Technical Report
Experimental Archaeology
Part 2:2 Whorl or bead? 2006

Linda Mårtensson, Eva Andersson, Marie-Louise Nosch, Anne Batzer

Tools and Textiles – Texts and Contexts
Research Programme

The Danish National Research Foundation's
Centre for Textile Research
(CTR)
University of Copenhagen

Contents

Introduction

The experimental research programme described in the following is a component of the *Tools and Textiles – Texts and Contexts* (TTTC) project directed by archaeologist Eva B. Andersson, PhD, and historian Marie-Louise Nosch, PhD. The first aim of this programme is to investigate the function of textile tools from the eastern Mediterranean areas that are dated to the Bronze Age using experimental archaeology as a method. The second aim is to explore experimental archaeology as a method, including its potentials and risks. Three stages of research focussing on different questions have been performed during 2005 and 2006. Part one took place in November-December 2005; part two, presented here, took place in March-May 2006; and part three occurred in November 2006. The experiments have been conducted by textile technicians Anne Batzer, a professional weaver working at Lejre Historical-Archaeological Experimental Centre (HAF) in Denmark, and Linda Mårtensson, an archaeologist from Sweden and educated in prehistoric textile technology.

To ensure scientific control over the experiments, they have been conducted according to TTTC's principles for utilizing experimental archaeology as a scientific method:

- The primary parameter to be investigated is function
- Raw materials, such as wool and flax, must be selected according to our knowledge of Bronze Age fibres and work processes
- Tools must be reconstructed as precise copies of archaeological artefacts
- All processes must be performed by at least two skilled craftspeople
- Every new test should be preceded by some practice time
- All processes must be documented and described in writing, photographed and some filmed
- All processes must be analysed individually
- All products must be submitted to external experts on textile analysis

Stage 2:2: Spindle whorl or bead?

It has been argued that whorls weighing less than 10 g are too light to be used as spindle whorls (see Carington Smith 1992). It was confirmed in our earlier research that whorls lighter than 10 g do work as spindle whorls (Mårtensson *et al.* 2006; 2006a). This was done by conducting spinning tests on a whorl weighing 8 g and by weaving with the spun thread on a warp weighted loom.

In the current experiment, we examined whorls considered to be extremely light in weight. Many of these light objects are called beads, buttons and conuli (see for example Carington Smith 1992), but their function is not made clear. The focus has been to investigate these objects' function as spindle whorls, thus not excluding their function as beads or buttons. The aim was to try to spin wool fibres with a whorl weighing about 4 g. This is half the weight of the whorl used in the earlier tests. The aim was also to test if and how the spun thread worked in a warp weighted loom. The question asked was simple but of most importance for the interpretation of these objects: How will a whorl as light as 4 g work as a spindle whorl?

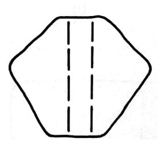

Fig. 1. Whorl or Bead, type 4, 2605.
Height (max) 1.7 cm; Diameter (max) 1,8 cm;
Diameter, hole 0,3 cm; Weight 3.62 g

Whorl or bead?

As with the 8 and 18 g whorls used in the earlier experiment, we decided again to use whorls from Nichoria, dated to the Bronze Age, as models. The reason for this was that information on the whorls' weight, height, diameter and hole diameter is already well documented and published (Carington Smith 1992). A biconical ceramic whorl weighing 3.62 g (fig. 1) was selected and reconstructed. The reconstructions were made by ceramist Inger Hildebrandt from HAF. The reconstructed whorls had a weight of close to under 4 g. The whorl was put on a 14 cm long wooden rod weighing 1 g (fig. 2).

Fig. 2. Reconstructed spindle.

Fig. 3. Samples of wool selected for the experiment.

Fig. 4. Washing the wool.

Preparing wool

Still, we had no information on what kind of sheep existed and what kind of wool was used in the period and area of study. We decided to continue using wool from Shetland sheep and from the same fleece as in the earlier spinning test with wool fibres (fig. 3). In this way, the spinning tests with different weight classes of whorls would be more comparable. We assumed that threads spun with a 4 g whorl would be more sensitive than those spun by an 8 g whorl. We decided not to select the wool from fleece that is extremely dense and has tight curls along the whole fibre. This wool is much alike the fuzzy underwool and would probably have made the thread irregular and fragile.

Washing wool

We conducted some initial test spinning with the 4 g whorl. Rather immediately we noticed that the process of providing wool fibres with the hand while spinning took more time then was reasonable. The spindle started to rotate the other way around before this procedure was done. The fibres provided too much resistance in contrast to this light whorl. To be able to estimate if this was a suitable spinning tool at all, both spinners conducted a small reference test, spinning with another kind of wool. This test was made with rather soft and homogenous wool that was machine carded and washed. It appeared to be much easier to spin with these fibres and the thread produced felt strong. We decided based on this experience that the wool should be washed, to try to obtain a fibre material that could fit this tool better. A couple of tufts of wool were washed in water to get rid of dirt and some lanolin, which can make the fibres struggle. It is known from other periods, for example, from the Sumerian written sources, that wool has been washed before spinning (Waetzoldt 1972: 109-119). The wool was then combed and spun. Washing had a positive effect on the spinning. The wool was easier to pull out while spinning. It was decided that the remaining part of the wool should be washed (fig. 4). In total, 254 g wool was washed in 40-60 centigrade hot water in three stages for about 6 minutes. The wool lost 17 g weight in this process.

Combing wool

We decided to take out as much underwool as possible with only one wool comb. We used the same comb that was used in the earlier experiment with spinning wool. The washed and dried wool, with a total weight of 237 g, was carefully combed and mixed together. Tufts of wool were put on the wool comb and drawn out into a band of fibres. Only a total amount of 66 g wool was taken out of the comb and made ready to be used in the experiment. It took approximately 9 hours for Batzer and Mårtensson to prepare the wool after it had been washed and dried.

We could have spent extra time on wool preparation, discarding the fuzzy underwool as well as hairy and coarse fibres in order to get a softer material. But, we decided not to work the wool further since we wanted to be able to compare the results with the results from spinning 8 g and 18 g whorls. In another context, we would probably have chosen another wool type which is softer and more homogenous to work with.

	yarn weight g	yarn length m	spinning time h
Batzer, 7 tests	14	225.3	7.5
Mårtensson, 7 tests	17.1	290	7.6
Tot. 14 tests	31.1	515.3	15.1

Fig. 5. Total result, 4 g whorl.

Spinning

Fourteen tests were conducted with the 4 g whorl. Both spinners conducted 7 tests each[1]. Each test was documented with the same procedure used when spinning with the 8 and 18 g whorls. One test and one number in the schedule represent one spindleful. The weight and length of the threads and the time it took spin a full spindle were measured in each test (Appendix).

Both spinners added more twist with the hand than they did when spinning with the 8 and 18 g whorls. In general, both spinners were comfortable with giving the spindle a twist by hand two times while the thread was spun ca. 50 cm, and then one extra twist, and then two times while the thread was spun ca. 50 cm more. After approximately 1 m spun thread, the spindle was twisted one or two extra times before the thread was wound up on to the spindle rod. If we had not done it like this, the thread would have unspun itself soon after we had added the twist.

While spinning, both spinners marked how fragile the threads became. If the threads were spun thicker, the spindle would not twist and if they were spun thinner they would break. The spinners had to work a lot with their hands to make sure that the spindle was fed with a suitable amount of fibres while spinning. After spinning some time and with several metres of thread wound on the spindle rod, the spindle started to wobble a lot and the thread broke easily. When this happened, we considered the spindle as full. The thread also broke a couple of times because of the incise in the spindle rod’s upper part. This part had sharp edges which sometimes cut the thread.

[1] Further tests were conducted but these are not included here, since too much disturbance took place while spinning. For example, the spindle rod broke and we ran out of wool.

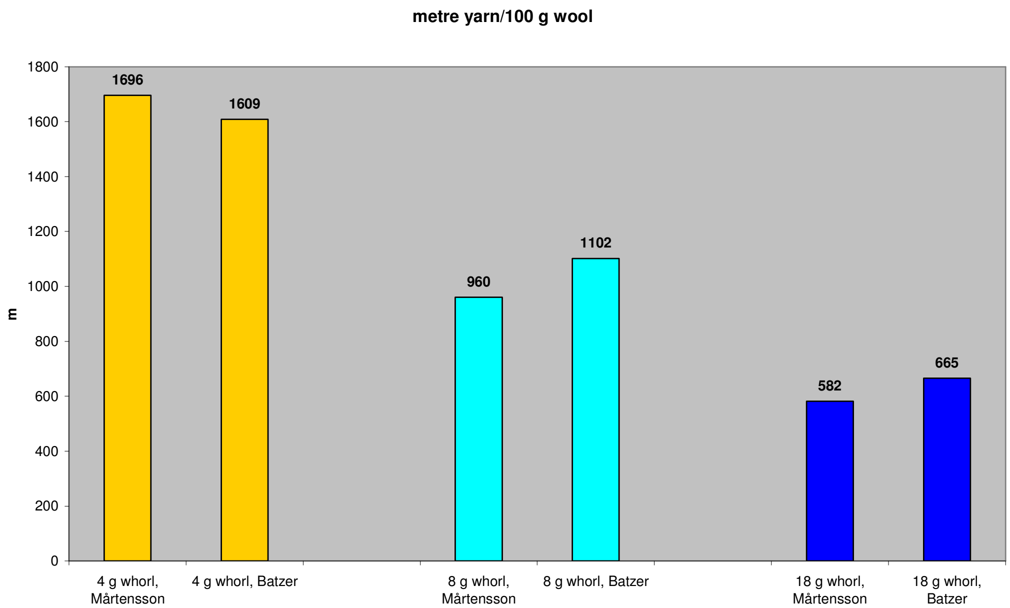

Fig. 6. Calculation of metre yarn per 100 g spun wool, 4 g, 8 g and 18 g whorls.

It took nearly the same time for both spinners to spin 7 spindelfuls each (fig. 5). When calculating how many metres of thread were spun per 100 g spun wool, one can see that Batzer's threads contained slightly more fibres than did Mårtensson's (fig. 6). This difference was not noticed by simply observing and feeling the threads. Another difference between the two spinners can be seen in the time used (fig. 7). One can also see a difference between the different whorls, 4 g, 8 g and 18 g. It was more time consuming to spin a thread with a light whorl than it was with a heavy whorl. Furthermore, when comparing the results from spinning with 4, 8 and 18 g whorls, there is an obvious difference in how many fibres the thread contains between using different whorls. The thread spun with the 4 g whorl contains remarkably less fibres than the others do (we call these threads thinner).

Samples of thread were sent to an external expert on textile analysis. The samples were taken from Batzer's and Mårtensson's spinning tests numbers 2, 5, 7 and also from number 9, even though this last had not been included in the earlier measurements. Every sample consisted of approximately 7 meters of thread.

Conclusion, spinning

In the current experiment we examined whorls considered to be extremely light in weight: How did whorls as light as 4 g work as spindle whorls? The results show that it is possible to spin with a whorl as light as 4 g. No great difference was seen between the two spinners' threads. The greatest difference was seen when comparing the results from spinning using the 8 and 18 g whorls with using the 4 g whorl; the thread from 4 g whorl spinning was much thinner. Even though the 4 g whorl worked for spinning thread, both spinners reported that another type of wool, which is softer and more homogenous, would be preferable.

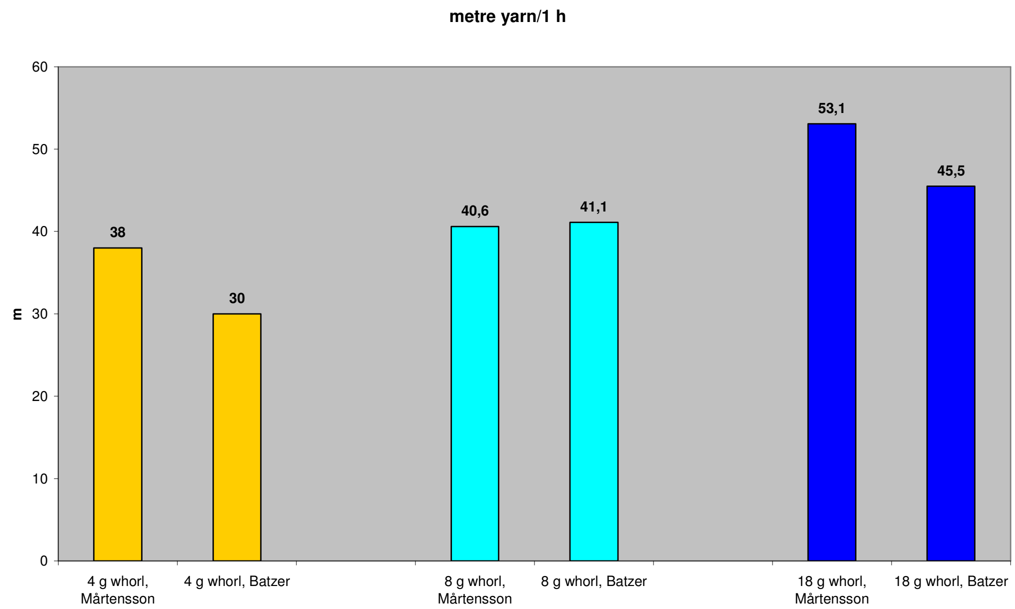

Fig. 7. Calculation of metre yarn spun per 1 hour with 4 g, 8 g and 18 g whorls.

Fig. 8. Ceramic spool with thread on, placed in the glass vessel.

Fig. 9. Plying yarn.

Weaving

As with the prior experiment, spinning thread with 8 g whorl, the aim was also to try to weave with the spun threads in a warp weighted loom. The threads were arranged on the loom in the same way as in the earlier tests, with some exceptions.

Since the threads spun with the 4 g whorl were so thin, we had to do something to make the starting border compact and stable, keeping the warp threads in place. For this reason, we decided to ply (two single threads twisted into one) the threads for this use. We had no reconstructed tools for plying, so we decided to improvise with what we had available. The yarn was wound on two spools. These were placed in a glass vessel. One of the spools was made of ceramic and was heavier than the other one was. The use of the ceramic spool felt perfect since it stayed in the vessel while plying (fig. 8). The lighter spool, made of paper, was jumping up and down while plying. The yarn was plied using a spindle with an 8 g whorl (fig. 9).

Except for this, the starting border was made in the same way as the other weaving tests (fig. 10). One half of the warp consisted of only Mårtensson's threads (marked with a red sewing thread in the edge) and one half with only Batzer's threads, altogether a ca. 24 cm wide warp with ca. 14 threads per cm. The plied threads felt perfect to work with.

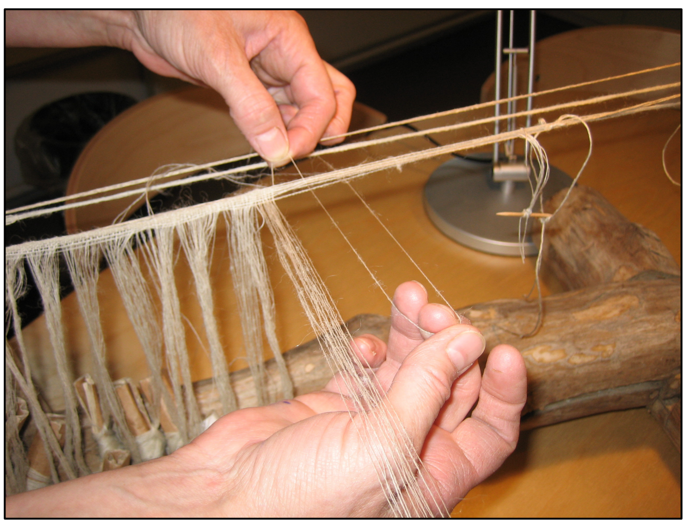

Fig. 10. Making the starting border.

Loom weights

By making small reference tests with different loom weights, we discovered that the threads would need about 13 g weight per thread. We used 28 discoid rounded loom weights, the same weights as in the earlier tests, weighing ca. 180-187 g and with a thickness of 2 cm. Every loom weight was attached to 14 warp threads. As a result, we got an even distribution of loom weighs in relationship to the starting borders' width (fig. 11).

Fig. 11. Warp threads arranged on the loom.

The weaving process

When we started to weave, the threads felt elastic and quite strong. But, they got stuck in each other in an extreme way when the shed was changed. As a consequence, the threads became more and more fragile and after a short while some of them started to break. After weaving about 5 cm, several threads had broken, or rather slid apart. During the last centimetre, more than one thread broke per weft. The last centimetre with 9 weft threads took one hour to weave, including reparation of threads. This was considered too much effort. After a total length of ca. 7 cm, the weaving was stopped and the sample cut down for evaluation (fig. 12)[2].

It has to be said that these threads were not suitable for weaving within the arrangement we tried. The warp threads were probably too close to each other; the threads should have been woven into a more open fabric so that changing the shed would not put as much strain on the threads. Some of the threads probably also should have had more twist, to prevent them from sliding apart. An alternative would have been to use the threads with less twist as wefts instead of warps.

[2] Just before cutting the warp threads, some olive oil was smeared on the warp threads. This was done to see if the warp threads stopped sticking together. No difference was noticed.

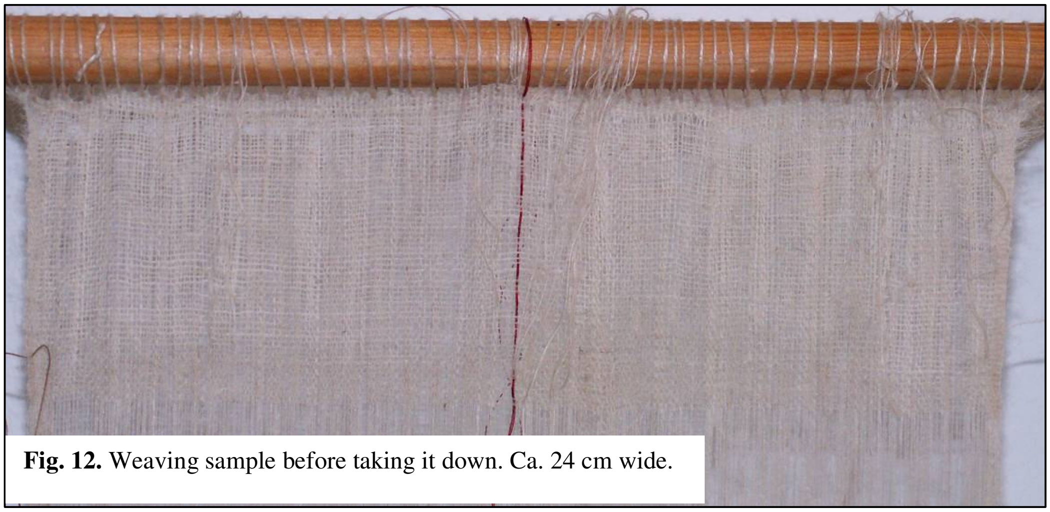

Fig. 12. Weaving sample before taking it down. Ca. 24 cm wide.

In comparison to Batzer's experience of working with thin machine spun yarn, the threads spun by the 4 g whorl did seem rather strong. A machine spun yarn of this type would usually be gloomed. It might have been more effective to add some sort of gloom on our fragile threads as well.

Conclusion, part two: Whorl or bead?

The aim of this stage of the experimental testing was to try to spin wool fibres with a very light whorl weighing about 4 g, and also to try to weave with the spun threads in a warp weighted loom. The test indicated that a 4 g whorl works as a spindle whorl for spinning wool fibres. But the preparation of the wool and the spinning process demand more effort than when using the 8 and 18 g whorls. The outcome thread was much thinner when using the 4 g whorl than it was when using the heavier whorls and thus more fragile. The threads' function in a warp weighted loom was also tested. While weaving, the threads became torn by the friction against each other and broke. Even though the threads did not work especially well for weaving in our setup, we would not regard the threads as useless. The threads would probably work better if they were arranged in a more open tabby with more space in between the warp threads, avoiding the tearing when changing the shed, or if they were treated with some kind of gloom. The starting border was made of plied threads. For this purpose the thread worked perfectly. The reference test, spinning with another type of wool, indicates that the thread was stronger when using homogenous and soft wool that had been washed. For further understanding of the function of the 4 g whorl and the use of the spun threads in a warp weighted loom, we suggest the use of such softer wool. One must bear in mind that different qualities of wool might have existed during the Bronze Age and that sorting and selection of wool probably occurred, depending on what textile was produced. It is known from other periods, for example from the Sumerian written sources, that wool existed in different qualities and that refining sorting and selection occurred (Waetzoldt 1972: 39-69). We can not exclude these whorls used as beads or buttons, but we can now say that they are well suited as spindle whorls.

References

Carington Smith, J. 1992, Spinning and Weaving Equipment, in *Excavations at Nichoria. II*, Minneapolis, (eds.) W.A. Macdonald & N.C. Wilkie, 674-711.

Waetzoldt, H. 1972, *Untersuchungen zur neusumerischen Textilindustrie*.

Mårtensson, L., Andersson, E., Nosch, M-L. & A. Batzer. 2006. *Technical Report, Experimental Archaeology, Part, 2005-2006*. Tools and Textiles – Texts and Contexts Research Programme. The Danish National Research Foundation's Centre for Textile Research University of Copenhagen. ctr.hum.ku.dk

Mårtensson, L., Andersson, E., Nosch, M-L. & A. Batzer. 2006a. *Technical Report Experimental Archaeology, Part 2:1 flax, 2006.* Tools and Textiles – Texts and Contexts Research Programme. The Danish National Research Foundation's Centre for Textile Research University of Copenhagen. ctr.hum.ku.dk

Appendix

	Batzer									
nr	**date**	**whorl**	**rod**	**wool type**	**wool before (g)**			**yarn weight (g)**	**yarn length (m)**	**spinning time (min)**
1	28-04-2006	F	2	fleece3	33			1.5	23.1	30.21
2	03-05-2006	F	2	fleece3				1.5	24.8	54
3	03-05-2006	F	2	fleece3				2	32	60
4	03-05-2006	F	2	fleece3				1.5	22.4	41
5	04-05-2006	F	2	fleece3				1.8	32	77
6	05-05-2006	B	3	fleece3				2.9	46.2	99
7	05-05-2006	B	3	fleece3				2.8	44.8	89
	Mårtensson									
nr	**date**	**whorl**	**rod**	**wool type**	**wool before (g)**			**yarn weight (g)**	**yarn length (m)**	**spinning time (min)**
1	03-05-2006	B	3	fleece 3	33			2.5	49	69
2	03-05-2006	B	3	fleece 3				2.1	35	51
3	03-05-2006	B	3	fleece 3				2.1	33.6	59
4	04-05-2006	B	3	fleece 3				2.4	41	73
5	04-05-2006	B	3	fleece 3				2.7	44.8	69
6	05-05-2006	F	2	fleece 3				2.5	43	71
7	05-05-2006	F	2	fleece 3				2.8	43.6	65