

Actual size of the sample: 40 mm x 13 mm x 42 mm.



Fig. 1: Enlargement of the sample, warp face (front of cloth).

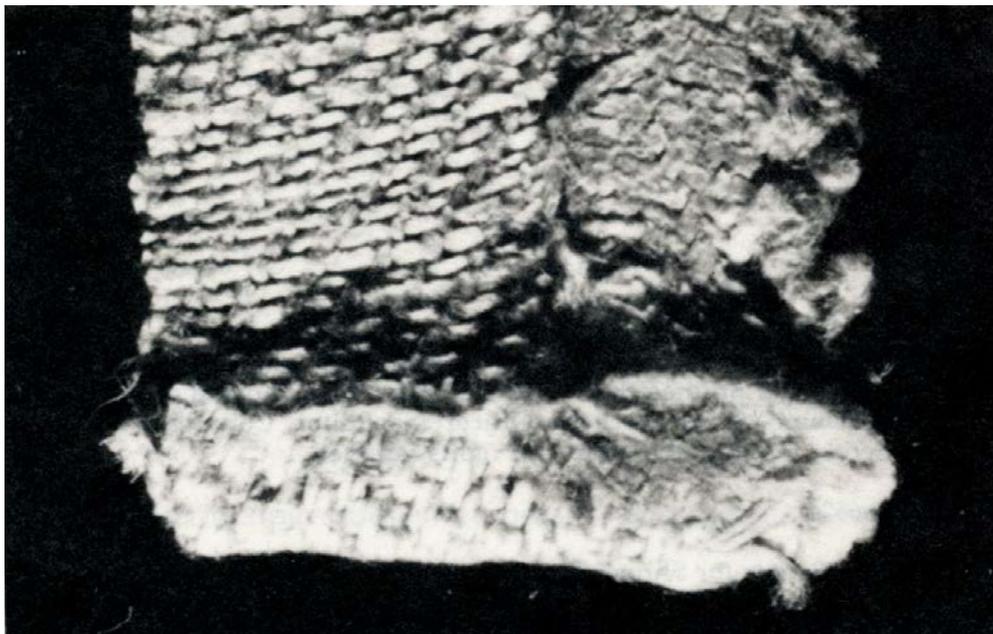


Fig. 2: Enlargement of the sample, weft face (backside of cloth).

THE TEXTILE STUDY OF 1973-1974

GILBERT RAES

The Assignment

In a letter of 8 June 1973, Professor Silvio Curto informed me that plans were being considered for an exhibition of the Shroud, and that this could be an occasion for preliminary observations on the Relic. In the name of the Archbishop of Turin, he asked if I would be willing to assist at the reunion in my capacity as textile expert. Contacting Prof. Curto by telephone, I asked what exactly would be expected of a textile expert and whether there were plans to take a sample. The Professor explained that textile expertise would focus on the confection of the Shroud cloth and the nature of the primary material; and he confirmed the possibility that small samples would be taken.

On November 10, Prof. Curto informed me that there would be an exposition of the Shroud on the evening of 23 November 1973, and that on November 24, from 8 a.m. until 4 p.m., the experts would have the opportunity to examine it.

Due to a delay at the Paris airport, I did not arrive in Turin until about noon on November 24.

The small sample for my analysis, cut from one extremity of the Shroud, included part of the seam that joins the main piece to a strip about 6-7 cm wide, along one lengthwise side.

Characteristics of the fabric

The fabric from the main piece, designated as Piece I, and that from the added strip, designated as Piece II, were examined separately. These are our findings:

	Piece I		Piece II	
	Warp	Weft	Warp	Weft
Number of threads/cm	38,6	25,7	-	25,7
Yarn number in Tex	16,3	53,6	18	73,1
English yarn count Na	10,1	3,1	9,2	2,3
Twist direction	Z	Z	Z	Z

Amplified version (1991) of Prof. Raes' Report published in Appendix B of Prof. Silvio Curto's article, 1974, in *La S. Sindone, Ricerche e studi della Commissione di Esperti nominata dall'Arcivescovo di Torino, Card. Michele Pellegrino, nel 1969*, a supplement of *Rivista Diocesana Torinese*, Jan. 1976.

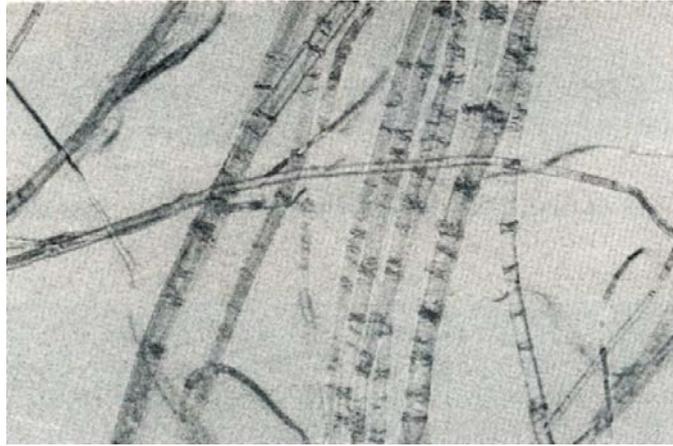


Plate I, Fibers extracted from the weft of Piece II (flax fibers).

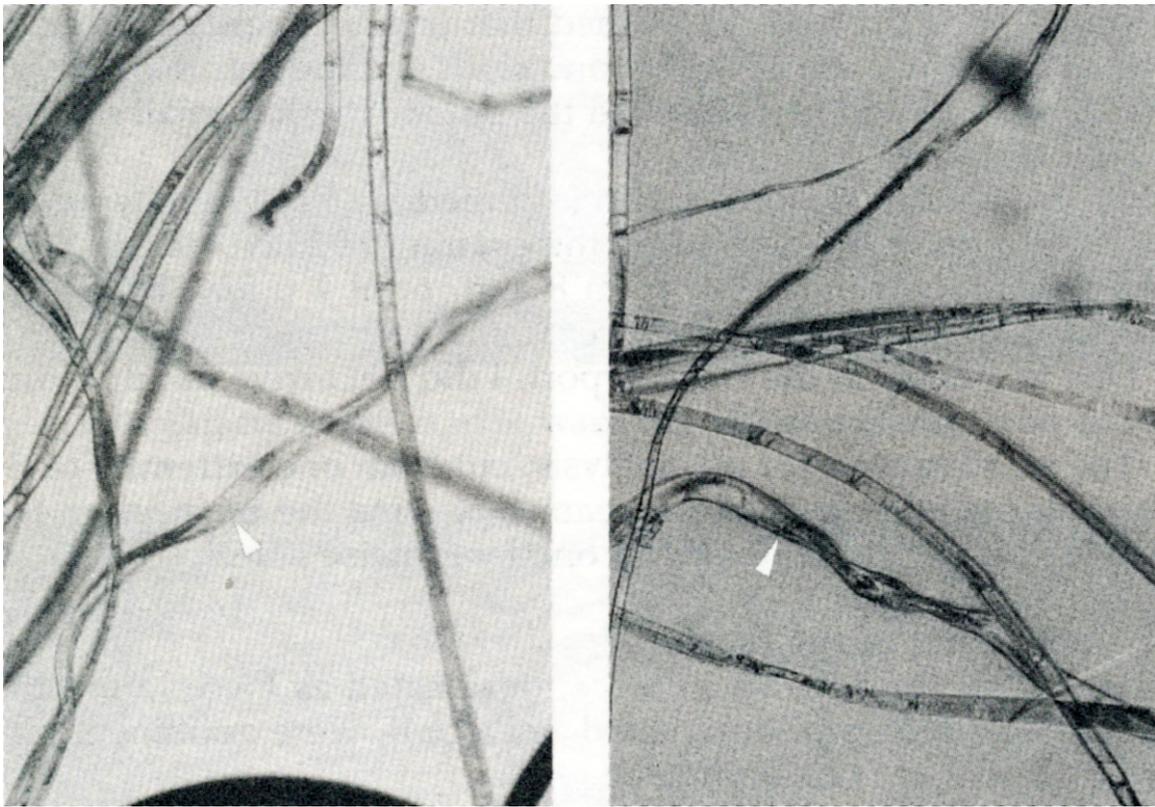


Plate II, Fibers extracted from the weft of Piece I (flax fibers and one cotton fiber indicated by arrow).

Plate III, Fibers extracted from the warp of Piece I (flax fibers and one cotton fiber indicated by arrow).

The thread used to sew together Pieces I and II is a two-ply yarn (27 x 2 Tex, or Na 6,9/2). The plied yarn has an S-twist, while the single-twist threads have a Z-twist. The weave of both I and II is identical: a 3:1 twill.

The thread count of Piece II seems to be different from the count in Piece I, especially for the weft direction. But the count could only be determined on a very short length of material, and we have no indication about the irregularities of the yarn. Therefore it is not possible to state with certainty that Pieces I and II originate from fabrics of different manufacture.

Analysis of the primary material of the threads

Several microscopic preparations were made from the fibers extracted from the warp and weft threads of Pieces I and II, as well as from the sewing thread. The preparations were examined under polarized light in order to obtain better contrast. The basic fiber was indisputably linen, for both Piece I and Piece II and for the sewing thread. The X- and V-structures observed are very characteristic and leave no doubt about the primary material.

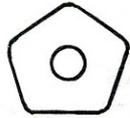
It must be pointed out, however, that in some of the preparations from the warp as well as from the weft of Piece I, traces of cotton fibers were observed. It would seem that the linen threads had been spun where cotton had also been spun. The structure of these fibers was examined to determine the type of the cotton. One of the important features allowing typing is the number of reversals. Cotton of the *Barbadense* type has an average number of reversals of 18-20 per cm; the *Hirsutum* type presents up to 20-30 reversals per cm.

All the cotton fibers found in the linen yarn of Piece I, warp and weft, were of the *Gossypium herbaceum* variety, the number of reversals being less than 10. It has sometimes been remarked that these were superficial fibers having come upon the Shroud at times of the numerous expositions. If this were the case, it is scarcely probable that all the cotton fibers would be of the *Gossypium herbaceum* variety.

At the beginning of our era, both cotton and linen were known in the Middle East; spinners often worked with both. It is evident that if traces of cotton are found in the linen, it is necessarily at the time of spinning that the mixture came about, and not at the time of weaving.*

* Until the advent of the Industrial Era, spinning and weaving were carried out in the same room, where piles of raw cotton would be heaped in one corner, piles of flax in another. Cotton fibers float about everywhere and stick to anything they touch. Spinners often twisted fibers by rolling them against the thigh, where, on the spinners' long skirts, cotton lint had wafted. Cotton fibers, then, would quite legitimately be incorporated inside the flax. I am grateful to Hilda Leynen for this glimpse into the ancient arts of Minerva. Ed.

There is a method by which one can ascertain if the cotton fibers are inside the linen threads. One needs only to coat the linen fiber in a synthetic resin and effect a transversal section. Since the transversal section of cotton fibers is distinctly different from that of the linen fiber, the presence of a cotton fiber can readily be determined. In fact, the linen fiber has a pentagonal form with a circular lumen, whereas the cotton fiber resembles the form of a broad-bean (*Vicia fava*), with an elongated lumen.



Section of a linen fiber



Section of a cotton fiber

Conclusion

The sample examined is of linen in 3:1 twill weave. It is not possible to affirm that Pieces I and II are different from each other, even though the weft threads of Piece II are significantly heavier than those of Piece I.

The linen threads from Piece I show traces of cotton fibers in the warp as well as in the weft.

The weave used for this fabric does not present any particular characteristics and does not allow a determination of the period of manufacture.

In view of these observations, one can say that we have no precise indication permitting us to affirm with certainty that the fabric does not date from the time of Christ. It is, however, equally true that there is nothing that would permit us to state that the manufacture of this fabric was effected in that period.