

A CHRONOLOGICAL SURVEY OF OBSERVATIONS
ON THE SHROUD TEXTILE

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Notes from various authors concerning the physical properties of the Shroud fabric: knowledge basic to conservation studies. This is by no means a complete bibliography but a culling of technical details from primary sources at hand.

1. At eight o'clock in the morning of 16 April 1534, the Shroud, having escaped destruction in the fire of 1532, was solemnly carried in procession to the convent of the Poor Clare Nuns of Chambéry, France. To them had been entrusted the task of mending and patching the damage from the fire.

The text of the Reverend Mother Abbess was presented in *Spectrum* #2, March 1982. On page 23 we read: "After dinner, the embroiderer brought the wooden frame to stretch the Holland cloth on which the Holy Shroud was to be placed; after two hours, the cloth was fixed on the loom and we laid out the precious Holy Shroud upon it, and basted all around." And page 25 [describing the wounds]: "The blood drops appear as large as marjoram leaves ... on looking through the underside of the Shroud, when it was stretched on the Holland cloth or on the loom, we saw the wounds as if we had looked through a glass."

2. ALFONSO PALEOTTO: *Esplicatione del Sacro Lenzuolo ove fu involto it Signore*, first published in 1598. Anastatic copy by Bottega d'Erasmus, Turin, 1975.

Mons. Paleotto's description is based on his close observation during the Exposition of 13-14 June 1582. "It is worth considering the fact that the sacrosanct Shroud is of linen; one notices that the material of origin is quite coarse. Length 12 feet, width 3 feet."

3. PAUL VIGNON: *Le Saint Suaire de Turin*, Masson, Paris, 1939. Anastatic copy by Bottega d'Erasmus, Turin, 1978.

In pages 78-83, Vignon initiates textile analysis; he identifies the 3:1 twill weave; describes the method of weaving a twill and compares the Shroud fabric to various ancient examples.

Vignon was one of the few privately admitted to study the Shroud previous to Giuseppe Enrie's photographic session. With Enrie, the group had passed the night of Friday, 22 May 1931, in vigil before the Shroud.

4. VIRGINIO TIMOSSO: "Analisi del tessuto della S. Sindone", *La Santa Sindone nelle ricerche moderne*, Acts of the Congress of Studies, Turin 1939 and Rome /Turin 1950. Marietti reprint, 1980, pp. 105-111. First pub. by Berruti, Turin, 1941.

This analysis of the Shroud fabric by a textile expert was awarded a gold medal at the National Meeting of Textile Experts in Rome, 1938. The study is based on observations and data that Timossi collected during a direct examination: "In 1933, I was able to observe the Shroud intensely in every detail, close to it with eyes and heart...."

The fabric is opaque, closely woven with raw fiber. The cloth used has the necessary consistency for the practical considerations for which it was intended, i.e., for a bedsheet. A bedsheet must be robust and compact, able also to absorb perspiration, "a consideration observed up to recent times ... for high quality bed linen". In fact (p. 108) one of the outstanding characteristics of linen is its excellent absorbency.

Timossi suggests that the species is *Linum usitatissimum*, which has a marvelous brilliance and fineness.

Pliny tells that cotton was widely used in Egypt; from early times, Egyptians had made use of this plant growing so commonly in their land. But linen was preferred for bed linen and undergarments because in a warm climate it remains fresh while cotton, more porous, clings to the body.

The structure is a 45° diagonal, an uneven herringbone in irregular longitudinal bands about 11 mm wide. The thread count is approximately 50 for the warp (English title for flax), a reduction of 40 threads/cm; and a thread count of 30 for the weft, 27 insertions/ cm. On this basis, the weight of the cloth comes to 296 grams for every square meter. The Shroud measure being 436 cm x 110 cm, ergo 4.80 square meters, the probable weight would be 1.420 kgs.

The Holy Sheet no longer has the fresh clear color it originally had; candle fumes, the 1532 fire, etc., have darkened it to light ochre. The image is light brown.

The Shroud (p. 109) has the form of those that the Hebrews and Egyptians folded longitudinally for their narrow beds. In Turin's Egyptian Museum there is a sheet from the XIIth Dynasty (1996-1784 B.C.) in perfect condition, 7 m long and narrow like the Holy Shroud.

The cloth is solid and compact but soft, supple and easily folded; it does not tend to ravel. Although it has been folded and refolded thousands of times, it presents no splitting in the folds [Timossi's italics]. A fabric of this quality was woven on a vertical loom. Each warp thread was kept in tension by a separate weight, instead of all being attached to a beam, as in most looms.

In the section of the Rome Acts (1950), Mons. Pietro Scotti presents a summary of the 1939-1949 research. He reports (p. 226) that

Timossi had constructed a loom on which an exact replica of the Shroud was woven as a gift for Cardinal Maurilio Fossati, "The Cardinal of the Holy Shroud". In May 1965 the replica was given to the Centro in memory of Card. Fossati (*Sindon* 9:36). It was on display in the temporarily constructed Museum on occasion of the 1978 Exposition.

5. GIOVANNI JUDICA-CORDIGLIA: "La S. Sindone document autentico della Passione di Cristo", Acts of the First Regional Congress of the Centro Internazionale di Sindonologia, Vercelli, 1960.

Ordinary linen was grown and woven in Palestine; fine linen was imported from Egypt for temple paraments, clothing and burials for the nobility, and other special uses. Funeral cloths even longer and more ample than the Shroud have been found at Antinoë. Prof. Marmowski, expert in textile history at the University of Magonza (Germany) asserts that it would be practically impossible to paint on such an uneven weave.

6. VITTORIO MARCHIS: "Interrogativi e risposte sul tessuto della Sindone", *Sindon* #4, 1960, pp. 15-17.

Remarking that information about the linen industry in ancient times is scarce, Marchis poses three questions: 1, Looking at the fabric, what does one see, what is its structure? 2, Could such a weave exist in the time of Christ? 3, Could the fabric have been manufactured in the XIVth century?

Marchis had no answer for opponents who objected that ancient Egyptian cloth was plain weave, and that there was no documentation that in ancient times there existed looms, however rudimentary, capable of weaving a herringbone, that is, with at least four heddles.

By now the doubts have all been discussed and for the most part resolved. But in 1960 Marchis' ponderings were a challenge to a widowed weaver in Germany, Frau Lindermüller. At the end of this survey you will find a few words about her.

7. *La S. Sindone* #10, 1967; Newsletter of the Cappella S. Sindone.

1868, Shroud measured 4.10 m x 1.40 m (incorrectly measured).

1898, Shroud measured 4.36 m x 1.10 m. The measure in the middle (widthwise) was 1.105; at one end, 1.104; at the other end, 1.10. Measure was taken before the 1898 Exposition.

1898, measured 4.34 m x 1.095 m in a double-check measuring after the Exposition.

1978, Shroud measures 4.36 m x 1.10 m.

8. PIETRO SAVIO: *Ricerche sul Tessuto della Santa Sindone*, Grottaferrata, 1973.

In Mons. Savio's compilation of ancient texts, he discusses Egyptian weaving techniques, linen merchants, *othonia* and *sindone*,

linen garments. What interests us here is in the Preface, written by Mons. Giulio Ricci. According to Roman law, the clothes of a condemned criminal became the property of the executioners. The criminal was buried naked, as we see on the Shroud. Joseph of Arimathea therefore purchased "an excessive length" of material to cover the entire Body, back and front. An abundant measure would have been cut from a bolt, on which 30 m of material would have been rolled at the time of weaving. Persons deceased in normal circumstances would be washed, the hair cut and nails trimmed; the deceased dressed and wrapped in a shroud, leaving the face exposed. A *sudarium* was then laid over the face, completing the burial dress.

9. From *La S. Sindone: Ricerche e studi della Commissione di Esperti nominata dall'Arcivescovo di Torino*, Card. Michele Pellegrino, nel 1969. Published by Rivista Diocesana, Turin, 1976.

SILVIO CURTO: "Osservazioni archeologiche circa il tessuto e l'immagine", p. 59.

Observations from direct examination.

The cloth measures ca. 4.36 m x 1.203 m. Ancient Egyptian cloths of the same remarkable dimensions have been found. All the Egyptian cloths were of linen up to the III^d century; but all of plain weave. For a technical analysis, we contacted a specialist in the field, Prof. Raes, whose report is Appendix B.

Cotton originated in India and spread in the Mediterranean area during the Roman Empire.

During our investigation (p. 65), a small area of the Holland cloth was unstitched and it was seen that the image lay on only one surface of the original cloth, i.e., it did not penetrate the thickness of the fabric. Laboratory analyses of samples taken from places of the most intense coloration proved, with sufficient certainty, the absence of impregnation of the threads by any substance whatsoever, pointing to an infinite probability that the entire image is superficial overall.

Since the cloth is pure linen, it is practically impervious to parasites, microbes, humidity less than 90%; it is less resistant to smog. The image can suffer from sunlight, artificial light, radiation. It is unacceptable that the Shroud is kept rolled up in a silk sheet, closed in a double chest practically of lead. It would be well to conserve the Object, even permanently exposed, laid out flat, under crystal....

10. ENZO DELORENZI: "Osservazioni sui Rappezzati e Rammendi della Sindone", (ibid.).

The sidestrip (p. 108) is sewn to the main piece by a stitch used to join fabrics that lack selvages. This results in a "little cord seam", in this case a seam 4-5 mm wide. At the extreme right [above dorsal figure], the cloth is worn away leaving nothing except about 2 cm of the cord seam.

11. RICCARDO GERVASIO: "Bruciatore, Macchie ed Aloni the si riscontrano sul tessuto della Sindone", *Sindon* #24, 1976.

Prof. Gervasio, an assiduous and deeply devoted student of the Shroud, was one of those invited to attend an all-night prayer vigil preceding the Shroud's first television appearance on 23 November 1973. His research is thus imbued by direct observation.

The sidestrip is attached by an overcast seam or an almost invisible cord seam, perhaps formed by a rolled hem. The outer ends of the sidestrip were completely consumed from the habit of grasping the corners at times of exhibiting [notice the manner on the Duch illumination, *Spectrum* #37]. Therefore, "before 1532" the frayed ends were replaced by two rectangles of smooth white cloth. One addition is 35 cm long, the other 15 cm; attached with close stitching with frequent back-stitches. The sewing of the longer piece was later mended with an irregular whip-stitch in brown thread.

12. JOHN TYRER: "Looking at the Turin Shroud as a Textile", *Spectrum* #6, March 1983; based on the Author's paper published in *Textile Horizons*, 1981.

The study was made from photographs.

Tyrer quotes Pausinius: "The flax of Palestine is a beautiful yellow color. Galilee is the center of production, in a city called Arbeel."

The Gerumsberg cloak, Bronze Age, from Northern Europe, in wool, was woven in a 2:2 herringbone twill with a Z-twist warp. The cloak is shaped (by dropping warp threads) and without seam.

Flax fibers are not attacked by moth grubs; under certain conditions of warmth, dampness and contamination, micro-organisms may attack cellulose, notably cotton, but flax fibers resist damage well if kept dry. The fire at Chambéry would have sterilized the Shroud and helped with its preservation.

There are numerous dark warp threads that run for some distance and cross from image to non-image areas. The color difference indicates that the yarns were bleached in hanks before weaving.

"In a reversing twill the opposing lines of twill are mirror images; in a herringbone weave the two opposing lines of twill drop out of strict correspondence by two or three weft threads." It would appear that the Shroud twill is not always a true mirror image, but "drops out" to give a herringbone effect. "These changes may be faults in the weave because of incorrect drawing-in through the healds [heddles].... Only one warp thread in 4 would need to be lifted ... by handloom, a 3:1 fabric was easier to weave than a plain-weave."

The structure of the Shroud linen is closely sett; so may not be immediately absorbent of water, let alone the more viscous liquids draining from a corpse. Concerning its draping qualities, the cloth would be stiffer warpways than weftways. Mr. Tyrer suggests that

the "cord" in the seam that joins the sidestrip to the main piece could have aided in the weaving; but could also have caused difficulties when the cloth was wound onto a roller at the front of the loom.

"...the Shroud is probably the most remarkable 'Standard Sample' for the interpretation of the history of textiles that has come down to us."

13. P. L. BAIMA BOLLONE: "Indagini identificative su fili della Sindone". Reprint from *Giornale dell'Accademia di Medicina di Torino*, 1981.

Doctor Baima reports on his direct examination of the Shroud in 1978.

The thickness of the fabric, depending on the area and the traction, measures 300-350 microns. Threads are not homogeneous: some are knotted, some double. Warp and weft seem to show structural differences. Each thread is composed of about 70 fibers. Diameter of threads is variable between 10-20 microns. The overwhelming majority of fibers are of linen, with occasional cotton fibers.

14. NICOLA SCARPELLI: "Analisi delle deformazioni del tessuto della S. Sindone", *La Sindone, Scienza e Fede*, Acts of the II National Congress of Sindonology, Bologna, CLUEB, Bologna, 1983.

Scarpelli's study offers an explanation of the observation, often noticed but never explained, of why the weft threads appear thicker than the warp. In 7 pages, with diagrams, Prof. Scarpelli demonstrates that hanging and rolling have altered the original dimensions of the Shroud: the chevrons have stretched lengthwise, narrowing their angle; consequently widthwise the chevrons contracted.

Robert de Clary's description comes immediately to mind: every Friday (for how many years?) the *sydoine* stood up straight.... (See P. Dembowski's analysis in *Spectrum* #2). Hanging vertically, probably doubled over between the heads, as many treasured "true copies" are today.

To experiment, Scarpelli split longitudinally part way up the center of a swatch of Timossi's exact replica; he applied traction to one half. After 6 hours the angle of the chevron on the weighted portion had diminished from 58° to 47°; the overall length increased from 11.6 cm to 12.7 cm while the width lost 1 cm. The weft threads bunch up as the warp threads draw closer to each other by the traction.

Photos of some areas of the Shroud confirm the distortions. The angles resulting from a 3:4 proportion (40 warp threads/30 weft) are calculated by trigonometry; but the actual proportion on some parts of the Shroud are found to be only 2.7:4 — an absurd choice for any weaver.

The most important consequence of the lengthwise stretching of the fabric is that the Holy Face appears longer and narrower by 20%, a fact that obliterates the effects of the curvature of the cloth over the Face. The effect is illustrated by comparing a photo of the Holy Face as we see it with a photo of the Face dilated 20%, giving a fuller, more natural appearance.

15. L. A. SCHWALBE and R. N. ROGERS: "Physics and Chemistry of the Shroud of Turin; A Summary of the 1978 Investigation," *Analytica Chimica Acta*, 135 (1982), pp. 41ff.

The Shroud appears to consist of two panels of visually identical linen joined by a seam 4-5 mm wide. The sidestrip varies between 7.8-8.4 cm. A radiograph suggests that the sidestrip is, or was at one time, an integral portion of the main cloth. The radiogram [illustrated on p. 42] shows "alternating high- and low-material-density 'bands' that evidently correspond to weft lots of different weight used in the weaving". The weft structure is continuous across the seam.

One of the pilgrims to the 1978 Exposition was a middle-aged weaver from Dachau vor München, Frau Anna Lippoldt-Lindermüller. Having read the textile article by Vittorio Marchis in *Sindon* #4, 1960, Frau Lindermüller determined to fabricate a replica of the Shroud. She studied Timossi's book *La Santa Sindone nella sua costituzione tessile; analisi e ricostruzione tecnica del Sacro Lenzuolo* (Turin 1942) concerning the structure, attentively noting the faults and imperfections of the ancient weave, so clearly shown on Enrie's photographs. Believing that there must have been a technique now lost, she studied Egyptian papiri and hieroglyphs seeking the key to a technique different from what is generally known to have been in use in Egypt. In the end, she constructed a vertical loom on which she wove an exact replica. Her first results were examined by Turin's textile experts, who found them scrupulously scientific.

Lindermüller's loom is conserved in the Museum of the Centro.



Ancient Loom. (Vatican Vergil.)