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NEOLITHIC TEXTILE PRODUCTION ARTIFACTS AT BRONOCICE

ABSTRACT

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The first evidence for fiber and textile production appeared around 5500 BC with the advent of Linear Pottery culture in southeastern Poland. By the fourth millennium BC, agricultural societies were well established and becoming increasingly sophisticated. Around 3700 BC the settlement of Bronocice began to develop economically, politically and technologically. From that time until the settlement collapsed around 2900 BC fiber and cloth production increased in scale. Unfortunately, there are few traces of textiles and no artistic representations exist of clothes worn by people living at the site. Instead, the proof lies in sheep skeletal remains, bone tools and clay artifacts.

Keywords: Neolithic, Funnel Beaker, textile and fiber production, Bronocice
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INTRODUCTION

The purpose of this article is to present a summary of the results of textile production artifact analysis from Funnel Beaker (FB), Lublin-Volhynian (L-V), and Funnel Beaker-Baden (FB-B) cultural occupations at Bronocice, approximately from 3900 BC to 2900/2800 BC. Numerous textile production artifacts were recovered during the 1974-1978 excavations conducted by the State University of New York at Buffalo and Polish Academy of Sciences. The Director and Principal Polish investigator was Witold Hensel and Sarunas Milisauskas was the Principal American investigator. The objectives of this research were twofold: 1) to investigate the prehistoric environments, chronologies, economies, settlement systems, and social organizations of the Funnel Beaker and Funnel Beaker-Baden communities, and 2) to demonstrate the origin of complex societies in that region.

The origins of textile production are linked with the beginning of domestication of plants and animals and the appearance of sedentary societies (Burnham 1965; Bogaard 2004; Bogucki 1988, 1993). Weaving requires preparation of fibrous materials and the technological apparatus used to generate fabric. In southeastern Poland the earliest evidence for weaving is found on early Neolithic sites associated with Linear Pottery culture (Barber 1991; Milisauskas and Kruk 2011; Wiślański 1970). This culture spread into south-eastern Poland from regions south of the Carpathians introducing new technologies, subsistence practices and lifestyles. Sites such as Olszanica yielded spindle whorls and loom weights in small numbers suggesting that textile production was small and associated with only a few households (Milisauskas 1986). Later Lengyel sites also contain small numbers of these artifact types showing continuity in practice and scale. These data suggest that textiles may have been made for purposes other than clothing. Textiles may have had more utilitarian purposes, e.g. such as a 'tablecloth'. There is no way to know. However, some later Neolithic sites such as Bronocice, Gródek Nadbużny, and Ćmielów yielded greater frequencies of weaving related artifacts indicating an increasing scale of cloth production which may be linked to the use of fabric for clothing. Who made the textiles at these sites? Most likely women were the weavers.

The Funnel Beaker settlement at Bronocice was an agricultural and livestock rearing based subsistence society with a complex economy involved in specialized production of lithics and trade in livestock and textiles. Comparative studies of subsistence based agricultural and livestock production societies, past and present, are typically patriarchal patrilocal in social structure (Service 1975). In these societies, exogamous marriage patterns tend to be the norm. A settlement like Bronocice would have likely been composed mainly of Funnel Beaker households in which women were locally born and originating from nearby communities. However, there are ample data at Bronocice observed in burials and pottery that show that non-Funnel Beaker people lived and died there (Milisauskas *et*

al. 2016). The presence of non-Funnel Beaker people is also seen in a few decorated fiber and textile production artifacts, which are typical of cultures found to the east and south of the region (Chmielewski 2009a). They likely belonged to non-Funnel Beaker women who either married into the community or came to live there with their husbands who may have been trading agents. It is impossible to conclusively demonstrate that weaving fell within the realm of women. Nonetheless it can be shown that it was a household-based production as most loom weights and spindle whorls were recovered within pits along with other domestic artifacts like pottery and lithic tools. The production of cloth required skills which were often depicted in illustrations and described in texts around the Mediterranean basin dating to the Bronze Age as belonging to women (Ackerman 2008; Chadwick *et al.* 1962; Firth and Nosch 2012; McCorriston 1997; Randsborg 2011; Smith and Tzachili 2012). No men were directly associated with the production of cloth in Europe during that time. The real question however is not whether women produced textiles but who traded it. Because ultimately at Bronocice it was the trade in textiles that drove the economic expansion and regional dominance of this settlement. One study conducted on control over manufacture and sale of cloth in ancient Mesopotamia showed that intensified cloth production resulted in a loss of control and autonomy by women to men, a pattern which may have occurred at Bronocice in the last stages of the settlement (McCorriston 1997).

ARCHAEOLOGICAL CONTEXT

Bronocice (50°21'00" N latitude, 20°19'30" E longitude) is located on the highest local elevation above the Nidzica River floodplain, near the small town of Działoszyce, Świętokrzyskie province. The Bronocice site has a total area of 52 ha; its length is about 1600 m and its width varying from 300 to 500 m. Excavations were carried out in three natural topographic areas: A 18 ha, B 18 ha and C 16 ha to define the chronological, functional, and cultural variability of the site. A total of 25 excavation units, encompassing 5608 square meters were uncovered. Between 1979 and 1981 additional test excavations were carried out, bringing the total investigated area to 8668 square meters. Over 550 pits, 3 ditches, and 26 burials were excavated at Bronocice (Kruk and Milisauskas 1981a and b; Milisauskas and Kruk 1984, 1989). The radiocarbon dates indicate that the Neolithic occupation lasted for approximately 1100 years at Bronocice and it is associated with three archaeological cultures: Funnel Beaker, Lublin-Volhynian and Funnel Beaker-Baden (Table 1). The latest Neolithic material at Bronocice belongs to the Corded Ware culture burial (Milisauskas and Kruk 1984a and b).

The longest occupations belonged to the Funnel Beaker and Funnel Beaker-Baden cultures. We classified the Funnel Beaker and Funnel Beaker-Baden features into 5 phases, BR I-BR V. We have used two parallel time frames for classifying the Bronocice material, phases 1 thru 6 and phases BR I, L-V, BR II, BR III, BR IV and BR V. We prefer the latter, BR I-V.

The first Funnel Beaker group, probably no more than several families, appeared around 3900 BC, or even earlier, and occupied an area of ca 2 ha at Bronocice. After two or three generations, around 3800 BC, the Funnel Beaker settlement was replaced by one of the Lublin-Volhynian culture. They built a fortification enclosing 2.4 ha. Bronocice was re-occupied by the Funnel Beaker people, phase BR II, around 3700 BC. The settlement now occupied 8 ha. The classic Funnel Beaker occupation lasted 400 years, and included phases BR II, 3700-3500 BC, and BR III, 3500-3300 BC. In the latter phase the settlement expanded to 21 ha, mostly in Area A. Around 3300 BC Funnel Beaker ceramics began to incorporate Baden ceramic forms and surface treatments. Thus, the culture is now referred to as Funnel Beaker-Baden, occupying the site from 3300 to 2900/2800 BC. We assume there was continuity between the Funnel Beaker and Funnel Beaker-Baden cultures. The Funnel Beaker-Baden occupation, BR IV, represents the largest expansion of the settlement covering about 26 ha in Areas A and B. In phase BR V, 3100-2900/2800 BC, it shrank to 17 ha, mostly in Area B.

Excavations at Bronocice revealed an extensive area of settlement and recovered a large volume of diverse cultural materials including pottery, lithics, burials, fiber and textile production artifacts, and floral and faunal remains (Kruk and Milisauskas 1985). Numerous household pits, human burials, two defensive ditches, and two enclosures for domestic animals were investigated at Bronocice (Diachenko *et al*. 2016; Kruk and Milisauskas 1981a and b, 1983, Milisauskas and Kruk 1984, 1989; Milisauskas *et al*. 2012, 2016).

Table 1. Length of the six occupational phases at Bronocice

Phase	Culture	Dates (BC cal)
Phase BR I	Funnel Beaker	3900-3800
Phase L-V	Lublin-Volhynian	3800-3700
Phase BR II	Funnel-Beaker	3700-3500
Phase BR III	Funnel Beaker	3500-3300
Phase BR IV	Funnel Beaker-Baden	3300-3100
Phase BR V	Funnel Beaker-Baden	3100-2900/2800

THE FIBER AND TEXTILE PRODUCTION ASSEMBLAGE

The archaeological evidence for spinning and weaving at Bronocice is comprised of clay and bone artifacts, pseudomorphs, collapsed workshop or sheds, storage pits and postmold stains. Clay artifacts include spindle whorls, loom weights and spools, while bone tools consist of pin and sword beaters and one bone comb. Other bone tools were found which include awls and tools of unknown function. Impressions of textiles and fi-

bers, known as pseudomorphs, were found on some clay objects. This type of analysis has proven informative as it offers a chance to glimpse fragments of ancient cloth, straps, thread and rope (Kośko and Szmyt 2010; Drooker 2000). Collapsed wattle and daub workshops, huts or sheds as well as storage pits were found which contained sets of spindle whorls, loom weights and spools. And though no actual looms were found, some postmold stains were uncovered inside houses which point to their existence.

The fiber and textile production artifacts described here are a representative sample of a much larger assemblage. Criteria were established for inclusion in the study. First, the artifacts had to come from undisturbed deposits. Undisturbed deposits are important because they may be assigned to specific phases of occupation. Second, preference was given to deposits that yielded multiple whorls, spools or loom weights. Having sets of artifacts from the same deposits revealed variability in terms of shape and size of tools found within a household. And third, preference was given to specimens bearing ornamentation. Ornamentation may be a marker of social identity though the meaning may remain elusive. As such comparing decorated specimens across households at the site as well those found at other sites opens a new line of thought which considers the possibility that some of their makers traveled to and from Bronocice and that they may have been related extended families.

1. Clay Artifacts

Clay fiber and textile production artifacts included spindle whorls, loom weight and spools. There were other artifacts which may also be related to these activities but whose function is unclear. For example, there was a broken flat clay disk with two perforated holes and a circular groove which was classified as a potential loom weight (Figure 1). In a few cases, objects could not be classified as weights or spools because they were seemed either too large to be a spool or too small to be a weight (Figure 2). They were nonetheless classified as textile production artifacts though it is possible they served other purposes, such as curtain weights, tie downs for canvasses transporting goods, or other kinds of non-textile production weights.

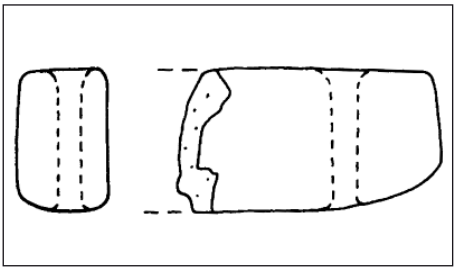

Fig. 1. Loom weight with two holes, Phase BR II

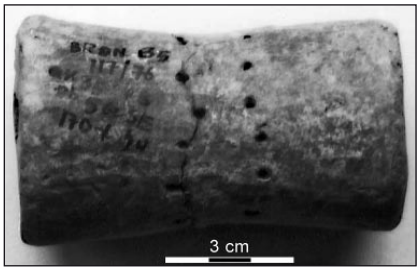

Fig. 2. Spool-shaped loom weight. Object has a center hole

Fig. 3. Foundation of a weaver's hut, Structure A1-125

The total clay fiber and textile production assemblage at Bronocice obtained from controlled excavations consisted of 696 objects (Table 2). These few objects deposited after the abandonment of the settlement are not considered here. Within the fiber and textile production assemblage, spindle whorls were the most abundant artifact type (n = 341), followed by loom weights (n = 267) and spools (n = 85).

Fiber and textile production artifacts (herein referred to as FT artifacts) increased in frequencies over the thousand years plus that the settlement was occupied. Spindle whorls were found in a variety of depositional contexts including trash pits, house cellars and storage pits, burials, fortification ditches, and enclosure trenches. Loom weights and

Table 2. Summary of sampled fiber and textile production clay objects by phase of occupation

Object	Br I	LV	BR II	BR II/III	BR III	BR IV	BR V
Loom Weight	1	-	13	4	7	29	33
Spindle Whorl	12	7	15	4	32	50	42
Spool	1	-	8	3	14	16	5
	14	7	36	11	53	95	80

Fig. 4. Whorl with grit temper

Fig. 6. Burnished whorl, Pit 5-B6

Fig. 5. Blackened surface from being in an oxidized oven, Pit 82-A1

Fig. 7. Comparison of loom weights likely made by the same hand, Pit 12-B5

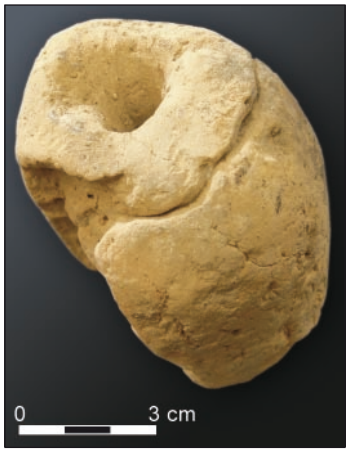

Fig. 8. Broken oblong loom weight showing signs of rolling, Pit 1-A2

Fig. 9. Well-made oblong loom weight, rolled, trimmed, and burnished, Pit 56-B1

Fig. 10. Fabric impressed loom weight, Pit 82-A1

Fig. 12. Traces of cloth left on this disk loom weight, Pit 12-B5

Fig. 14. Whorl from made on a wheel, Pit 8-B7

Fig. 15. Whorl from made on a wheel, Pit 95-B1

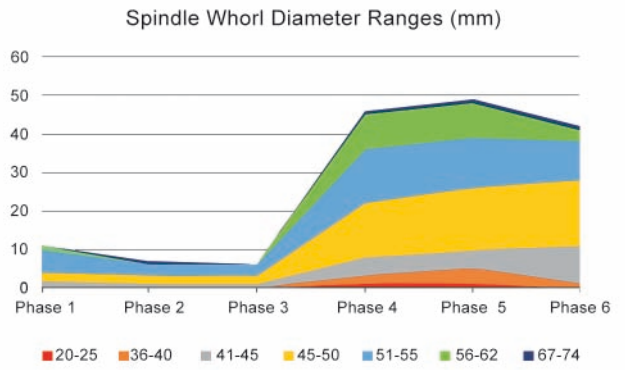

Fig. 16. Spindle whorl diameter ranges (mm) by phase of occupation

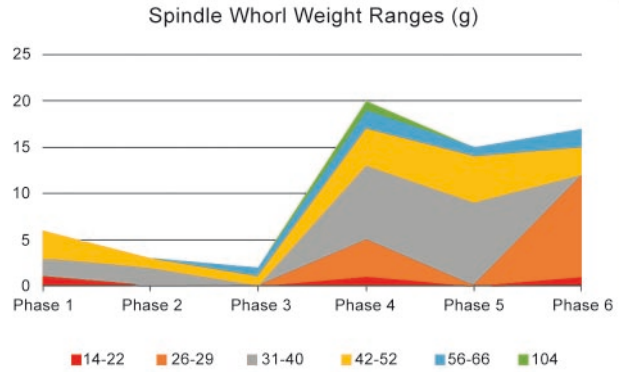

Fig. 17. Spindle whorl weight ranges (grams) by phase of occupation

Fig. 19. Decorated disk weight with heavy thread wear, Pit 12-B5

Fig. 20. Oblong loom weight with a deep thread mark, Pit 5-A2

Fig. 26. Set of weights from the weaver's hut 82-A1, two three have decorated edges

Fig. 28. Examples of size and shape variations in spools, top and bottom rows specimens on the left and right Pit 5-B5

Fig. 29. Pin beater (right), Pit 20-B5

Fig. 30. Pin beater (left, Unit B2) and awl (right, Unit B4)

Fig. 31. Awls, possible beaters Pit 97-A1

Fig. 32. Double pointed beaters Pit 20-B7

Fig. 33. Possible pin beaters or awls Pit 39-B1

Fig. 34. Sword beater Pit 115-A1

Fig. 35. Pin beater (left), robust tool (right) possible beater Pit 77-B1

spools on the other hand were mainly recovered from house cellars and storage pits. In one instance a large concentration of loom weights and spindle whorls was discovered inside a collapsed daub hut dating to Phase BR II (82-A1) (Figure 3). The sample selected for this study were generally found near or at the bottom of house pits though some were found in barns.

It was possible to determine the manufacturing techniques used to produce some of the clay objects. All the FT artifacts were made of low fired earthenware clay, tempered mainly with straw or grass though a few specimens had grit inclusions (Figure 4). Many objects were discolored, often only on one side. The discoloration was the result of oxygen reduction during firing (Figure 5). There were many examples where the surface of whorls and spools were burnished prior to firing (Figure 6). These artifacts were among the best-preserved specimens, while those that had not been burnished were more inclined to deteriorate.

The handmade nature of these artifacts revealed much about the skill levels of their makers as the quality varied considerably. Some specimens were well-made and symmetrical in shape; many were not, a fact particularly evident when multiple specimens came out of the same depositional context. Standardization in size and shape was also evident in deposits with multiple specimens, indicating that that they were produced by the same hand (Figure 7).

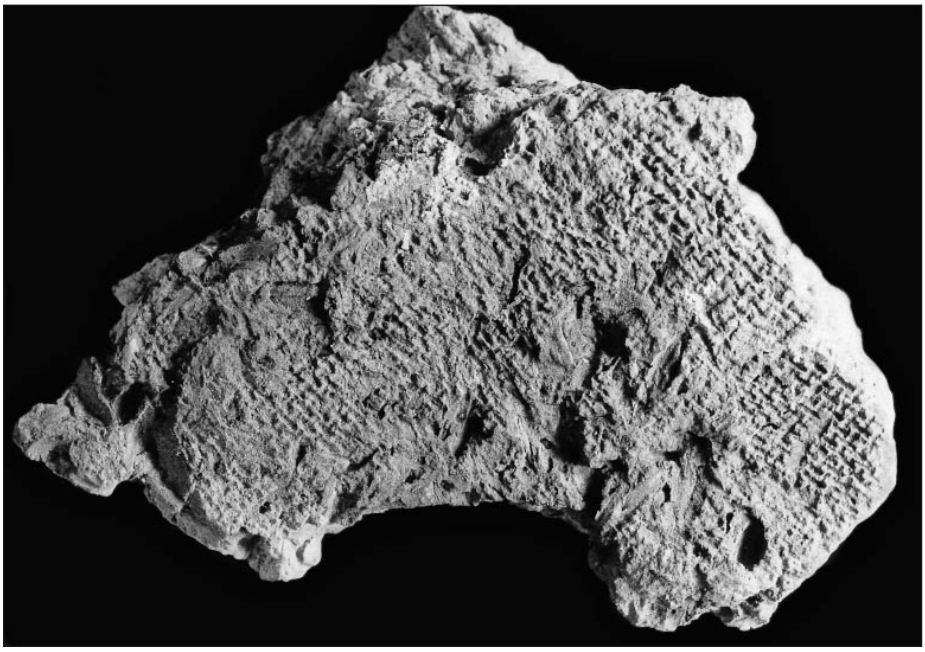

Fig. 11. Fabric impressed put from Niedźwiedź (Burchard and Lityńska-Zając 2002)

Table 3. List of Decorative Elements found on spindle whorls, loom weights and spools

Decorative Element	Spindle Whorls	Loom Weights	Spools
Random dots	P	P	-
Non-random arrays of dots	P	P	P
Dashed Rays	P	-	-
Radiating Lines	P	P	-
Other incised line	-	P	P
Petals	P	P	-
Notched edging	P	-	-
X	-	-	P
Indentations	-	P	-

Oblong loom weights also varied considerably in quality of manufacture and degree of preservation. A few poorly preserved oblong loom weights provided insights into their manufacturing technique. Some broken into pieces revealed that they were produced from rolled slabs of clay. A rectangular piece of flat clay was placed on a piece of cloth. The slab was flattened and then rolled over a stick. Most often the outer edges were trimmed by cutting off excess clay which well-defined edges, though not always (Figures 8 and 9). The cloth impression was smoother and burnished away, as was the seam, which nearly always removed any traces of the cloth. The stick was then removed, and the weight baked in an oven. Some of the loom weights however were fired before fabric impressions were burnished away (Figure 10). The use of cloth in producing clay artifacts is interesting. Fabric impressed pots have been occasionally found on sites. For example, at the contemporary settlement of Niedźwiedź (Phase BR III) the base of a pot was found that was fabric impressed (Figure 11). This use of cloth expands our understanding of the uses and importance of fabric production in Neolithic society. The loose weave of the fabric seen on the weight in Figure 10 as well as on the pot base seen in Figure 11 indicates two different types of coarse woven cloth. Traces of cloth were also seen on some of the disk weights though most were smoothed or burnished before being fired (Figure 12).

Most FT artifacts were plain and undecorated. Though they were few, some of the decorated specimens bore similar designs (Table 3). There were a few instances where the same decoration was present on whorls and loom weights found in the same deposits indicating they belonged to matched sets.

1.1. Spindle Whorls

Spindle whorls were the most abundant of all FT artifacts. A sample of 174 whorls were examined, of which 106 were whole, 47 partial and 21 fragmentary. They were recovered from a wide range of depositional contexts and date to all phases of occupation. Most

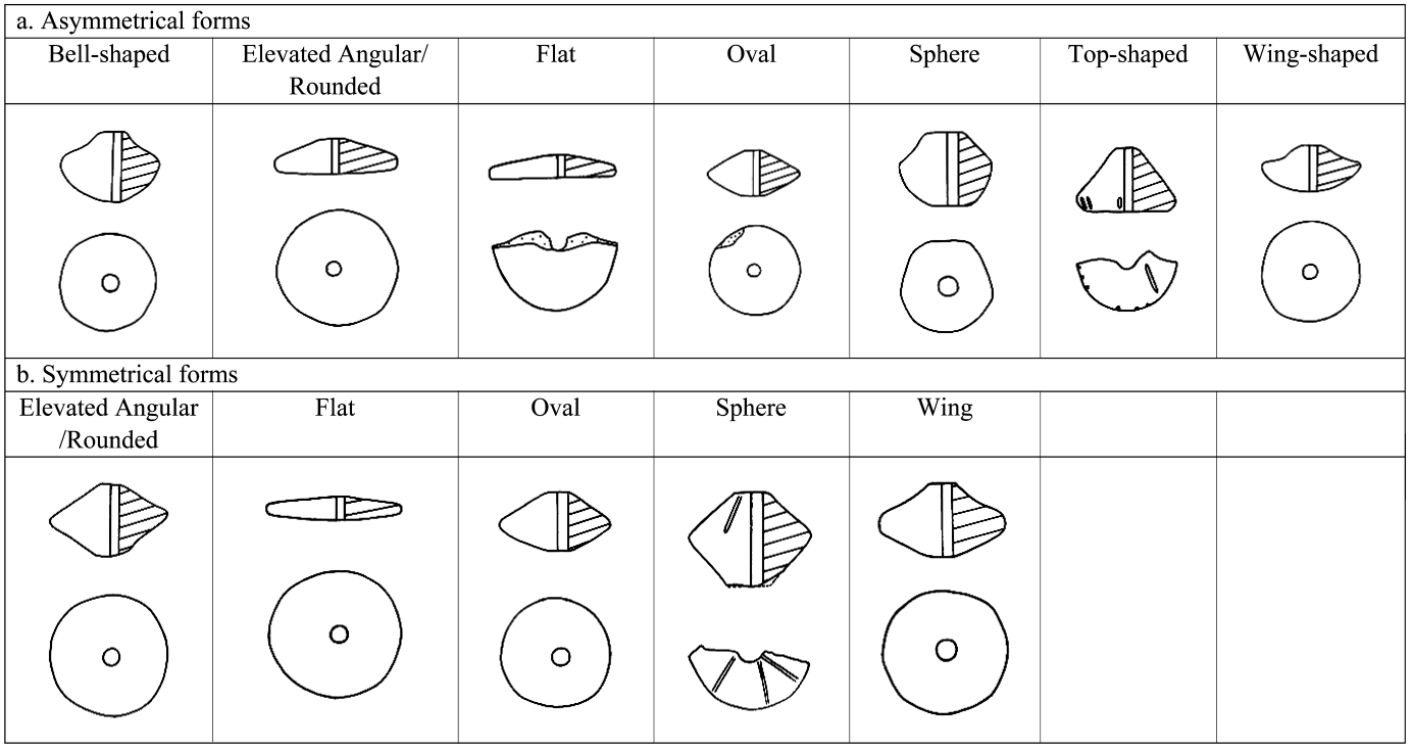

Fig. 13. Typology used in describing asymmetrical and symmetrical spindle whorls

spindle whorls were found in houses and workshops, though they were also recovered from other depositional contexts such as trenches and burials.

Spindle whorls were highly variable in terms of body shape. A simple typology was used to describe spindle whorl shapes (Table 4). Spindle whorls were divided into two basic categories, symmetrical and asymmetrical, both of which were well represented throughout most phases. The most common shapes are illustrated in Figure 13. Whorls from both categories often occurred together within the same deposits so that no temporal distinctions could be assigned to either category (Table 5). The most common shape observed throughout all phases was an elevated angular form that overlapped considerably with oval forms. In general, there was no evidence to suggest that whorls were made in molds, as many of them were crudely made and imperfect. However, there were two examples from Phase BR V that were clearly turned on a wheel (Figures 14 and 15). Their presence reveals that the potter's wheel was in use by that time.

Spindle whorls were measured by disk diameter, width of the spindle hole and disk thickness. Whorl diameters ranged from 33 mm to 70 mm (Figure 16). The great majority fell between 43 mm and 58 mm (n = 149). Of the remaining whorls, 14 had disk diameters between 20-42 mm while 10 had diameters between 59-74 mm. There was a correlation between decreasing diameter and increasing bulbousness. Smaller diameter whorls tended to be more bulbous while larger diameter whorls tended to be flatter. All 66 complete spindle whorls were weighed. Their weights ranged from 14 grams to 104 grams, with most weights falling between 31 grams and 40 grams (Figure 17). Based on previous studies, it is evident that some of the variation in size and form was functional and dependent on the type of fiber spun, such as flax or wool (Chmielewski 2009b; Keith 1998; Mårtensson *et al.*

Table 4. Spindle whorl typology

General Shape	Specific Form	Diameter Range	Thickness Range
Asymmetrical	Sphere	41	31-35
	Wing-shaped	42-47	16-25
	Oval	43-53	16-30
	Top-shaped	44-59	16-30
	Elevated Angular/Round	47-71	11-30
	Flat	52-54	<10-15
	Bell-shaped	53-62	21-45
Symmetrical	Elevated Angular/Round	33-59	<10-40
	Wing-shaped	39-58	16-45
	Oval	40-59	16-35
	Sphere	43-51	31-40
	Flat	46-72	<10-25

Table 5. Spindle whorl shape variability by phase

Symmetry	Shape	Br I		BR II		BR III		BR IV		BR V	
		#	%	#	%			#	%	#	%
Asymmetrical	Bell	-	-	-	-	2	.08	1	.04	1	.06
	Elevated Angular	1	1.00	4	.57	9	.35	9	.36	4	.24
	Rounded edge	-	-	-	-	2	.08	3	.12	5	.29
	Flat	-	-	-	-	1	.04	1	.04	1	.06
	Oval	-	-	1	.14	-	-	2	.08	2	.12
	Sphere	-	-	-	-	-	-	1	.04	-	-
	Top	-	-	2	.29	12	.50	5	.20	4	.24
	Wing	-	-	-	-	-	-	3	.12	-	-
	Total	1	1.00	7	1.00	26	1.00	25	1.00	17	1.00
Symmetrical	Elevated Angular	2	1.00	2	.20	2	.10	2	.06	5	.22
	Rounded edge	-	-	-	-	-	-	-	-	1	.04
	Flat	-	-	1	.10	5	.25	5	.16	4	.17
	Oval	-	-	3	.30	6	.30	13	.42	8	.35
	Sphere	-	-	-	-	2	.10	2	.06	-	-
	Wing	-	-	4	.40	5	.25	9	.29	5	.22
	Total	2	1.00	10	1.00	20	1.00	31	1.00	23	1.00

2006a and b). By the last phase of occupation, there was trend towards lighter weight whorls.

Overall, most spindle whorls were plain and undecorated. Of the 174 specimens examined, only 31 exhibited some form of decoration. Decorated whorls did not increase significantly in number or frequency over time. There were five basic types of decorative elements: dots, dashed rays, petals, lines and notches (Table 6). Decorations often appeared randomly applied to the whorl body. A partial list of decorated spindle whorls from Bronocice is presented in Table 5 and are illustrated in Figure 18. The range of decorations found within the assemblage was like those found on spindle whorls found at other sites such as Gródek Nadbużny, Ćmielów, Książnice Wielkie, Mozgawa and some Cucuteni Tripillia sites (Burchard and Eker 1964; Chmielewski 2009a; Chmielewski and Gardyński 2010; Florek and Wiśniewski 2008; Kowalczyk 1962; Podkowińska and Rauhut 1960). In general, increasing frequencies of decorated whorls appear on Funnel Beaker sites on sites located east and south of the Carpathians where Tripillia and later the Baden cultures exerted their influence (Gumiński 1989; Neustupný and Neustupný 1961).

The presence of decorated and uniquely shaped spindle whorls from the same contexts as undecorated specimens suggests the presence of different women within a household,

Table 6. List of sampled spindle whorls with decorative elements

Phase	Category	Form	Description
BR II	Symmetrical	Flat	3 stamped or impressed indentations
BR II	Symmetrical	Oval	6 rays, both sides
BR II	Symmetrical	Elevated angular	Notched edge
BR II	Symmetrical	Elevated angular	Notched edge
BR III	Asymmetrical	Elevated rounded edge	3 radiating lines from center
BR III	Symmetrical	Elevated rounded edge	Random dots
BR III	Asymmetrical	Elevated rounded edge	2 sets dashed lines around center
BR III	Asymmetrical	Oval	6 rays
BR IV	Symmetrical	Elevated angular	Dots around center
BR IV	Symmetrical	Oval	6 rays
BR IV	Asymmetrical	Top-shaped	2 rays
BR IV	Asymmetrical	Top-shaped	6 rays
BR IV	Symmetrical	Elevated angular	6 rays
BR IV	Asymmetrical	Top-shaped	3 notches on edge, center ray
BR IV	Symmetrical	Elevated rounded edge	Notched edge
BR V	Symmetrical	Elevated angular	3 diagonal rays
BR V	Asymmetrical	Top-shaped	8 dots around center
BR V	Asymmetrical	Top-shaped	6 dashed rays
BR V	Symmetrical	Elevated angular	Random dots
BR V	Asymmetrical	Flat	Random dots around center
BR V	Symmetrical	Elevated angular	15 lines radiating from center
BR V	Symmetrical	Elevated angular	Random dots around center

and the possibility that some may have come from outside the Bronocice region. Furthermore, the great similarities of certain decorative styles observed across sites suggests a wider cultural link between non-local women who lived in other communities.

1.2. Loom Weights

267 loom weights were recovered during excavation of which 98 were measured and some weighed (Table 7). Loom weights were generally found inside house cellars though in a few instances they were recovered from workshops, storage pits and barns. A few large of sets of loom weights were recovered though most often they were found in small numbers. Loom weights increased in numbers over time and were more abundant than spindle whorls during the last occupational phase (Table 7). There may be a practical explanation

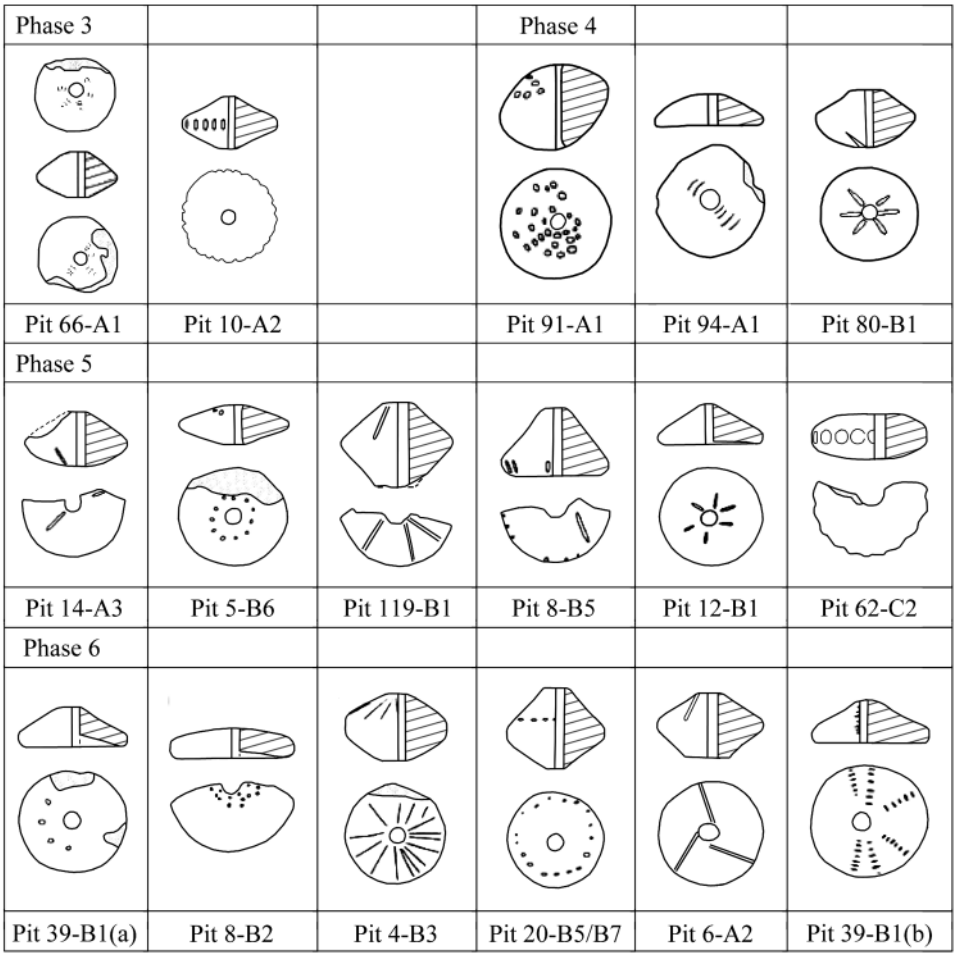

Fig. 18. Decorated spindle whorls from Bronocice by phase

for this. Perhaps when people left they took spindle whorls with them, since spinning was a constant activity, and left behind loom weights, since weaving was not a constant practice.

There were essentially two basic shapes of loom weights: oblong loaves and flat disks (Table 7, Figure 19 and 20). Other types of loom weight shapes were present in smaller numbers including two-hole disk-shaped, donut-shaped, spool-shaped, bowed oblong, and so-called 'mini axe'. Oblong shaped weights were more common throughout all phases. Two trends were noted: 1) there was increasing divergence in the shapes of loom weights over time, and 2) during the last occupational phase disk-shaped weights increased in

Table 7. Summary of sampled all loom weights by occupational phase

Shape	BR I	LV	BR II	BR II/III	BR III	BR IV	BR V
Oblong	1	-	12	3	3	23	5
Disk	-	-	-	2	2	3	24
Diamond	-	-	-	-	-	-	1
Spool	-	-	-	1	1	-	
Unknown	-	-	1	1	1	1	2
Total	1	-	13	8	7	27	32

frequency. The shape, weight, and size of loom weights is partly functional in nature dependent on the fiber being woven (Mårtensson *et al.* 2007, Mårtensson *et al.* 2009). While it might be inferred that oblong shaped weights were used for heavier fabrics that has yet to be demonstrated. It is possible that this shape was commonly made by Funnel Beaker weavers, while disk-shaped weights were introduced by women from other cultural areas.

As was the case with spindle whorls, loom weight dimensions varied considerably. Disk and oval weights were lighter during the earliest occupational phases whereas their weights were more variable during later phases. Unfortunately, most of the loom weights were partial specimens so it was rarely possible to obtain precise weights. As with spindle whorls, some specimens were better made than others, an indication of the differences in the skills of their makers (Figure 18). Some pits contained sets of loom weights that were similar in size and appeared to have been made by the same hand (Figure 9). Many specimens of both types had deep thread marks resulting from extensive use (Figures 19 and 20). These marks also revealed the direction in which they hung.

Oblong shaped loom weights were the most common form during all phases. This generalized shape is the most commonly recovered from Funnel Beaker sites in southeastern Poland. Within the oblong group of weights there was considerable variability in length, thickness and edge treatment (Figure 21). Some oblong weights had rounded edges while others had straight cut edges. Some were slightly bowed in the center, others were straight. Some were poorly made and had uneven edges and still others the ends were tapered. Seven oblong weights were weighed, all dating from later phases. Their weights ranged from 135g to 824g (Table 8). There was one small Phase BR I oblong weight which was not weighed since it was incomplete. Nonetheless, its length (44.48 mm) and thickness (35.07) indicate it would have been light weight (Table 9). A few other small oblong weights were found dating to Phases BR III-V Theses measured between 68.75 mm and 78.67 mm in length and 43.69 mm to 64.33 mm in thickness. A set of 38 oblong loom weights were found in Structure 82-A1 dating to Phase BR I five of which are illustrated in Figure 22.

The frequency and occurrence of disk shaped loom weights was far less than oblong weights. They appeared at the end of Phase BR II. Based on the data in Tables 6 and 7 it

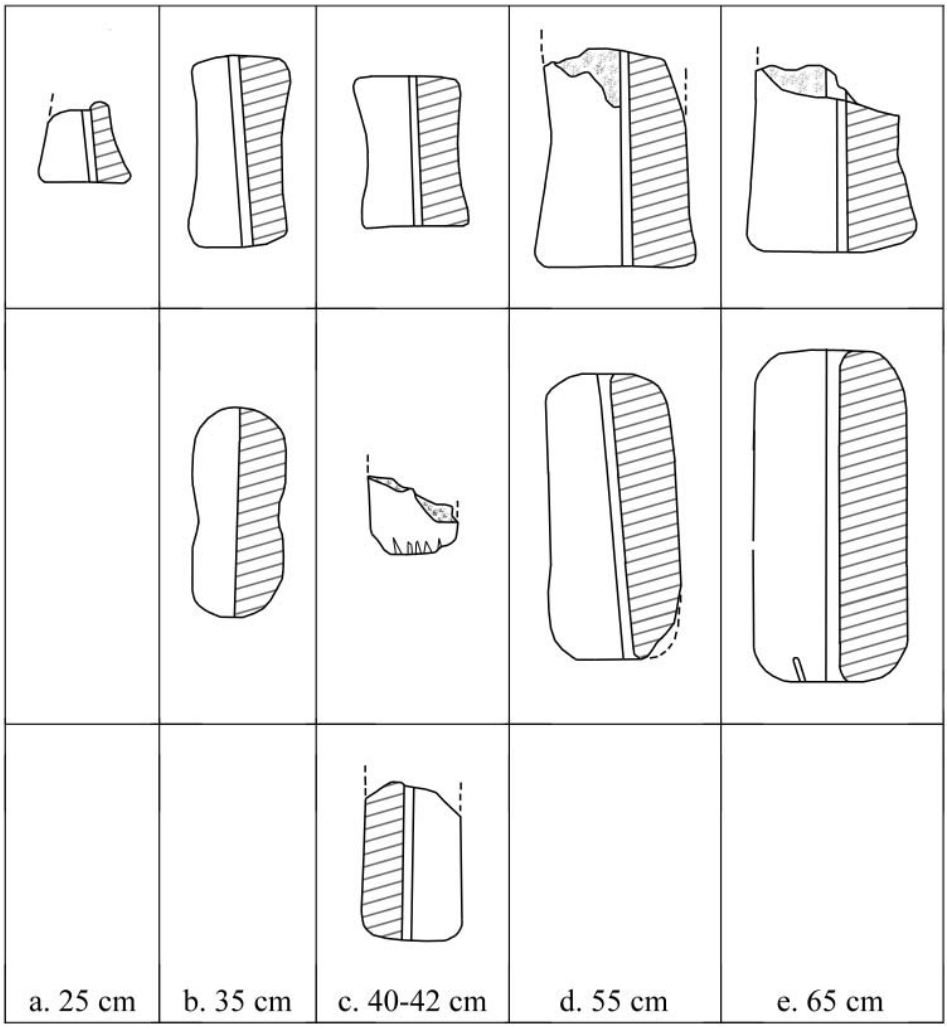

Fig. 21. Variations in center diameter, shape and edge treatments of oblong loom weights

might seem that they increase in frequency by the end of Phase BR V. They appeared in four houses while oval weights appeared in five houses, two of which had both shapes. Disks tended to be lighter in weight than oblong weights. Within the sample they ranged from 278 grams to 758 grams. With one exception these dated to Phase BR V and nearly all of them came from the same storage pit. The heaviest one came from a different house. The lightest one dated earlier in time.

While it was not always possible to obtain weights for these specimens, a greater number of specimens could be measured, even when they were partial. Disk weights ranged in

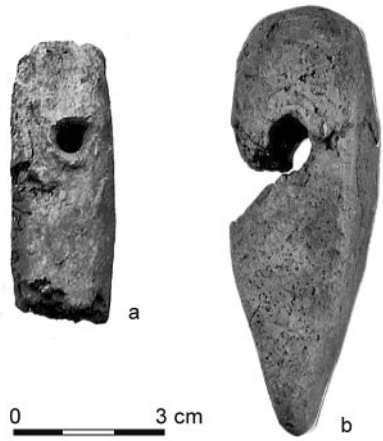

Fig. 22. 'Mini Axe' loom weights, (a) Phase BR II-III, Pit 42-A1, (b) Phase BR IV, Pit 56-B1

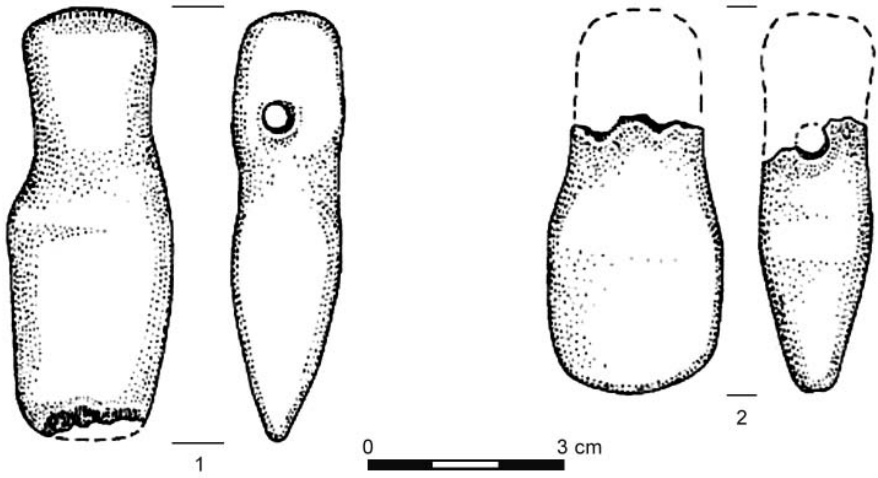

Fig. 23. Examples of 'Mini Axe" loom weights from Żawarża (Kulczycka-Leciejewiczowa 2002)

diameter from 109-149 mm and in thickness from 27-52 mm. Overall there was a general conformity in diameter to within 10 mm. There was one outlier, 140 mm in diameter, which was also the heaviest of all disk weights.

Two so-called 'mini axes' were recovered from Phases BR II and BR IV (Figure 22). These objects remain a topic of discussion as some archaeologists believe them to be toys (Chmielewski 2014; Chmielewski 2015). Because they have been recovered as Bronocice,

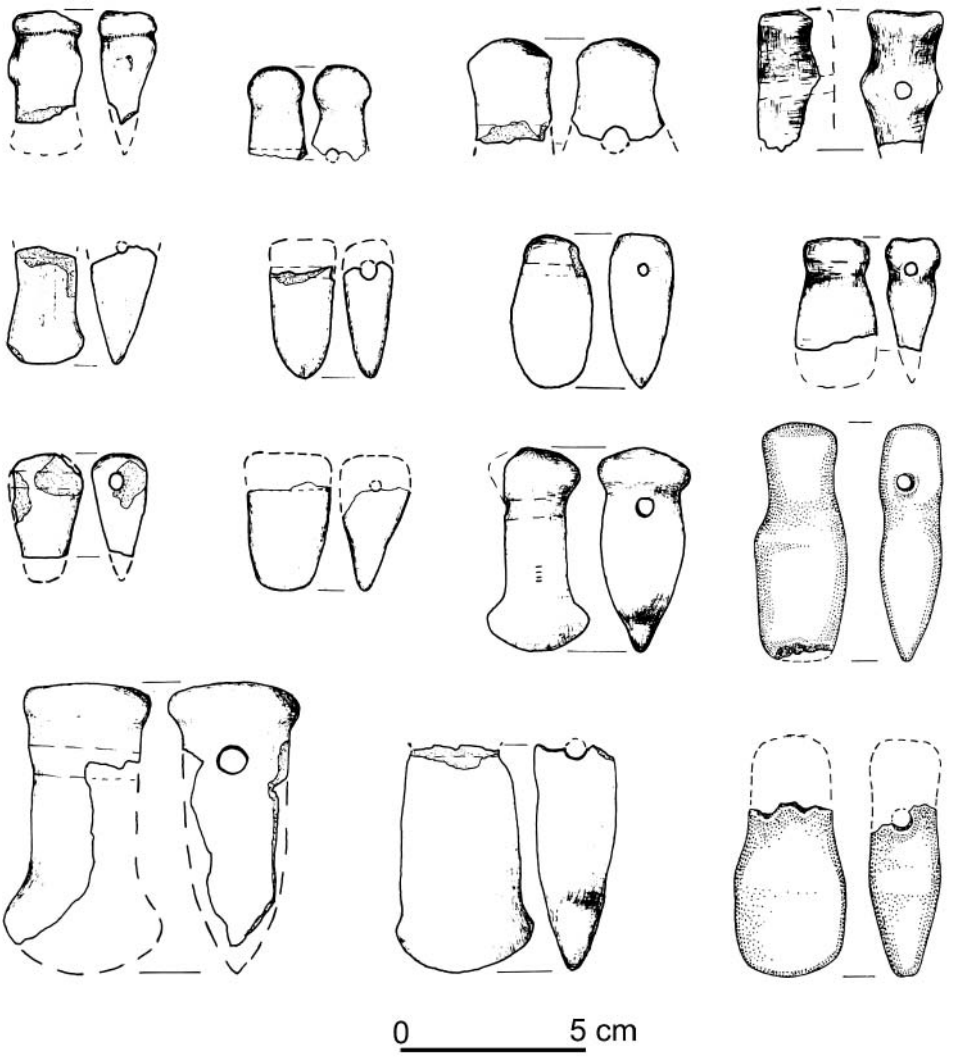

Fig. 24. Examples of 'Mini Axe" loom weights from Gródek Nadbużny (Kowalczyk 1962)

Żawarża and Gródek Nadbużny in conjunction with other fiber and textile production artifacts it seems more likely to us that they are loom weights and so are treated as such in this article. When compared between sites the 'mini axes' share a generalized shape, but their styles are in fact quite distinct. The phase BR II specimen from Bronocice is unlike any other found in the region. The phase BR IV specimen however is very similar to two specimens found at Niedźwiedź (Figure 23). Other examples were found at, Gródek Nadbużny

Table 8. Summary of loom weights by phase

Shape	Weight Range (g)	BR I	L-V	BR II	BR II/III	BR III	BR IV	BR V
Oblong	135	-	-	-	-	1	-	-
	181	-	-	-	-	-	-	1
	471	-	-	-	1	-	-	-
	485	-	-	-	-	1	-	-
	588	-	-	-	-	-	1	-
	749	-	-	-	-	1	-	-
	824	-	-	-	-	1	-	-
Spool	239	-	-	-	-	1	-	-
Disk	278	-	-	-	-	1	-	-
	330	-	-	-	-	-	-	1
	350	-	-	-	-	-	-	2
	359	-	-	-	-	-	-	1
	365	-	-	-	-	-	-	1
	368	-	-	-	-	-	-	1
	371	-	-	-	-	-	-	1
	375	-	-	-	-	-	-	1
	395	-	-	-	-	-	-	1
	405	-	-	-	-	-	-	1
	406	-	-	-	-	-	-	1
	416	-	-	-	-	-	-	2
	758	-	-	-	-	-	-	1
Total		-	-	-	1	6	1	14

and Książnice Wielkie (Burchard and Eker 1964; Gumiński 1989; Kowalczyk 1962; Kulczycka-Leciejewiczowa 2002). But they are not the same size nor are their shapes identical to those from Bronocice (Figure 24). It seems possible, based on the high frequency of this type of loom weight from Gródek Nadbużny, that this site was the point of origin.

Loom weights were rarely decorated. There was a total of 22 decorated loom weights. Some of these are illustrated in Figures 25-26. The range of decorative elements was like those found on spindle whorls, consisting of random dots, aligned dots, radiating lines, petals and finger nail impressions (Table 10). Some of the 'decorations' may be unintentional marks left by their makers consisting of fingertip marks. These were found on an oblong weight and a disk. Finger nail impressions were made arranged in rows indicating the decorations were deliberate. Three of the oblong weights found in the weaver's hut (82-A1) had decorative treatments which suggests they belonged to a set of weights (Figure 26).

Table 9. Length and width of measurable oblong and disk loom weights by phase

Basic Form	Length/ Diameter mm	Greatest Thickness mm	BR I	L-V	BR II	BR II/III	BR III	BR IV	BR V
Oblong	44.48	35.07	1	-	-	-	-	-	-
	68.75	64.33	-	-	-	-	-	1	-
	77.00	58.00	-	-	-	-	-	1	1
	78.67	43.69	-	-	-	-	1	-	-
	87.99	44.66	-	-	-	-	-	-	1
	95.71	59.07	-	-	-	-	-	1	-
	96.32	57.57	-	-	-	-	-	-	1
	110.10	72.95	-	-	-	-	-	1	-
	123.00	56.00	-	-	-	-	-	1	-
	133.11	63.62	-	-	-	-	-	1	-
	133.32	66.72	-	-	-	1	-	-	-
	144.82	66.60	-	-	1	-	-	-	-
	145.48	73.20	-	-	1	-	-	-	-
	143.80	67.69	-	-	1	-	-	-	-
	143.00	68.00	-	-	-	-	1	-	-
	149.01	70.25	-	-	-	-	1	-	-
Disk	109.40	28.39	-	-	-	-	-	-	1
	109.07	34.72	-	-	-	-	-	-	1
	110.79	31.84	-	-	-	-	-	-	1
	110.88	36.87	-	-	-	-	-	-	1
	112.45	29.10	-	-	-	-	1	-	-
	112.87	28.87	-	-	-	-	-	-	1
	114.25	41.86	-	-	-	-	1	-	-
	114.67	36.27	-	-	-	-	-	-	1
	115.45	37.56	-	-	-	-	-	-	1
	116.25	45.47	-	-	-	-	-	-	2
	116.48	34.30	-	-	-	-	-	-	1
	117.11	33.63	-	-	-	-	-	-	1
	117.18	34.73	-	-	-	-	-	-	1
	117.49	35.92	-	-	-	-	-	-	1
	118.21	27.14	-	-	-	-	-	-	1
	118.65	40.33	-	-	-	-	-	1	-
	119.36	31.92	-	-	-	-	-	-	1
	120.21	34.74	-	-	-	-	-	-	1
	120.47	43.88	-	-	-	-	-	-	1
	120.73	33.83	-	-	-	-	-	-	1
	140.27	51.98	-	-	-	-	-	-	1
		Total	1	-	3	1	5	7	22

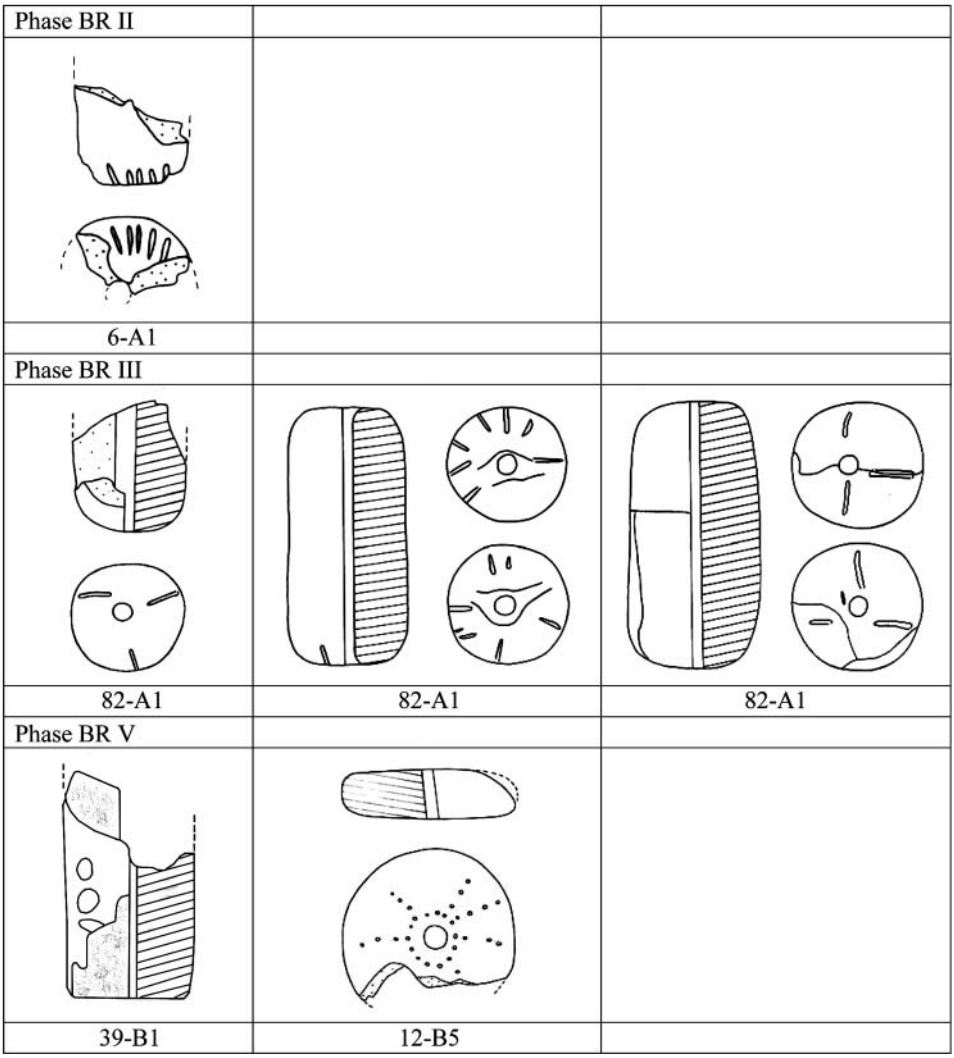

Fig. 25. Decorated loom weights from Bronocice

1.3. Spools

Spools were less common than either spindle whorls or loom weights. 85 were recovered at Bronocice, of which 51 were selected for study. There is some debate about the function of these objects. Some have questioned if they are even related to fiber and textile production (Horváth 2008). Mårtensson and her colleagues at the Centre for Textile Re-

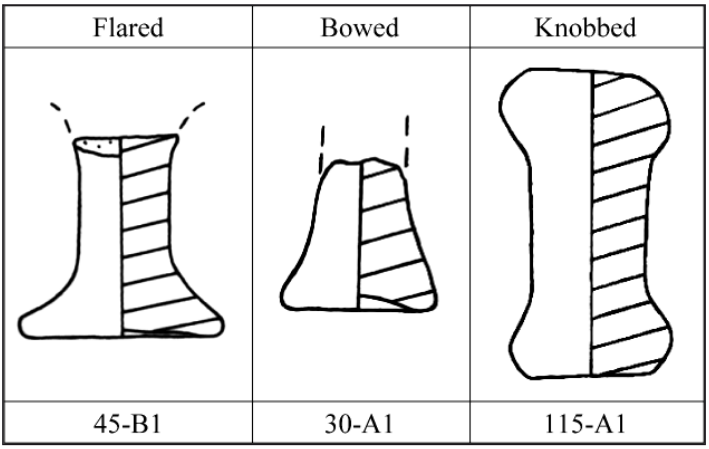

Fig. 27. Examples of spool forms, all from Phase BR III

search at the University of Copenhagen have made a convincing argument that spools functioned as small loom weights (Mårtensson *et al.* 2007; Mårtensson *et al.* 2006b). The lack of a center hole is not considered to be a factor.

Spools were best represented during Phases BR II-BR IV. There were three basic forms: bow-shape, flared and knobbed (Table 11, Figures 27 and 28). Flared spools were the most common form in Phases BR III and BR IV, though all forms were represented during all phases. The general trend was an increase in length for each of these forms. Regardless of the form and length, specimens generally measured between 21-36 mm in diameter. Two

Table 10. Description of decorated loom weights

Phase	Area	Pit	Shape	Comment	Count
BR II	A1	1	Oval	Incised lines on end	1
BR II	A1	6	Oval	Rays	1
BR III	A1	82	Oval	Rays	1
BR III	A1	82	Oval	Rays both ends	2
BR IV	B1	115	Oval	Row of dots	1
BR IV	B1	52	Oval	Two dots	1
BR IV	B1	56	Oval	Row of incised marks	1
BR V	B5	12	Disk	Rays	1
BR V	B5	12	Disk	Finger impressions	2
BR V	B1	39	Oval	Dots	1

Table 11. Basic spool measurements by phase

Basic Form	Thickness mm	Diameter / Length mm	BR I	BR III	BR III	BR IV	BR V
Bow	24-38	26-53	-	2	-	1	-
	23-25	40-44	-	-	2	-	-
	35	60	-	-	-	1	-
	35	66	-	-	-	-	1
	29-36	n.d.	-	-	-	2	1
	n.d.	n.d.	-	1	1	-	-
Flared	21	35	1	-	-	-	-
	26-27	23-28	-	2	-	-	-
	22-28	43-44	-	-	-	-	2
	27-32	43-46	-	-	3	-	-
	25-36	37-50	-	-	-	2	-
	24	n.d.	-	-	2	-	-
	28-39	n.d.	-	-	2	5	-
	33	n.d.	-	1	-	-	-
	41	n.d.	-	-	-	-	1
	47	n.d.	-	-	-	1	-
Knobbed	27-36	41-58	-	-	3	-	-
	29-32	46-61	-	-	-	3	-
	32	n.d.	-	-	-	-	1
		Total	1	6	13	15	6

flared specimens had larger diameters, 41-47 mm. Only three specimens were decorated. One had a line encircling the center of the body, another had two rows of dots on the edge face and a third had an 'X' on the edge face. Spool edges did not exhibit any wear patterns. These spools appear to represent small loom weights used for making a specific kind of textile.

2. Bone Tools

Bone tools were highly repetitive in size and shape and how they broke. Seventy bone tools were examined in this study. They consisted mainly of pin and sword beaters, and awls (Table 12). One bone comb was recovered during excavation. These artifacts were all made of mammal bones, consisting of a range of skeletal elements from different species, large and small. Most of these tools were made by splitting a longbone vertically into slivers and sharpening one end. The tools were worn smooth through use, acquiring a polish in the process (Figure 29). None of the tools were decorated in any way. Nearly all of them were broken which made it impossible limiting the ability to get complete measurements.

Table 12. Summary of bone tools related to weaving and cloth production by phase of occupation

Class	Type	Phase Br I	Phase L-V	Phase BR II	Phase BR II/III	Phase Br III	Phase BR IV	Phase BR V
Bone								
	Awl / Awl-like	2	1	-	3	4	10	5
	Beater / Beater-like	-	3	6	7	11	12	6
Total		2	4	6	10	15	22	11

It is possible that some of the beaters were in fact awls. However, it is also possible that some of the awls were beaters (Figures 30-31). Some of the tools were double pointed and more robust (Figures 32-33). Beaters varied in length as well as in width (Figures 34-35). It was often the case that in deposits yielding fiber and textile production artifacts there was also a single awl. That pattern suggests that awls were a component of the toolkit used by in making cloth.

3. Contexts of Deposition

The depositional context within which fiber and textile production artifacts are recovered is an important factor in determining the physical and social contexts where these activities took place. Primary deposits are those in which the remains were found, where they were made, consumed, used and placed. For example, when a fully furnished house collapses in an earthquake all the cultural remains remain in their primary context, albeit slightly shifted. Secondary deposits are composed of culturally generated materials that have been removed from their primary context and deposited elsewhere. A good example is the removal of household garbage to a midden. Secondary deposits vary in their analytical value. When they have been disturbed by later cultural activities their value may be diminished.

Creating depositional contexts makes it possible to group data into comparable units, which facilitates interpretation of cultural materials found within them. The length of time during which materials accumulated in a depositional context is typically impossible to ascertain without fine-grained chronological control, or unless a catastrophic event has sealed the deposit. The depositional contexts created for the interpretation of fiber and textile production artifacts at Bronocice were established by identifying structures and internal features. Structures included houses and workshops. Internal features were almost always semi-subterranean storage pits, cellar floors, earthen benches and counters or platforms and hearths. Burials constituted another primary depositional context. In most cases, the length of accumulation was considered in years, that is the length of time a structure may have stood, perhaps 25-30 years. The only exceptions were burials which represent short term events.

Fig. 36. Storage pit in a weaver's house containing large set of loom weights Pit 12-B5

Artifacts were retrieved in primary contexts such as burials and houses and from secondary contexts such as trash deposits and random finds. Because Bronocice experienced extensive soil erosion in the second half of the fourth millennium BC much of the original information concerning house shape and size has been erased (Kruk *et al.* 1996). Soil cores taken from the Nidzica River indicate that as much as 4 meters of soil sediments were eroded from the uplands on which Neolithic settlements were located (Kruk *et al.* 1996). Consequently, many of the houses identified and the features grouped within them into depositional units are inferred based on size, shape and location of pits.

Often storage pits at Bronocice were found to contain *in situ* pots and stone tools (Figure 36), while in other cases they were filled with refuse. A few storage pits contained sets of loom weights and spindle whorls, indicating that they were used by weavers for storing their equipment and perhaps also raw materials that have long since decayed. There are a couple of small circular structures lacking pits whose function is unknown.

One of these structures is interpreted as a weaver's hut because it contained sets of spindle whorls and loom weights. The complex of structures found in Units B5 and B7 yielded large concentrations of spinning and weaving artifacts. It is likely that this area of the settlement was a weaver's district and that descendants inherited the practice either through family ties or by training.

Burials were another type of depositional context in which artifacts were found in primary context. Several burials yielded spinning or weaving artifacts. Some of these burials were found in the cemetery located in Area C, others were found within the settlement itself.

There was a tight correlation between where spinning and weaving artifacts were recovered and type of depositional context. The association of whorls and weights is thought to be a potential indicator of gender or status within the community. The presence of textile objects with two females suggest they were involved in production (Milisauskas *et al.* 2016).

GENERAL OBSERVATIONS

Bronocice evolved over time into a major regional political and economic center. Signs of increasing social complexity at this site were found in settlement data, burial practices, and the presence of specialists and non-local people residing within the community. Economic shifts were seen in the intensification of sheep and cattle rearing and increasing emphasis on fiber and textile production in the household (Pipes *et al.* 2009, 2010, 2014, 2015, 2017). The increase in sheep population consisting of a majority of adults indicates a broadening of economic importance and a divergence in roles that may signify wool or dairy production. The co-occurrence of increasing numbers of fiber and textile production materials may also be linked to wool production.

All these trends reflect social, economic and technological changes apparent during the fourth millennium BC not only at Bronocice but also throughout Europe which formed the basis from which Bronze Age societies emerged (Anthony 2007; Bogucki and Grygiel 1981; Greenfield 2013; Gregg 1988; Kowalczyk 1970; Milisauskas and Kruk 1986, 2011; Sherratt 1997; Whittle 1986, 2002; Zastawny 2008).

It seems that by 3500-3000 BC, ards, wagons, metallurgy, the riding of horses, wool production, and milking of cows, goats and sheep were present in central Europe. At Bronocice, a vessel incised with wagon motifs was found in a late Funnel Beaker culture pit, which was dated at 3400 BC (Figure 37).

The increase in sheep rearing appears to be tied to an increase in cloth production. Intensification of sheep occurs at the same time (Phase BR II) with the increase in the volume of fiber and textile production artifacts. The sheep increase which began in Phase BR II and expanded greatly in Phases BR III and BR IV was accomplished mainly by of animal importation, based on a study conducted on strontium concentrations in sheep teeth from Phases BR I-BR V at Bronocice (Pipes 2014).

Fig. 37. Pot with wagon motif

As the settlement expanded in size and population from Phase BR II to Phase BR IV, so did the number of household engaged in fiber and textile production (Table 3). The initial scale of fiber and textile production was small and undifferentiated from that of surrounding communities. As weaving became more common, however, there was an increasing need for large quantities of spun fibers. Spinning was a persistent activity undertaken in many social contexts as indicated not only by increased numbers of spindle whorls over time, but also by their recovery from a wide range of depositional contexts. Ethnographic and historic sources record that spinning was a ubiquitous activity for women in cultures throughout time and space, occurring in a wide variety of settings including the home, fields and other casual settings (Barber 1994).

We assume that Neolithic spindle whorls, loom weights and spools were made, used, and owned by women. These artifacts are embedded with social and economic meaning. Others have discussed the association of these types of artifacts with women, their use as markers of cultural diversity, the status of women as textile producers and the value of textiles and the prestige of clothing (Barber 1991; Brumfiel 1991; Keith 1998; McCafferty and McCafferty 1991; Randsborg 2011; Schneider 1987).

It is evident that cloth production was centered around households at Bronocice. The majority of relate artifacts were found in houses and in association with other household artifacts used for food storage and preparation as well as cooking. The household was the basic unit of production as well as the main unit of social organization. Tasks would most likely have been gender based (Bender 1978; Blanton 1994; Brumfiel 2006; Hastorf 1991;

Hendon 1996). Direct evidence linking spinning and weaving to women is rare at Bronocice, in large part because most Funnel Beaker burials at Bronocice lacked grave goods. Tools and other household items were found in household pits and were associated with the living. Indirect evidence tying women to weaving and spinning can be found in the appearance of decorations and shapes of spindle whorls and loom weights. In general, most spindle whorls recovered from Funnel Beaker settlements, including those from Bronocice, tend to be plain and undecorated (Burchard and Eker 1964; Florek and Wiśniewski 2008; Kulczycka-Leciejewiczowa 2002).

The variability seen in the size and shape of spindle whorls within households suggests the presence of multiple individuals because these artifacts were made by different hands. Furthermore, the inclusion of decorated and undecorated specimens suggests different identities and origins of individuals within the same household.

In a broader context it is not surprising that textiles became an important commodity at Bronocice. By 3100 BC textiles had become a valuable commodity throughout Europe and the Mediterranean basin as documented by various sources including texts, imagery, pseudomorphs, and preserved remains found in burial contexts (Barber 1991; Good 2001; Leuzinger and Rast-Eicher 2011; Sherratt 1997; Shishlina *et al*. 2003). Cloth served as a means of exchange for other commodities such as exotic lithic materials and other resources at Bronocice. The archaeological evidence shows that textile production continued to increase through time. The development of a social hierarchy within the settlement over time suggests control was established over cloth production by the more powerful households. The logistics of the textile trade remains an unexplored area.

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