Greek neighbours and that thus the distaffs from Bulhakovo were Scythian products.

All other wooden objects, such as the trays, the bowl, the closed vessel with handles (which has Scythian parallels in ceramic and precious metals), the chest and the various textile tools were

likely of Scythian manufacture, as they are common in Scythian burials and are produced in locally available materials. The animal-style iconography of the remains of the wooden chest clearly points towards its origin in the Scythian sphere. The wooden arrow shafts could be made by the archers themselves, which would explain the use of different types of wood in the same set of arrows. Shafts were likely cut from coppiced trees of various species growing near the rivers often frequented by the nomads, which produced very straight and thin shoots. Wood working, including lathe turning, is certainly not impeded by a mobile lifestyle; nomads across Eurasia carved easily transportable items such as those found at Bulhakovo (Simpson and Pankova 2017, 157).

The leather items can also be attributed to Scythian craftsmanship. As noted above, the leather ankle boots found on Individual 2 are well known from Scythian iconography and were a distinctive element of Scythian dress. The almost intact leather quiver from Bulhakovo provides important information about this most iconic Scythian item, allowing the reconstructing of the more fragmentary examples found in other burials (Daragan 2020). Various details of its design correspond not only to the archaeological material known from the territory of the Pontic Steppe but also an earlier find from Arzhan-2 in Russia (Chugunov 2013, 439), indicating that its form and shape are indigenous to the steppe nomadic milieu. It is highly likely that, at least originally, quivers would have been produced by the Scythians themselves. Ethnographic studies illustrate that nomads can make skins and leather themselves (e.g. Thargyal 2007, 89–91 on skin production by Tibetan pastoralists). Nevertheless, the possibility that by the fourth century BC some of their production was outsourced to the settled craftspeople living within the Scythian sphere of influence should not be excluded. In favour of the latter scenario are the embossed designs of a distinctly Hellenic style and synthetic pigments (Egyptian blue) used in the decoration on quiver fragments in burials contemporaneous with Bulhakovo, such as Ilyinka Kurgan 4 Burial 3 (Spindler *et al.* 2020, 588; Gleba *et al.* 2020a, 162). Still, if we are to believe Herodotus, the use of human skin in the construction of quivers at both Bulhakovo and Ilyinka points to a distinctly Scythian tradition.

Mobility is also not a hindrance to textile work. Wool could be obtained from the sheep and goats kept by the nomads. Spinning with a drop spindle is well-known from historic and ethnographic contexts to be done on the move (Ahmed 2002). Weaving can be accomplished on small ground or back-strap looms, and these can be easily dismantled and carried. Present-day Mongolian and other Asian nomads practise textile production this way (Ahmed 2002; Kristen Pearson, pers. comm. 2018). Dyeing does not require permanent infrastructure and can be done in small cauldrons or pits dug in the ground, although it does presuppose specialized skills and knowledge. Madder for dyeing could be procured locally since it is a native plant in the region and the dyeing process is relatively quick.

While we can say little about the makers of the wooden or leather artefacts, we can surmise that textile production was a female domain. Scythian women's skill in textile crafts is demonstrated by sets of textile tools which accompanied them into the afterlife, such as the one found at Bulhakovo and many other Scythian female burials (Daragan *et al.* 2016). Short distaffs are indicative of spinning wool and, indeed, the majority of Scythian textiles analysed to date are made of sheep wool (Gleba *et al.* 2020b). Weaving tablets found in at least two Scythian textile tool sets indicate a familiarity of the Scythian populations with tablet weaving (Collingwood 1982), a technique particularly suitable for a mobile lifestyle considering the small size of the equipment. To date, though, no tablet-woven textile has been identified among Scythian archaeological textiles, but it should be kept in mind that very few of them have been analysed (Gleba and Krupa 2012; Gleba *et al.* 2020b). The three-directional plaiting identified in one of the Bulhakovo textiles would not have required any tools.

CONCLUSION

The Scythians left no written records and – being nomads – very few settlements, hence most of what is known about them is filtered through the ancient Greek and Persian accounts and their archaeological funerary record. The discussion of the latter is disproportionately geared towards the gold objects found in the richest burials. Yet, in keeping with other non-writing cultures, and as demonstrated by the rich Scytho-Siberian finds, it is their perishable – wooden, leather, and textile – objects that reflect Scythian life first and foremost. The window into the past provided by the unusual preservation of organic materials at Bulhakovo and their study using a variety of archaeometric methods has allowed us for the first time to identify the wide variety of wood species utilized by the Scythians for different categories of objects, the animal species employed to produce leather, and the types of textiles, dyes, and pigments they used. These new data allow us to hypothesize about the primary elements of Scythian economy, those that were indigenous, largely based on animal husbandry and compatible with nomadic lifestyle, as is also corroborated by the ethnographic evidence. The burial assemblage from Burial 2 in Kurgan 5 at Bulhakovo furthermore allows us to gain a much more nuanced and complete picture of the complex networks of production and exchange that existed in the Pontic Steppe region in the fourth century BC. Distinguishing between Scythian and Greek production is not always straightforward – Scythian craftspeople may have settled in Greek settlements and vice versa, and both catered to the diverse populations of the region. It is our hope that future systematic scientific studies of organic and inorganic materials used by the Scythians may shed light on these complex relationships. The Bulhakovo burial presented in this contribution demonstrates how much deeper our understanding of the Scythian life and culture can be if we take a holistic approach to the material studies of this nomadic civilization.

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At the time of writing, the Scythian sites of southern Ukraine are in a war zone and in grave danger of being looted and/or destroyed. We are grateful to the editors of *OJA* for accepting this contribution for publication and bringing much-needed attention to the heritage of Ukraine.

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(MD) National Academy of Sciences of Ukraine
 Institute of Archaeology
 Heroiv Stalingradu Ave. 12
 Kyiv 04210
 UKRAINE
 ORCID: <https://orcid.org/0000-0003-1019-9407>

(LL) *St. Petersburg State Forest Technical University*
Institute per. 5
St. Petersburg 194021
RUSSIA

ORCID: <https://orcid.org/0000-0003-1019-9407>

(MR) *Institute of Archaeology*
University College London
31-34 Gordon Square. WC1H 0PY
London
UK

ORCID: <https://orcid.org/0000-0003-1019-9407>

(LØB) *The GLOBE Institute*
University of Copenhagen
Øster Farimagsgade 5
Copenhagen K
DENMARK

ORCID: <https://orcid.org/0000-0003-1019-9407>

(IV-B) *Textile Research Laboratory*
Royal Institute for Cultural Heritage (KIK/IRPA)
Jubelpark 1, 1000, Brussels
BELGIUM

ORCID: <https://orcid.org/0000-0003-1019-9407>

(MG) *Department of Cultural Heritage*
Piazza Capitaniato, 7, 35139, Padova
ITALY

(Corresponding author) E-mail: margarita.gleba@unipd.it

ORCID: <https://orcid.org/0000-0003-1019-9407>

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Data S1. Supporting Information