Caratteri Poco Noti Della Santa Sindone
(Little Known Characteristics of the Holy Shroud)

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Sindon N.S., Quad n.7, June 1994, pp. 59-68

On 7 September 1992, Monday, five of the most famous experts in the restoration of ancient fabrics, at the invitation of the Pontifical Custodian of the Holy Shroud, Cardinal Giovanni Saldarini, carried out a survey of the Sacred Linen to ascertain its state of conservation and indicate whether possible, a better one for the future.

Listening to the news on television I thought of the difficulties certainly encountered in observing the unusual Artifact, the insufficient time available to notice every detail, while their conclusions will probably not be far from what Prof. Curto suggested in 1969: "Keep the object stretched out and placed on a horizontal plane, [...] in a watertight container". Unfortunately, the Experts should also have noted the damage caused by a new fold, extending from one cheek to the other of the Holy Shroud face.

Perhaps to those experts in restoration, but certainly not of the Shroud, a synthesis of the characteristics of the Sacred Sheet would have been useful, even those less known and often overlooked.

In fact, it is easy to find in articles or books on the subject affirmations and hypotheses in stark contrast to the already established reality. Perhaps the Author did not find the time to get information, or even did not care yet, but even serious and competent scholars can make mistakes, especially on issues considered secondary or recently ascertained.

I will cite three examples. A devotee of the Shroud, priest and doctor considers to be joined on the reverse side with a green fabric, which never existed. According to some, the "lateral strip" would have been brought back to the left after cutting it from the right side to center the Image, but yet on the right there is the selvedge. Although the photometric measurements have disproved it, many are still convinced of the "Shroud monochrome", an illusion created by black and white photographs, where somatic imprint, blood spots and burns are of the same hue and differ only in their intensity.

To deepen each topic, a true treatise would be needed, and even for a detailed documentation I would occupy too many pages beyond my intentions. I will only say that my sources start from the reports of the Commission of Experts appointed by Cardinal Pellegrino, particularly from that of Prof. Delorenzi on damages, patches and mending, very precise. This is followed by the Proceedings of the various Congresses, the articles in SINDON and other specialized magazines, many books, even the most recent, with particular interest in the observations made Each news item was compared, if possible, with the natural-size photographs of Enrie, positive and negative, with the color one by Judica Cordiglia, with the macro-photographs by Ghio and finally with the transmitted-light ones by STURP, and their partial radiograph.

I will deal with the fabric, the damage suffered and the attachments to which it is sewn, the somatic imprint and the blood stains, to finish with some hints to photographic techniques, also answer questions posed to me about it by other scholars.

The Shroud linen is hand-spun with "Z" twist, due to the clockwise or clockwise rotation of the spindle, the same that we see in the reinforcement cloth and in the patches, but opposite to that used in ancient Egypt, both Pharaonic and Ptolemaic. The presence of rare cotton fibers inside the threads, also ascertained on behalf of the Oxford Laboratory, indicates the provenance from regions in which this fiber was used before the 14th century, the eastern or middle eastern ones. The X-ray revealed an unexpected radiopacity of part of the weft threads: the interesting thing is that they continue regularly on the two sides of the seam of the "side strip", confirming that it was torn and then stitched back exactly in its place, with reduction of the width estimated at two centimeters, corresponding to 80 warp threads: in fact the herringbone pattern matches perfectly.

It is known that the Shroud cloth is a twill of four (3 + 1) in a herringbone pattern, that the warp threads are on average 39 per cm against 26 weft passes, so the diagonal effect is not at 45° but only at about 35° and is reversed every 40 warp threads, with possible variations of 4 and exceptionally of 8. Prof. Vial has recently ascertained that along the seam both the main cloth and the strip have free termination threads; he has also described the selvedges present on the two longer sides: there are very rare (few examples from the 16th century) and formed by only two warp threads, thicker and practically superimposed; the weft in going back wraps alternately one or the other, while the normal thickening of the edge is missing.

On the short sides there must be hems of 3 or 4 millimeters, folded in for a couple: they were never described but were seen in the shoot televised on April 21, 1988. They seem to have stopped with a dot on the back, visible for just one millimeter on the obverse and ten on the reverse, but I cannot guarantee. I tried to calculate how much thread was used to weave the Holy Shroud, taking into account that the undulation of the thread is less than in the cloth and can be estimated between two and three percent.

To the approximately 3980 warp threads present in the 102 cm. of the main cloth and the 310 of the 8 cm. of the side strip we have to add the 80 lost due to the tear or hidden in the seam. Each had to be four and a half meters long, taking into account the hems and the undulation, so making the product we get an overall length for the warp of over 19.5 km. The weft passages are about 11,360 over a length of 115 cm, considering the tear and the undulation, so the product indicates an overall length of the weft of about 13 km.

We come to the damage: we have already dealt with the tearing of the strip; two terminal portions, respectively for about 14 and 36 cm, were removed and replaced with simple cloth before the Chambéry fire; of these ends only what was included in the seam remained. Prof. Delorenzi described the two patches in 1969 but in 1978 the one at the front was missing: it is not known when and by whom it was removed.

There are five groups of ancient burns: 4 symmetrical about the center of the rectangles that are obtained by folding the cloth lengthwise and then transversely. The fifth group, less well known, is located on the center line at the height of the buttocks. The largest of their 18 holes were pinned to the Holland cloth with overedging stitches, leading some to believe they were patched on the reverse; but due to the collapse of the charred linen, those points have now remained partially isolated.

The damage from the fire of the night between 3 and 4 December 1532 was of various types. The two longitudinal folds on the sides of the footprints partially charred due to the proximity to the front wall of the reliquary, more directly exposed to the flames. Along them we find three patches of gray canvas and 19 small holes, few of which were mended with dark thread to camouflage them in the surrounding blackening. However, other blackening, albeit of less intensity, spread to the higher layers of fabric, therefore more exposed to heat, almost in correspondence of the imprints of the shoulders.

8 centimeters from the folds the drop of molten silver fell from the lid, more or less widely affecting all 48 layers in which the Holy Shroud was folded, as the Salesian Don Antonio Tonelli reconstructed. A "pupil" of the course that I carry out at the University of the Third Age of Turin asked me how the Shroud was not burned at the temperature of 961°, the melting point of silver. I replied that silver is not used pure but in alloy 800, and melts at 770° - then the title had to be much lower and with more metals, so we could go down another 100°: in the welding points then the addition of a considerable amount of tin could reduce it by another 180°. An external temperature of 500° degrees was therefore sufficient to cause the detachment of the drop, and among the semi-carbonized fibers of the damaged areas we find almost microscopic black silver particles. The temperature inside the container did not have to exceed 280°, but there were also phenomena of partial dry distillation with diffusion of volatile tarry substances: the Shroud linen is in fact much more opaque in transmitted light than the patches of the *Corporale*, at least the double; and this opacity is also noticeable in the lateral stripe and in its terminal patch, the only one present at the time of the fire. I suppose that the opacifying substances have been absorbed within the fibrils, and the apparent radiocarbon rejuvenation should be precisely these.

On the basis of my calculations and many attempts to reconstruct the fact, I am convinced that the direction of fall of the melted drop was at about 45° with respect to the base of the reliquary, therefore the detachment had to take place just as it was extracted from the niche that contained: imagine the damage if there had been a moment of further delay. Perhaps in contact with the fabric a flame developed, immediately suffocated due to the lack of oxygen: this would be witnessed by the burns that prolong the patches of the Poor Clares. Four of them were covered with patches of gray cloth, identical to the three along the charred line already mentioned, certainly applied before 1620: in fact they appear in the copy painted in that year, now preserved in Lisbon. Three other similar burns each show an unpatched hole, through one of them I made a discovery which I will talk about soon. The confluence of two or more contiguous damages through the interposed folds meant that the Poor Clares' patches were only 22, one of which was later replaced with coarse gray cloth, it is not known when.

Don Tonelli thought that others may also have been replaced or covered at a later time, but he does not bring elements to support this hypothesis which I consider unfounded.

Four holes remain on the minor midline, not patched, but with the margins fixed to the Holland cloth with a button stitch: certainly the fiery drop only touched the fold in those points that are exactly symmetrical to the small patches on the shorter sides. Along the edges of the 21 patches of the Poor Clares, 29 further small tears varying in size from a few millimeters to a few centimeters can be identified.

If we add a hole due to a candle flame, as evidenced by a nearby drop of wax, photographed by Ghio and located, after a long search, at about cm. 5 from the long right side and about fifty from the short front side, we come to 74 between holes and minor lacerations not patched.

A consequence of the fire was also the use of water to extinguish the flames and cool the hot metal: however, it did not impregnate the entire fabric, as it could not reach the folded corners located higher up, which therefore remained dry. Thus 21 halos were formed around them, sixteen subtriangular along the sides and diamond shaped the five on the median line, the only ones of interest correspond to the experimental halos obtained on dry linens but previously impregnated with solutions of aloe and myrrh, the aromas red in the Gospel. Indeed, where the fabric had not been treated, the halo also formed. In transmitted light these halos are evident because in them the impurities dispersed elsewhere on the fabric were concentrated in them. Their position does not correspond exactly to that of the burns, which shows that in the movements impressed on the reliquary the folds partly changed position due to the sagging of the fabric.

Even the withdrawals carried out constitute a damage, all the more serious the greater the extension and proximity to the Imprint. The oldest known is that of a thread, probably a few centimeters long, removed by Blessed Sebastiano Valfré for the Duke, and then King, Vittorio Amedeo II, who always carried it with him in a reliquary. On November 24, 1973, the day following the "worldwide" television exhibition, 14 pieces of thread were taken, of which only one of weft, for a total of 20 cm, and a sub-triangular portion of cloth at the front end of the seam of the side strip (it is probable that precisely on that occasion the nearby patch was removed.) It was examined in Belgium, then returned and reapplied, divided into its two parts, previously sewn, in about the same place; it was then definitively removed in 1988. We can evaluate its extension respectively in cm^2 5 and just under 3 cm^2.

On the night between 8 and 9 October 1978, just after the Exposition, Prof. Baima Bollone extracted, with the help of the Sisters assigned to this task, 12 thread samples of a couple of millimeters each. Overall, the single strands removed would measure from 25 to 30 centimeters.

On April 21, 1988 a sample weighing 478 mg was cut out, corresponding to about 20 cm^2 of fabric, even if partially hidden in the hem and in the seam: these parts were then eliminated for 178 mg. While the remainder was divided among the three laboratories for radiocarbon analyzes and a rectangle weighing 141 or 144.8 mg according to two discordant versions, like the other weighings carried out on that occasion, when unfortunately they were not registered by anyone, lacking the presence of a notary. But the less documented sampling was another, probably occurred immediately before the opening of the 1978 Exposition: Prof. Brandone of Pavia examined a piece of the Shroud at the Neutron Activation in that period and reported it to the Congress that took place in the two last days. The weight was 10.22 mg, equal to less than half a cm^2 and "the sampling was done on the edge less than half the length" according to its report, but there is no record or anything similar at the time of the sampling itself.

Since the analysis by Neutron Activation does not involve destruction of the fabric, we can say that there are six pieces of Shroud linen that should be recovered: the last described, the two in which the Raes sample was divided, the two "eliminated" portions in 1988 and the small rectangle kept in reserve on that same occasion. Macro-photographs of these pieces, on the right and the reverse side, on graph paper, could be used for many useful observations, also confirming some of the above data.

I have tried to calculate the extension of the fabric so far lost: over 500 cm^2 in the tearing and re-sewing of the lateral strip; another 400 removed at its two ends; 2000 covered or missing under the patches of the Poor Clares and 300 under those of gray cloth; we add 65 cm^2 for the 74

holes and lacerations and another 28 for withdrawals: we thus reach about 3300 cm², that is 14.5% or more than one seventh of the entire cloth.

We have not counted among the losses blackening and folds, which cause very serious aesthetic damage if they affect the areas of the image. On the other hand, for the crumbling of the dried blood of the blood stains, a more competent scholar than me gave an evaluation of over 50% of that originally present on the fabric. And every movement aggravates those losses.

Let us now describe the “annexes”, which currently are attached to the Sacred Linen. The "side strip" should not be counted among them because it originally had to be part of the same cloth. We recalled the 30 patches still present and visible from the right of the sacred find. The major annex is the Holland cloth, applied and stitched by the Poor Clares on the reverse of the Shroud. I found that it is not of a single piece, but formed by two strips of different widths: the largest supports the center and the right part for a total of 93 cm. while the one on the left is only 23 cm wide. The seam between the two strips forms a relief 8 cm outside the left charred line. You can see a thickening running under the Shroud cloth and under the patches and can be seen through one of the holes located at the height of the left shoulder: it seems to be an overedge between the two selvedges, but the current photos are not clear enough to a secure identification. This Holland cloth is sturdy, although a mended tear has been noted, but it is much less dense than the Shroud cloth. The two fabrics are joined with a cord stitch along the four sides and by an odd number of stitching, perhaps nine, for all the length, except for the central one in correspondence of the Sacred Face.

On the obverse the stitches are camouflaged between the warp passages, of which they have the direction and length; on the reverse they are immediately noticeable for the greater length. Similar stitching is found around the scorched areas, probably to secure the two fabrics together before sewing to both Corporal scraps. In 1978 parts of these stitching were removed to insert some examination equipment between the two layers of linen: perhaps now the whole is weakened.

All around the Shroud, but stopped only at the reinforcement canvas, in 1898 some edges of red and pink silk were described, 2.5 cm wide on the two short sides, 5 cm on the long right side and only one on the left side, perhaps to better center the Figure. This is why the Holland cloth is wider than the Shroud. Now these edges are covered by bluish ribbons, also weighed down by metal sheets, perhaps to delimit and keep the Holy Cloth stretched during the photographs, but it is not certain that they date back to 1931.

The excessive thickness of these edges and of the metallic foils is deleterious when the Holy Shroud is rolled up, in fact this method of preservation is ideal for flexible layers of uniform thickness but not for the Shroud with too many attachments and with fragile parts such as charred linen and dried blood. Finally, we recall a piece of dark blue linen added to the blue border in 1978 because the front left corner did not occupy all the space available in that area of the Cloth.

History reminds us that in 1694 Valfré replaced the rear lining of the Shroud with a new one in black silk, to prevent excessive transparency during open-air expositions. It was replaced in 1868 by Princess Clotilde, who always worked on her knees, with a red silk one, which still exists today. It is sewn only on the left side to be able to fold it on the reverse side during the ostension and on the front when it was stored.

The black Valfré silk, cut into rectangles the size of a duly authenticated postage stamp, was then distributed to the faithful.

The double imprint of a naked man covered with wounds, which makes this precious Artifact absolutely unique, is much studied but perhaps there are few who know the intimate structure on which the properties of negativity, superficiality, nuance and evanescence depend. It was described by the architect Mosso, who kept in his studio a negative enlargement of the Sacred Face at at least six diameters, obtained from the life-size plate of Enrie. The individual threads were clearly visible: for less than 2 mm those of the weft, which he called "unitary knots", and for at least four those of warp, referred to as "binary knots". I excerpt a few words from his report to the Turin Congress in 1978: "... he arranged diagonals in both directions ... strange dotted ... can be seen clearly ... on the strong enlargement of the Face ... and they clearly tell us that the negative chiaroscuro ... is impressed only on the unitary nodes. .. and they are of various dimensions which precisely demonstrate the different intensities of the chiaroscuro". Then the dark spots on the upper surface of the weft threads become smaller and smaller, fading into nothingness on the edges.

In each square centimeter there are about a thousand crossings between weft and warp, but only in a quarter of them does the weft cover the warp. Calculating that the double footprint covers about a quarter of the Shroud cloth, that is 12000 cm^2, the points that interest us are about three million, and each of them affects only one thread, in its superficial portion.

Where the intensity of the Imprint is greater, the points occupy three quarters of the visible surface of the cloth and, taking into account its dimensions, never cover more than one sixth of the total surface. We can thus explain why intense frontal lighting does not allow us to perceive the body image, since it is such a limited and gradual variation in light intensity.

Let us now consider that in the shades on the outlines the size of the points decreases, reducing the average to about three fifths; we can thus calculate the overall surface bearing the somatic imprint. Collecting together the three million points that form it we would come to cover a thousand square centimeters or a little more. We must then take into account that only the most superficial layer of the fibrils is altered.

It has been shown that the darkening of the linen fibers does not derive from the addition of other substances but from a "yellow discoloration" due to acid oxidation with dehydration and conjugation of the cellulose molecules. This reaction seems irreversible, in fact they had no effect the many reactants used on the fibrils, while the yellowing in the sun and the wringing due to the heat usually discolour at least in part.

The blood stains, spread over almost the entire imprint, differently from it affect both the weft and the warp and appear to have been removed by real clots: in fact, around each of them the ultraviolet rays highlight a halo of serum, invisible to the naked eye because of the same color as linen.

It seems proven that the image does not exist under the bloodstains.

Microhistochemical spectroscopic analysis showed that mixed with blood there are aloe, myrrh and vegetable saponin, the detergent of ancient times. The Americans Heller and Adler rencountered an excessive bilirubin content in this blood. Someone hypothesized a "superblood", but this excess is explained by the need to dispose of a large number of damaged red blood cells, and the Man of the Shroud has suffered a lot of torture. In fact, the liver has the task of recovering bilirubin from the red blood cells, as they are eliminated, to recycle it in the new ones that are produced.

In Turin, Prof. Baima Bollone, Professor of Forensic Medicine, also identified the blood group: it is group AB, the rarest but the same found in the Eucharistic Miracle of Lanciano.

There are also bloodstains outside the footprint: only those on the side of the sole of the right foot have been described, probably due to a fold in the cloth that allowed it to double by imbibition. Ghio photographed a small group of spots, believed to be blood but do not appear to have been thoroughly examined, visible beyond the dorsal patch on the right.

Microscopic particles of soil were detected, included in the coagulated blood, on the heels, knees and nose. In them the calcareous material is not the normal "calcite" but the rarer "aragonite", and with a high content of the element "strontium". It then turned out that the limestone rock on which Jerusalem stands is rich in "aragonite" with the same percentage of "strontium". In the bloodstains on the nape of the neck are included clear circles, like drops of a substance that cannot be mixed with it: Vignon thought they were residues of the "nard" also poured on the head of Jesus by the repentant sinner at the Bethany supper.

The use of photographs is essential in the study of the Holy Shroud, but we must keep in mind the characteristics of the various techniques used.

If the optical axis is not perpendicular to the fabric the angular and linear measurements vary with the direction; this also occurs at the ends of the photos of the entire Shroud, which are therefore slightly shorter than the correct one.

The color photos can make the colors veer towards the red or towards violet; from them we cannot identify the nature of the stains presumably of blood, but not yet directly examined, external to the Imprint and visible in groups near the long sides of the cloth.

The "orthochromatic" black and white photographs accentuate contrasts and contours, unlike the more nuanced "panchromatics", but therefore less understandable. With narrow aperture and longer exposure time the details are highlighted, but when the intertwining of the threads becomes visible, the chiaroscuro effect of the image is reduced. The greater the magnification, the greater the evanescence, therefore it is necessary to observe them from a greater distance. I have not exhibited anything new, but the collection of this information in a short space can be useful for those who want to be informed and do not have the time necessary for an in-depth personal research.