

Dagmar Drinkler

# Tight-Fitting Clothes in Antiquity – Experimental Reconstruction

Many works of ancient art show figures who stand out by wearing tight-fitting and strikingly patterned garments, especially hose. Greek vase painting of the fifth century BC in particular has a lot of such depictions (Figs: 1-2). Thanks to the important recent work on colour reconstruction by Vinzenz Brinkmann and his team (Brinkmann 2004; Brinkmann et al. 2008), Classical Greek sculpture now also offers important examples, as for example the image of Paris as archer from the western gable of the Temple of Athena Aphaia, today in the Glyptothek in Munich (Fig. 3), or the so-called Persian horseman in the Acropolis Museum in Athens (Fig. 6). The figures who are depicted wearing such hose are not Greeks but always foreigners such as Scythians and Persians, or the mythical Amazons.

How were these tight-fitting hose produced? Nothing is known about the production technique and there are no archaeological finds that could shed light on this matter. Literary sources also offer little help: the ancient historian Herodotos merely tells us that the Scythians and Persians wore trousers made of leather (Calmeyer 1975, 474) and actual examples of felt stockings have been found in the frozen Scythian tombs in Siberia (Rudenko 1970, 95). To secure a close fit seen in the iconography, even after having worn them for a long period of time, the material that such hose were made of must have been very elastic.

Usually, to make trousers or hose, two or more pieces of cloth are sewn together. If the cut of the hose is wide enough they allow for sufficient movement. The tight-fitting and patterned hose and upper garments depicted in ancient Greek images are unlikely to have been produced from woven or felted material because these materials do not stretch very much. Cut on the bias, they would be more elastic but the pattern would be diagonal, according to the cut. Knitting was not yet invented at that time, so the only

technique available to produce elastic textiles was sprang. Sprang is a Scandinavian term for an open-work textile, but recently it has been applied to a plaiting method on stretched threads (Collingwood 1999, 34). This technique is attested by archaeological finds, such as hairnets from prehistoric times (Hald 1980, 31, 59). Experiments with this technique show that it could also be used to create the tight-fitting and strikingly patterned garments depicted in ancient art.

Unlike the loom-woven textiles, which are produced through the interaction of two systems of threads (i.e. warp and weft), sprang is produced by manipulating only one system of threads, which are consequently positioned not at right angles to each other but diagonally. A crucial point in sprang is that the stretched threads are not several threads like warp threads used for weaving, rather sprang is produced with a continuous thread that is placed around a rod at the upper and lower ends respectively. The threads have to be available at all times in their complete length, which means they cannot be wound up. The extent of elasticity in sprang is related to the material used (e.g. wool, linen, silk or cotton), the strength and twist angle of the threads, and finally the method of working.

Simple, schematic sketches that show the interlinking of threads in sprang can be found in many publications. They suggest a loose and open-work structure because in this way the textile is always shown as if stretched, to explain how the thread is placed in the course of the production. In a relaxed position, however, the sprang textiles very often have tight and solid surfaces that have ridges similar to a woven twill. This solid, closed-work sprang technique only becomes apparent when a textile is finished, indicating that the technique offers various possibilities.

Furthermore, elasticity cannot be depicted in art very



Fig. 1. Amphora 2342, 430 BC, Munich, Staatliche Antikensammlung (From Starke Frauen 2008, cat. 7).



Fig. 2. Bowl 2644, c. 480 BC, Munich, Staatliche Antikensammlung (From Starke Frauen 2008, cat. 21).



Fig. 3. Colour reconstruction of Paris as archer from the western gable of the Aphaia-Temple, c. 490–480 BC, by V. Brinkmann, Munich Glyptothek. (From Brinkmann 2004).



Fig. 4. Simple vertical stripes are obtained by interlinking. By intertwining the colours alternately one can obtain a small zigzag pattern. (© Drinkler).

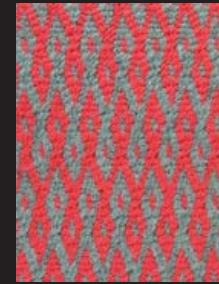


Fig. 5. Double zigzag pattern as found on the Paris sculpture. (© Drinkler).



Fig. 6. Colour reconstruction of so-called Persian horseman in the Acropolis Museum in Athens, c. 490 BC by O. Primavesi (From Brinkmann et al. 2008).



Fig. 7. Two-layered sprang with long lozenge pattern as found on the Persian horseman. (© Drinkler).



Fig. 8. Detail on amphora HA 120, c. 500 BC, Würzburg, Martin von Wagner Museum (From CVA Würzburg 1981)



Fig. 9. Horizontal stripes with uneven borders (© Drinkler).



Fig. 10. Detail on bowl Pell. 278, c. 450 BC, Bologna, Museo Civico (From CVA Bologna 1960)

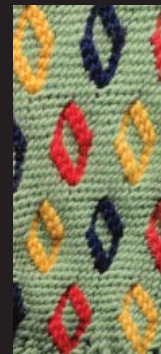


Fig. 11. Circle patterns (unstretched) on a plain ground (© Drinkler).



Fig. 12. Amphora 2342, 430 BC, Munich, Staatliche Antikensammlung (From Starke Frauen 2008, cat. 7).



Fig. 13. Bowl 2644, c. 480 BC, Munich, Staatliche Antikensammlung (From Starke Frauen 2008, cat. 21).



Fig. 14. Colour reconstruction of Paris as archer from the western gable of the Aphaia-Temple, c. 490–480 BC, by V. Brinkmann, Munich Glyptothek. (From Brinkmann 2004).



easily. Hence, textiles need to be touched in order to be understood.

### **The patterns of the hose and their application in sprang**

What is ingenious and stunning at the same time is the fact that all patterns found so far in painting and sculpture can be created easily in sprang. Some of the patterns can even be produced in different sprang techniques. Simply by interlinking the threads of one colour a plain braid can be achieved. By choosing several colours for the threads one can obtain vertical stripes. All conceivable variations in the width of the stripes and the combination of colours are possible. By winding up the stretched threads in two colours alternately using eight threads in colour A and eight threads in colour B, six pattern variations are possible. Simple vertical stripes are obtained by interlinking. By intertwining the colours alternately one can obtain a small zigzag pattern (Fig. 4); a rhomboid pattern in colour A with a border in colour B; a rhomboid pattern in colour B with a border in colour A; a rhomboid pattern with the two rhomb variations alternating; and, finally, the double zigzag pattern as found on the sculpture of Paris (Fig. 5). All these patterns are produced in one layer, so the front and back look the same.

In the technique of two-layered sprang, even more pattern variations can be created. The stretched threads consist of two threads in colour A alternating with two threads in colour B. By interlinking the threads, the threads of one colour are placed over the threads of the second colour each time, thus producing two layers that are not connected. When working a pattern, a change of layers causes a change of colours. Thus the front pattern is in opposite colours to the back pattern.

Because, as noted above, the threads move diagonally in sprang, patterns with diagonal lines like zigzag and rhomboid can easily be obtained while working. In each row one thread of one colour is replaced by one thread of the other colour. When the stretched threads consist of two threads in the same colour each time, but the following two threads always in a different colour, coloured stripes on a plain ground can be obtained. When the colours change only in every second row, long lozenges in oblique position to each other are created, as, for example, on the sculpture of the Persian horseman in the Akropolis Museum in Athens (Figs: 6-7).

In the same way as the two-layered braid, one can produce a three-layered braid. In this case, the stretched threads are in the following positions: two threads of colour A, two threads of colour B, two

threads of colour C. The front and back of the textile will show one colour, while the third colour will be hidden in between.

By exchanging layers in multi-layered sprang, other patterns depicted in iconography can also be produced: zigzag rows alternating with dots or stripes, only dots, only circles, stripes with uneven borders (Figs: 8-9), etc. All the pattern variations can also be obtained by alternating one- and two-layered sprang. However, it needs to be considered that a two-layered sprang has double the thickness and weight of a one-layered sprang produced with the same material. When using finer threads, the labour does not increase linearly but exponentially because more of the stretched threads have to be used. Furthermore, more threads are required than in a simple one-layered sprang because the elasticity is not as high. When the front of the textile shows only one colour, the other colour shows at the back. For making a pattern both colours are united in one layer.

The patterns of dots or circles appear to be on a plain ground. The colours of the dots and circles are determined when winding up the stretched threads, so they can be in one colour or in many (Figs: 10-11). When working with one- and two-layered sprang alternately, the border of the textile is uneven. So in hose the horizontal stripes are more solid. In small pattern repeats this would not have a negative effect when wearing the hose. However, in a vase painting that depicts hose with larger pattern repeats, it is clearly visible how these horizontal stripes cut into the thighs (Figs: 12-13). When producing this kind of pattern in two colours, the pattern of the back side is a negative of the front pattern.

### **Producing hose**

Both methods of winding up the stretched threads are theoretically possible for producing a pair of hose. As the depictions do not show any fringes around the ankles and the zigzag patterns are continuous I chose the flat sprang for making hose. Thus both leggings of the hose are produced on the same stretched threads. Taking into account the shrinkage of 30 %, I had to start with a length of about 320 to 360 cm.

Because of the length of the textile, a frame construction was used that is similar to the circular sprang method. After finishing the hose, the stretched threads were cut and knotted immediately, ensuring that the waistband stayed flexible. Then the vertical seams of the leggings were joined and the leggings were sewn together. By following the plaiting with the sewing thread one can avoid the seam being visible. So the hose worked in two colours, with the back showing a different colour scheme than the front, and

they can be worn inside out as well (Fig. 14). Upper garments (which have not been reconstructed yet) can be produced using the same method. Depictions of such clothes clearly show that the sleeves were mostly set in separately. In rare cases no seam is depicted at the shoulders, indicating that it is a continuous sprang piece from the hip to the wrist, with a low V-neckline.

Although the production of tight-fitting garments described here can not be proven by surviving examples from antiquity, there is no doubt that the sprang technique was known at this time and it was the only known technique which could be used to produce elastic textiles. The way in which the various patterns can be produced in sprang and how they can be developed from one another is truly remarkable.

### Acknowledgements

I am deeply indebted to my colleague Bettina Kammann, who taught me the basic sprang techniques, and to Prof. Erwin Emmerling, Chair of Restoration, Art Technology and Conservation Science at the Technische Universität München, who pointed out to me that nothing is presently known about the production of the tight-fitting clothes in antiquity and always supported my work.

The wonderful book *The Techniques of Sprang – Plaiting on Stretched Threads* by Peter Collingwood accompanied, taught and inspired me throughout my study. Unfortunately I was not able to show my work to Peter Collingwood before he passed away in October 2008. In deep respect for his life's work I would like to dedicate this article to Peter Collingwood.

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