Ulrikka Mokdad

Transparent Textiles

Experiments in Plain Gauze Carried Out on a Small-Frame Loom

Introduction

The weaving experiments conducted in the context of a project trying to better understand the weaving of gauze were partly inspired by an article written by Andersson Strand and Cybulska (2013). The authors advance the hypothesis that a so-called *guz-za* fabric described in a Mesopotamian Ur III text dated to *c.* 2050 BC may have been woven in gauze technique. Only very few preserved textile fragments have been unearthed from this area and period, but in the North Caucasus, wool textiles with twined warp ends were produced as early as the 3rd millennium BC (Shishlina *et al.* 2003, 333).

The gauze or warp-twining technique

Plain gauze has a unique weave structure that differs from all other known weaves (such as the three basic bindings of tabby, twill and satin) in having the warp ends arranged in pairs that twist around each other between each weft. A cloth woven in plain gauze technique is remarkable because the twined warp threads prevent the wefts from being beaten closely together, thus creating a light, airy fabric with a transparent structure (Fig. 1). Although almost the same amount of transparency can be achieved by weaving a very open tabby weave, an open tabby fabric has a tendency to bruise where the threads shift away from their uniformity, disturbing the regular structure of the weave. This is not the case with a gauze fabric where each weft will be kept firmly in place by the twined warp threads, thus securing a much more solid structure. The basic idea of this structure is rather simple and makes the creation of gauze a logical step on even the most primitive loom (Pancake and Baizerman 1980-81, 1).

Plain gauze technique seems to have developed simultaneously in different parts of the world by peoples who had no contact to each other. Ancient gauze fabrics have been excavated at archaeological sites as geographically far apart as China, North Caucasus and Peru. In China, one of the earliest known silk fabrics, found in a child's burial site in Qingtai Village, Yingyang County, Henan, is in fact a fabric with twined warps dating to 3650 BC (Zhao Feng 1999, 39). At the Novosvobodnaya sites in North

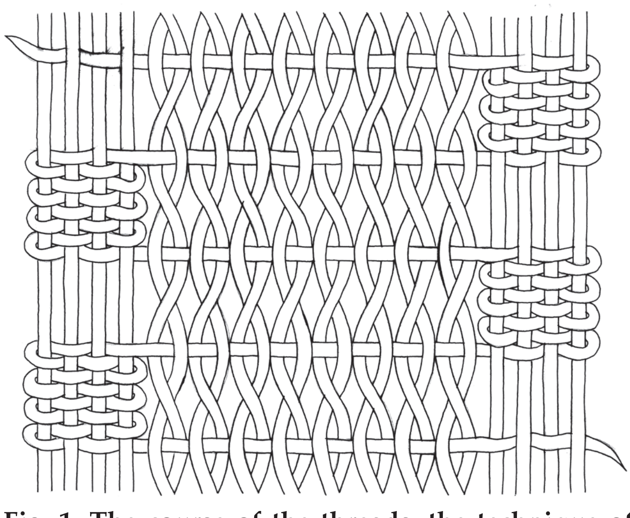

Fig. 1. The course of the threads: the technique of plain gauze with stabilising edges in tabby weave (Drawing: Author).

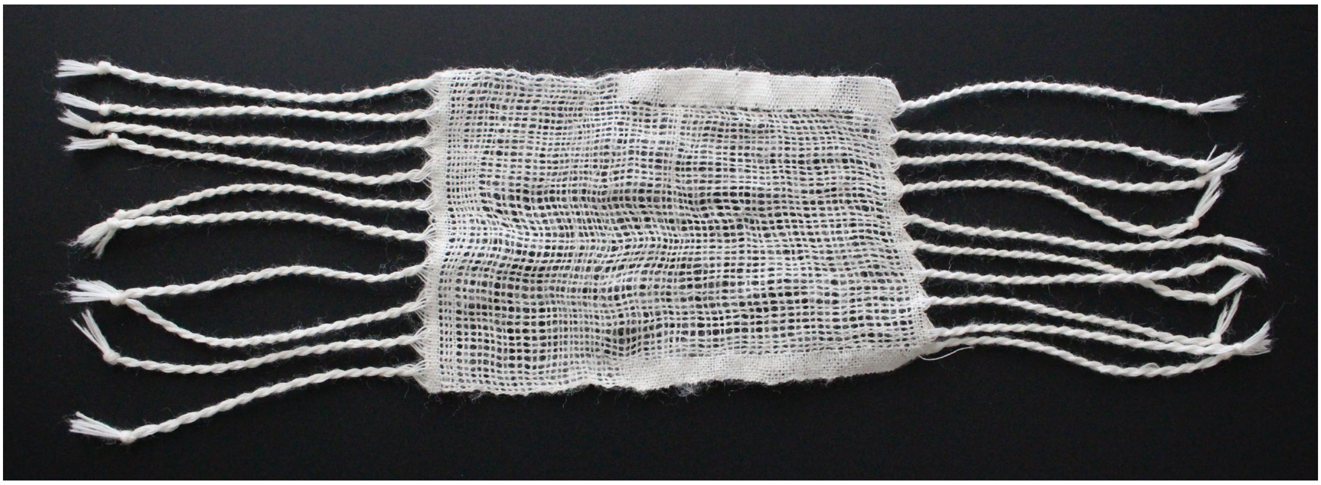

Fig. 2. The wool sample (Photo: Charlotte Rimstad).

Caucasus, fragments of wool cloth attributed to the Majkop culture (3700-3200 BC) were discovered in the late 19th century during the major excavations undertaken by Veselovsky. Recent analyses have revealed that several of these were also woven with twined warps (Shishlina *et al.* 2003, 331-333). In Peru, the translucent cotton textiles found in the Chancay Valley excavations show that the Chancay weavers in around 1300 AD had further developed the relatively simple technique of plain gauze to make complicated ornamental patterns for their headdresses (Fung Pineda 1995, 554). Finally, Barber mentions that tiny bits of gauze weave have been detected among linens from the Middle Kingdom in Egypt, 2000-1700 BC. They do not form part of any decorative pattern, so they most likely served as "weaver's marks" (Barber 1991, 151).

The looms used for warp-twining

Most ancient looms were probably made of perishable materials such as wood, which means that they have disappeared without leaving any trace in the archaeological record, an exception is the warp-weighted loom, which had its warp threads held taut by loom weights such as perforated pebbles or weights made of clay. A large number of clay loom weights from different periods have been unearthed at several sites in the Aegean. They prove that the warp-weighted loom was in use there for textile production from at least the early Bronze Age, *i.e.* mid-3rd millennium (Barber 1991, 93). But the fact that the only preserved evidence of looms point to the use of the warp-weighted loom should not be taken as a proof that this was the only type of loom employed in this area.

In other parts of the world where archaeological textiles have been preserved, analysis of the textiles has revealed that several loom types were in use simultaneously for different purposes.

The remarkable collection of Danish Iron Age textiles that was analysed by Hald in the 1930s has proven that before the warp-weighted loom came into use another large loom, probably a vertical two-beam loom well-suited for tubular weavings, served the inhabitants of the north (Hald 1980). At Akrotiri, loom weights have only been found in four out of 11 excavated houses, according to Tzachili (Tzachili 2007, 191). The author therefore advances the hypothesis that there may have been looms of a different type in the other houses, such as vertical two-beam looms like those known from depictions from New Kingdom Egypt (Tzachili 2007, 192). In pre-Columbian Peru there is evidence that both large vertical two-beam looms as well as the ordinary back-strap looms were in use in the Wari Empire during the Middle Horizon *c.* 700-1100 AD (Engelstad 1985, 8-9).

A small experiment that was carried out at the CTR Loom Laboratory in 2013 by the author showed that the warp-weighted loom was less suited for weaving plain gauze. Technically, it requires the possibility of opening and closing both the tabby shed and the warp-twining shed. However, the fact that the warp-weighted loom has the warp threads permanently divided into two layers, forming a natural shed that is practically always open, makes the task of warp-twining difficult on this type of loom. Weaving gauze

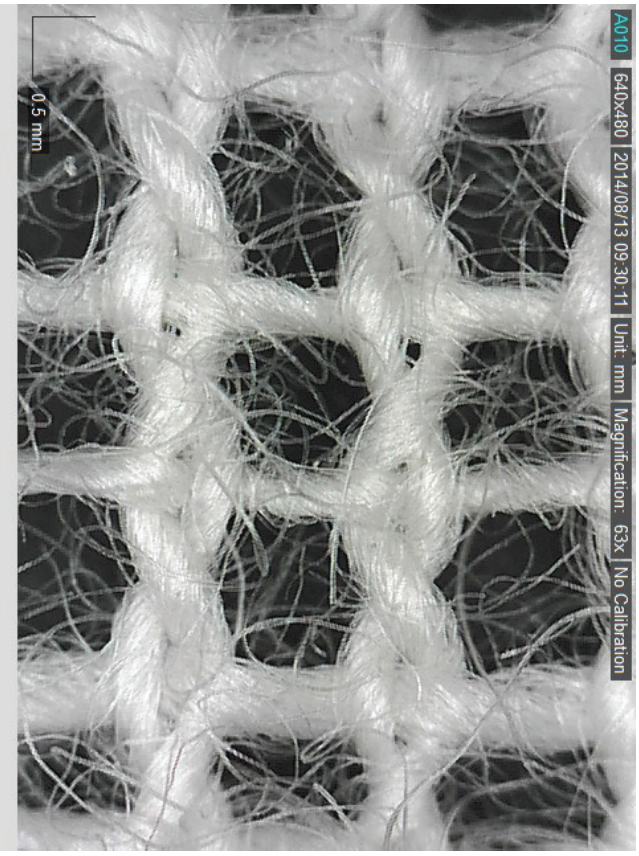

Fig. 3. Detail of the open plain gauze structure of the wool sample (Photo: Charlotte Rimstad).

on a back-strap or two-beam loom, in contrast, is much easier. The fact that the warp threads are not divided permanently into two layers as well as the much smaller sheds makes these types of loom better suited for working with warp-twining.

The experiments

The decision to carry out an experiment in plain gauze weaving on a small exercise frame loom was made by Nosch at the Danish National Research Foundation's Centre for Textile Research in early spring 2014. The samples were presented same year at the NESAT XII conference in Hallstatt, Austria. The aim of the experiment was to investigate if and how one could weave very fine gauze textiles on a very simple loom even without the aid of any additional shedding mechanisms like pearls or specially-produced long heddles as known from modern gauze weaving (Paulli Andersen 1971, 181) to open the gauze shed. As the exercise frame loom measured only 20 x 30 cm, it was not well suited for heddles. Furthermore, we cannot be sure whether or not the gauze weaves of the past were all woven with additional shedding.

In their study of Guatemalan gauze weaves, Pancake and Baizerman claim that some of the finds from ancient Peru were most probably executed without any shedding devices (Pancake and Baizerman 1982, 1). However, model-sized back-strap looms, presumably made as tomb offerings, have been found in Central Coast graves of the late Intermediate Period. Some of these little looms were set up with several heddle rods with special heddles in order to create a simple gauze weave (Rowe and Bird 1982, 33).

The first sample was made entirely of wool. I chose a rather thin yarn (nm 12/1 that runs 12 m/g). The exercise frame loom was set up with a tubular warp in order to ensure the warp threads were long enough for warp-twining. The setup was 100 warp threads for a 10 cm wide piece = 10 threads per cm. A natural tabby shed was made by inserting a flat stick between the warp threads at the far end of the frame. Turning this flat stick upright would open the tabby shed allowing the weft to be carried through by a very thin, pointed tapestry bobbin. The second shed, the one for warp-twining, was picked up by hand each time with the help of the pointed end of a bobbin before the weft was carried through. At first, the weaving was carried out without a stabilising selvedge, but after approximately 4 cm it turned out that the sample became narrower for each weft. In order to stabilise the width, 10 warp threads in weft-faced tabby weave were employed as selvedges on both sides. After having shrunk to 9 cm, the sample started to widen again, and finally the width was stabilised at 9.3 cm. About six passes of weft-faced tabby at the edges were made for every weft passing from selvedge to selvedge. The sample reached 14 cm before the warp threads began to break because of wear from the passing of the bobbin (Figs 2 and 3). A modern commercial yarn is generally less suitable for this kind of work than a hand-spun yarn with a high twist. The solution to this problem may be to use a warp made of a more hard-spun wool yarn, a single-ply worsted wool thread or a two-ply wool yarn.

As can be seen from the drawing in Figure 1 the four warp threads in the selvedge stabilises the edges. When the weft-faced tabby edges are beaten closely together, they tend to stretch out the weft in the gauze area, thus preventing the textile from shrinking during work. Further, it is shown that the paired warp threads are not twisted around each other in a continuing spiral, such as in a tablet weave where all the tablets are turned in the same direction. On the contrary, one of the two threads in a pair is always lying on top of the other, the one on the top passing under the weft and the underlying warp thread of the pair passing over the weft. This means that every time the weft has passed through the gauze shed, the warps will go back

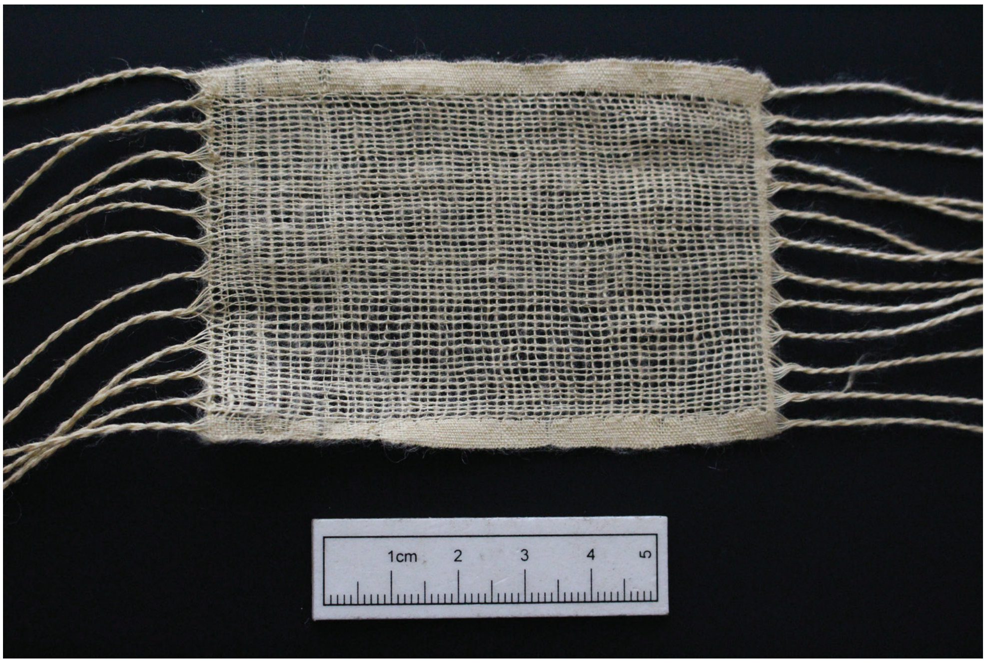

Fig. 5. The linen sample in plain gauze with tabby edges (Photo: Charlotte Rimstad).

to their normal position as the tabby weft is passed through the natural shed. This prevents the warp threads from becoming over-spun or under-spun.

The second sample was made of linen 60/1, a very thin thread that runs approximately 36.2 m/g. The method of weaving was the same as in the first sample, though from the beginning, the sample was set up with 10 warp threads on each side employed as stabilising selvedges, woven in weft-faced tabby with 10-12 wefts between every weft passing from selvedge to selvedge (Fig. 4). This sample reached 8.5 cm before it was cut off. It did not shrink and the warp threads did not break despite their thin quality (Fig. 5). This method of weaving gauze is quite slow due to the fact that every second shed has to be picked up by hand. The wool sample took 10 hours to weave, *i.e.* 1.4 cm/hour. The linen sample took 16 hours, *i.e.* less than 0.5 cm/hour. On a larger loom, it would be reasonable to tie heddles to lift the gauze shed.

Conclusion

The aim of the gauze experiment was to investigate if and how one can weave fine gauze textiles on a loom without special heddles. As the warp-weighted loom had proven difficult to work with for this task, my focus was on using a weaving frame as a substitute for a large, two-beam loom. The work pace was very slow, but despite this, it can be concluded that it was possible for trained weavers in the 4th millennium

Fig. 4. Detail showing the stabilizing tabby edge of the linen sample (Photo: Charlotte Rimstad).

BC to produce fine lace-like textiles on either a two-beam loom or a large frame using the warp-twining technique. However, due to the very slow pace, it is likely that they employed a special set of heddles for the twining shed. The next logical step would be to try to weave larger samples in wool and linen on the upright two-beam loom and include a natural shed as well as one or two heddle sheds.

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Author: umokdad@mailme.dk