

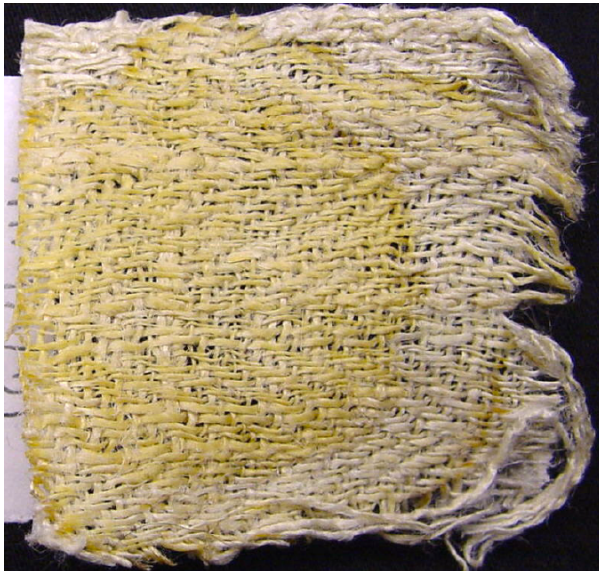
## RESEARCH ARTICLE

## REPLICATING THE WEAVE OF THE TURIN SHROUD

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From time to time we hear that someone has 'reproduced' the Shroud in one way or another, but very rarely indeed has anybody seriously attempted an accurate reconstruction of the weave. I do not think I have ever seen anything closely resembling it. Perhaps the best until recently has been a sample by Kate Edgerton. Edgerton grew her own flax and according to Ray Rogers, prepared thread from it "following the methods used in the Near East in Roman times", although how she knew what these methods were, and what, exactly, she did, and more importantly, whether the Shroud itself demonstrates that her method was correct, is not at all obvious.

Whatever she did, the result was far from perfect. Although the sample illustrated below, from Ray Rogers's book *"A Chemist's Perspective on the Shroud of Turin"* has no scale, it is evident that the weave is extremely loose.

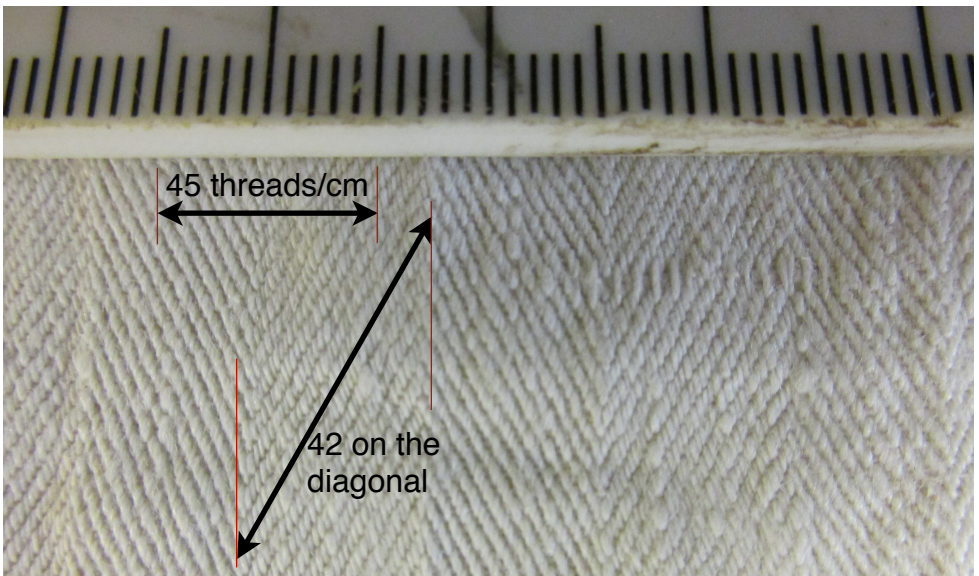
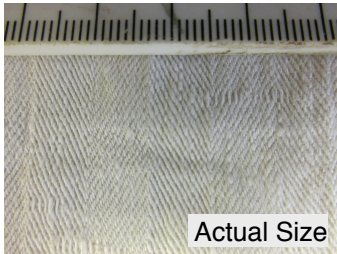


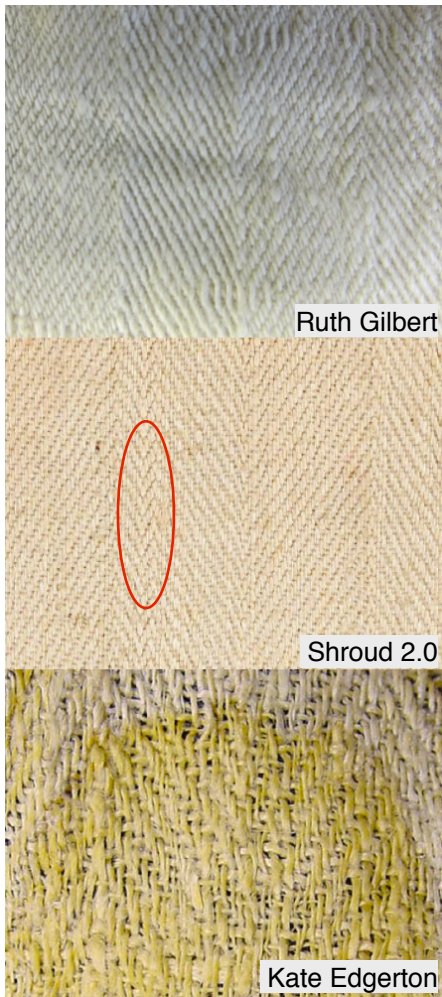
There are about 40 threads from side to side, which I take to be the warp, and 70 from top to bottom, which I think is the weft, but it is not possible to estimate the actual width and depth of the sample.

The most detailed description of the weave of the Shroud is that of

Gabriel Vial, in his *"The Shroud of Turin: A Technical Study"*, and an acknowledged expert in the art of replicating antique fabric in Britain is Ruth Gilbert, of the Standedge Creative Community, so by connecting the two, I hoped I could obtain a sample much closer to the original. This proved far from easy, as thread of the peculiar fineness of the Shroud is very difficult to find, and the tightness of the weave added complications of its own.

Nevertheless, Ms Gilbert has produced a representative sample, with most of the characteristics described by Gabriel Vial. It bears very little resemblance to Kate Edgerton's sample, but compares well with the Shroud itself. The preliminary experiment illustrated measures 13cm x 10cm, and weighs 5.2g, giving it an areal density of of about 40mg/cm<sup>2</sup>, which is considerably heavier than the Shroud, and Barrie Schwartz, who has handled both, says that the new sample feels too stiff, but the thread count is good.





Here we can see the attempts to recreate the Shroud weave (top and bottom), compared with the Shroud itself (middle). Note that fortuitously, this extract from Haltadefinizione's Shroud 2.0 shows an irregularity in the herringbone pattern (circled in red), where the diagonal changes into the wrong direction for a few passes of the weft before resuming the correct orientation.

The most important source for information on ancient weaving of the 1st Century seems to be Pliny the Elder's 'Natural History', a book first published in about 80AD. Book 19 is entitled "The Nature and Cultivation of Flax and an Account of Various Garden Plants", and is worth looking at in some detail.<sup>1</sup>

Chapter 2 describes twenty-seven different varieties of flax grown around the empire, from that grown in Gaul to make sailcloth to that grown in Italy, "the linen of which holds the third rank among the kinds manufactured in Europe" - Spanish flax producing the highest quality. "The flax of Egypt, though the least strong of all as a tissue, is that from which the greatest profits are derived", although Pliny does not specify how. Significantly, Pliny does not mention any flax from the Middle East at all.

<sup>1</sup> Quotations taken from the translation by John Bostock and H. T. Riley, 1855

Chapter 3 describes "The Mode of Preparing Flax"; how, "after the wheat harvest is over, the stalks of flax are plunged in water that has been warmed in the sun, and are then submitted to pressure with a weight. [...] When the outer coat is loosened, it is a sign that the stalks have been sufficiently steeped; after which they are again turned with the heads downwards, and left to dry as before in the sun: when thoroughly dried, they are beaten with a tow-mallet on a stone.

"The part that lies nearest to the outer coat is ... a flax of inferior quality, and is mostly employed for making the wicks of lamps. This, however, requires to be combed out with iron hatchels, until the whole of the outer skin is removed. The inner part presents numerous varieties of flax, esteemed respectively in proportion to their whiteness and their softness. [...] When spun into thread, it is rendered additionally supple by being soaked in water and then beaten out upon a stone; and after it is woven into a tissue, it is again beaten with heavy maces: indeed, the more roughly it is treated the better it is."

So much for the preparation of flax fibres for making linen thread, but Ray Rogers was particularly interested in another of Pliny's plants, which appears in Chapter 18, "The Radicula":

"The plant known to us by the name of "radicula" ... furnishes a juice that is extensively employed in washing wool, and it is quite wonderful how greatly it contributes to the whiteness and softness of wool. It may be produced anywhere by cultivation, but that which grows spontaneously in Asia, and Syria, upon rugged, rocky sites, is more highly esteemed. That, however, which is found beyond the Euphrates has the highest repute of all. The stalk of it is ferulaceous and thin, and is sought by the inhabitants of those countries as an article of food. It is employed also for making unguents, being boiled up with the other ingredients, whatever they may happen to be. In leaf it strongly resembles the olive. The Greeks have given it the name of "struthion." It blossoms in summer, and is agreeable to the sight, but entirely destitute of smell. It is somewhat thorny, and has a stalk covered with down. It has an extremely diminutive

seed, and a large root, which is cut up and employed for the purposes already mentioned."

Rogers identifies "struthion" as *Saponaria officinalis*, or soapwort, but this seems very unlikely, not least as *Saponaria* is nothing like as described. Most authorities suggest *Gypsophila struthium* as a better alternative. Also, there is some confusion between this chapter, which after all doesn't mention flax at all, with another plant in a different Book altogether, Book 20, "Remedies derived from the Garden Plants". Chapter 79 talks of a kind of wild poppy:

"There is another kind of wild poppy, known as "heraclion" by some persons, and as "aphron" by others. The leaves of it, when seen from a distance, have all the appearance of sparrows; the root lies on the surface of the ground, and the seed has exactly the colour of foam. This plant is used for the purpose of bleaching linen cloths in summer. It is bruised in a mortar for epilepsy, being given in white wine, in doses of one acetabulum, and acting as an emetic."

This plant is identified by Bostock and Riley as *Euphorbia esula*, which isn't actually a poppy at all, but Pliny seems to have derived some of his information on plants from a book written some 400 years earlier, Theophrastus's '*Historia Plantarum*', and in this case, misread it. In Theophrastus's Book 9, Chapter 12, Paragraph 5,<sup>2</sup> he says:

"Another kind of poppy is called Herakleia: it has a leaf like soapwort, with which they bleach linen: the root is slender and does not run deep, and the fruit is white."

It is clear that it is soapwort that is used for bleaching linen, not Herakleia, which merely resembles it. In this respect, Rogers seems to have got the right answer by an incorrect route. However, another of his

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<sup>2</sup> Quotations taken from the translation by Sir Arthur Hort, 1916.



statements seems wholly unjustified, and I dare to suspect that he had not, in fact, actually read Pliny's work at all. He says:

"I believe that the observations of bands of different colors agree with Pliny the Elder's description of ancient linen-production technology. Ancient linen yarn was spun by hand on a spindle whorl. When the spindle was full, the spinner prepared a hank of yarn for bleaching by the fuller. Each hank of yarn was bleached separately, and each was a little different; indeed, different parts of the same hank show slightly different colors, a little like variegated yarn. The warp yarn was protected with starch during the weaving process, making the cloth stiff. The final cloth was washed with "struthium," *Saponaria officinalis*, to make it more supple.

Medieval linen was bleached as the whole cloth. Most commercial bleaching took place in "bleach fields" in the Low Countries, the genesis of the name "Holland cloth" for the Medieval backing on the Shroud. Considerable material was lost during the bleaching process, and the newer linens are less dense than ancient linens, as can be seen by comparing the Holland cloth and patches with the main part of the Shroud. The newer linens are also homogeneous. They do not show bands of different-colored yarn in the weave."<sup>3</sup>

Pliny's account says nothing of this bleaching hank by hank, and nor, as far as I can find, does anybody else contemporary. Quite the reverse, in fact, as records from as far afield as Sumeria and Egypt refer to the bleaching of whole cloth, or garments, never to hanks. There are good reasons why individual hanks of linen thread differ both from one another and within the hank itself, but the idea that different bleaching methods enable one to distinguish between ancient and medieval cloth is unjustified.



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<sup>3</sup> *Scientific Method Applied to the Shroud of Turin*, Raymond N. Rogers, 2002