The Invisible Mending of the Shroud, the Theory and the Reality.

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Note: View the Illustrations for this article at www.shroud.com/mechthild.htm

The desire to prove erroneous the dating by a carbon-14 analysis of the Turin Shroud conducted in 1988 has lead to different theories in the past few years. One of these theories shall be examined here in light of the evidence the shroud presents. It is the thesis established by M. Sue Benford and Joseph Marino, and adopted by Ray Rogers in 2005, which postulates that in the Middle Ages the Turin Shroud underwent some mending in the area of the cloth from which the sample for the analysis was taken. These supposed repairs explain, according to the authors, the medieval dating of the shroud provided by the C-14 analysis (*footnote 1*).

The Manufacture of a Woven Fabric.

As the assessment of the "mending theory" requires the knowledge of what is practically feasible in the area of textiles, let us first have a look into the basics of the production of a woven cloth.
A woven fabric consists of the warp threads (mounted on a loom) and the weft threads (interlaced - at a right angle - with the warp threads during the weaving process). We distinguish woven fabrics by their **fineness** and their **structure**. When finished and taken off the loom, the fabric has a smooth surface marked at times by irregularities, the so-called weaving errors. These errors occur during the weaving process on the handloom as well as on the machine loom, the so-called jaquard loom, which was introduced in France in the early years of the 19th century. One of the ways by which the products of these two different looms are distinguishable is actually by the kind of weaving errors they display. A cloth woven on a handloom shows **irregular weaving errors**. This is one of the marks of antique textiles – it applies also for the Turin Shroud - which are usually scattered with weaving errors, undetectable though to the eyes of the uninitiated. On the other hand, on a machine woven textile we find fewer weaving errors, but they **recur regularly** - due to the mechanized weaving program.

The Professional Mending of Woven Fabrics.

If the surface of a fabric has been damaged by use and aging, a repair becomes necessary. At all times people tried to prolong the life of a precious textile by repairing it. To what extent those repairs are noticeable depends of course on the capability of the “restorer”, but first of all on the fineness of the woven material.

For example, whether dealing with a woven tapestry or with a linen cloth, the “restorers” of all ages face completely different problems when these textiles require mending.
The way, how to close a hole of 1 square centimetre in a thick tapestry is described in the following (*footnote 3).*

Example 1: coarse fabric in tapestry technique, wool,
6 warp threads per 1 centimetre, 25 weft threads per 1 centimetre.

First the missing warp threads are replaced by inserting new ones into the old material, **fig.1**, and then woollen threads matching the originals as closely as possible are darned in as weft threads according to the coarse structure of the fabric, **fig.2**.
The new warp threads must be secured at the edges of the hole - which should show as little as possible on the front of the fabric. The ends of these threads either form slight ridges over a stretch of about 1 centimetre around the hole on the front, **fig.2**, or lie open on the back of the fabric, around the edges of the hole. Then the weft threads are interlaced. With some skill it is possible to hide the ends of these threads, and the darned area is often recognizable only by the different quality of the new weft threads in comparison with the originals. The coarse weaving structure of the tapestry allows for such a hole to be closed in a way that the repair is unnoticeable on the front of the fabric - no magic is involved here, **fig 3 and 4**.
If the colour and the quality of the new weft threads are a perfect match for the original weft threads the operation is indeed **invisible on the front**, still it is always **clearly recognizable on the back** by the newly inserted warp threads.
If the warp threads have been preserved in a damaged area (which makes the insertion of new warp threads unnecessary), the operation is **invisible on both sides** of the textile and one can rightly call it "invisible inweaving" (*footnote 3),* **fig.5 and 6**.
This kind of technical proceeding applicable exclusively to the coarse weaving structure of a tapestry, seems to be the basis of the argumentation of Benford/Marino (f*ootnote 1)*.

A completely different procedure is required for the repair of a delicate fabric. The fineness of its threads and the resulting delicate, dense structure don't allow for the hiding of the added threads needed for repair.

Example 2: Fine woven fabric in twill technique, linen,
38 warp threads per 1 centimetre, 25 weft threads per 1 centimetre.

There is no method to make a hole of 1 square centimetre disappear in this type of delicate fabric. It is of course feasible to restore the missing part, imitating exactly the weaving structure of the original, as has been described for the first example. This method is called today invisible mending, and threads from the original are used in the process. But even the most successful execution can ultimately not conceal the operation completely to the trained eye, and it will always be **unequivocally visible on the reverse** of the fabric.

Examples 1 and 2 are cases of **inweaving**. This is the most comprehensive method to restore a missing part in a weaving and it requires a specialist in this area, today as in the past.

The Domestic Mending of a Woven Fabric.

One of the very common repairs of a woven cloth is the closing of a hole by **putting on a patch**, as the sisters at Chambery have done. A patch usually covers a hole or an especially brittle, worn out area of a cloth. It is placed on top of the front, rising a little higher than the surrounding area, and by this alone is easily recognizable. If the patch is added to the reverse of a fabric, the brittle parts are fixed onto it. This too is very noticeable. Even though the Chambery patches had been attached with great care, there is no way to call the results invisible. Another domestic way to close a hole has always been to simply **darn** it with no regard to the structure of the fabric. Certainly this does not fall into the category of "invisible" (as in invisible mending).
A fabric can also undergo other damages which do not result in a hole. Among these are damages caused by frequent handling or by abrasion of the fibres, or something else of the sort. The result would be a worn out, brittle, threadbare textile, **fig.9**. Such a weakened fabric can be supported by fixing it onto another piece of material, as already mentioned above. The other possibility of consolidation is by darning, using new yarns, as one does with a worn sock, **fig 9 and 10**. These methods used in normal daily life have always been and still are executed at very diverse levels of quality.
One thing though that all efforts have in common: no matter how carefully the work is done, **the operation** always stays documented as such, it is **never done in an invisible way.**

What then does "**invisible mending"** mean**?** The phrase has of course been created as a promise to the costumer. It tells him: the damaged article will be restored so perfectly that nothing will be seen of the former damage, and so it has been in most cases. The costumer, usually not an expert in the matter, can only be amazed by the artistry of the specialist who has been able to make the hole disappear. This means however: disappear as much as possible, which was satisfactory in many cases. By just looking at a tapestry, a garment or a tablecloth the layperson will never be able to discern easily a well mended hole. It does, however, not mean that the operation has to go undetected by the expert. To such a person mending will of course **always be noticeable to the naked eye**. As these repairs have been executed with the naked eye, they can also be recognized without a magnifying glass by the trained eye!

The Mending of the Shroud.

The Shroud of Turin is a woven linen cloth of the structure described above in example 2. The cloth - in its entirety exceptionally well preserved - has, in the course of its history, suffered some damage. After it was damaged in a fire the sisters of Chambery put the cloth on a support fabric and covered the burned holes very carefully with pieces of

fabric, in order to be able to show the relic without these disfiguring damages. The support lining was first fixed to the shroud by basting stitches executed from the back. For the purpose of getting the desired support when connecting the two fabrics it was necessary to also prick the back of the shroud. This joining of the two fabrics was done with great care. Long stitches were used on the lining, the so-called Dutch cloth, **fig.13,** very small stitches seized only the back of the shroud, **fig.14**, leaving on its front only the marks of tiny stitches or slight depressions (*footnote 2)*. Later in time, as the continued handling of the shroud caused small damages to the patched areas, these were darned coarsely with brown yarn, matching the colour that showed under the damaged patches. These repairs were the only historical stitching done on the shroud - apart from the one vertical seam and the small rolled hems at the edges of the width.
This is all that ever needed to be done - leaving out, for now, the two cut away corners.

The Theory and the Reality of the Invisible Medieval Mending of the Shroud.

The theory that repairs had been done to the corner areas in the Middle Ages, unfortunately is based on a false presupposition. The necessity of repairs to the corners has been postulated without ever examining the need for it. The real reason for the theory has been the desire to find a plausible explanation for the unsatisfying result of the carbon-14 analysis. Similar wishes, although understandable, have lead all too often in the history of the shroud to untenable theories. The starting point for every scientific study of the cloth, however, has to be the reality of the linen material itself including the equally very real traces of the history left on the cloth. Nor more, nor less. Even then enough room is left for misinterpretations; it is far from being scholarly research if the shroud is being used as proof for wishful thinking.

The linen shroud has never been buried in the ground. Its exceptionally good condition is in no way comparable to other shrouds which have spent hundreds of years in graves. Though the Turin shroud is burdened with the dust of centuries and with greasy dirt deposits on the corners, **fig.15** - a result of the countless handlings in the past - its weaving structure is cohesive and **untouched** even at the corners. Therefore **at no time has the need to reinforce the corner parts arisen**! If even the corner pieces cut away before the fire of Chambery, have not been replaced, why should remaining areas, dirty but intact, be reinforced or mended? The completion of the corner areas was only achieved by the conservation measures of Chambery, when the whole shroud had to be provided with a lining (the so-called Dutch cloth) to secure its stability. The chosen colour of the supportive lining also solved the problem of the missing corners by closing the gaps at least in an optical way. These corners appeared complete again, and the others received more support than a repair could have provided.

The late Raymond Rogers examined the surrounding areas where the sample had been taken, by means of infrared pictures of the shroud. The pictures show discolorations in these areas. This has been the inducement for the hypothesis of the mending in medieval times.

The infrared pictures show a diffuse discoloration at the corner in question, i.e. a discoloration without the definite outlines of an allegedly mended area. A darn would have to appear in the picture as clearly defined. The UV-fluorescent picture of a comparable woven material containing darns allows for the repairs to be recognized by the route of the threads used, **fig.8**! Furthermore the discoloured spot in the infrared picture is so big that it could not possibly be the location of a darn which had not previously been detected by the naked eye.
If looked at without a magnifying glass - an “unscientific” way according to Rogers - the area around the removed sample and the preserved corners display discolorations as big as human palms: blackish deposits under which the fibres appear to be sticking together. These coatings - obvious to the naked eye - are clearly in contrast to the surface of the rest of the shroud, **fig.15**. But they do not have their origins in added yarns used in darning or inweaving, as has been postulated, they are simply greasy dirt. This is a plausible explanation in view of the fact that innumerable unwashed hands have handled the shroud whenever it was shown in the past.
The rubbed off shoulder areas of a medieval gilded head reliquary, **fig.16**, exemplify sufficiently to what changes in the appearance, depending on the material, frequent touching by hands can lead.
Rogers attributed the colour change of the one area of the shroud to medieval repairs to which he was unable to give further indications. Nowhere in his analysis of the colour picture can be found a reference to the very real dirt deposit which is very visible without technical devices. So it could be expected that the deposit also showed in some way in the infrared picture. The question to the chemist in this regard would be: how do sweat and oil etc. from human hands show in an infrared picture? These imponderables, together with the fine coal dust embedded in all the fibres of the cloth make the use of the carbon-14 analysis unsuitable in this case. The presence of the **greasy dirt deposit** at the "removal site" alone would be sufficient to demonstrate the **uselessness of the carbon-14** method, without having to construct an untenable "mending theory".

Equally lacking any trace of evidence on the shroud is the hypothesis that a patch fixed onto the same minute spot which had been removed as a sample has falsified the result of the analysis. Where exactly had the patch been attached? How big was it? Was it so small that it covered only the sample area? Answers to these questions are lacking in the hypothesis of Benford/Marino and Rogers. They can only be given in a competent way by textile experts. One of them, who was present when the sample was taken, the late Gabriel Vial, confirmed repeatedly that the sample was taken from the original cloth! This affirmation seems to be unacceptable to a natural scientist even if it comes from such an excellent textile scholar as Gabriel Vial who moreover made this judgment in his very own field of expertise.
In any case, neither on the front nor on the back of the whole cloth is the slightest hint of a mending operation, a patch or some kind of reinforcing darning, to be found, **fig.17 and 18**.

Footnotes

1) ***Joseph G. Marin,/ M. Sue Benford,*** Evidence for the Skewing of the C-14dating of the Shroud of Turin due to Repairs.
M. Sue Benford, /Joseph G. Marino*,* New Evidence Explaining the "Invisible Patch" in the C-14 Sample Area of the Turin Shroud.
Raymond N. Rogers, Studies on the radiocarbon sample from the shroud of turin.

2) ***Mechthild Flury-Lemberg,*** Sindone 2000 /Preservation; Torino *2003 ODPF; p.67, Paragraph 24; Abb. 42a;*

3)***Mechthild Flury-Lemberg***, Textile Conservation and Research*;* Abegg-Stiftung Bern 1988; *„Tapestries": pp 75-98*

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Captions to the Illustrations.

1.) Section from the edge of a tapestry. The warp threads have been replaced where they were missing. The new threads have been secured at the edge of the material in such a way that they now lie on top of the old remaining threads in the original material for about 1 cm (on the right in the picture).
If the knotted ends of the threads lie on the face of the material they are cut and only a raised area around the former hole is visible, fig.2.
If the ends of the threads are left on the back they usually are not cut away and as a result are visible there.

2.) On the left the ends of the warp threads around the inweaving can be seen.

3.) and 4.) On the left: a hole with broken warp threads before the repair.
On the right: a perfectly done restoration which could be called "invisible", but still the trained eye recognizes without effort where the ends of the newly inserted warp threads have been secured.

5.) and 6.) Detail of a late Medieval tapestry. The weft threads have disappeared, the warp threads have stayed in place.
On the left: If the ends of the new weft threads did not appear on the reverse of the tapestry, we could call it an “invisible mending”. But, as has been stated already, even then is true: invisible does not necessarily mean unrecognizable by the expert.

7.) and 8.) Same detail:front and back of damask napkin, Abegg Stiftung Bern Inv. No 3829 ; displaying the most delicately done darning, hardly visible on the front, but much more obvious on the back of the textile.

9.) Banquet Napkin of Pope Urban VIII:, (1624) Headley Parish Church, Surrey.
A very used, literally threadbare damask worthy of a repair. This condition represents the extreme contrast to the well preserved corner of the shroud shown in fig.16.

10.) The UV-fluorescent picture of the damask shown in fig.9. The little white blotches indicate the repaired spots. In them the route taken by the darning threads can be followed.

11.) and 12.) Shown here is a darned area executed (by Irene Tomedi) on a copy (by Vercelli) on the scale 1:1 of the shroud material. Fig.11 shows the front where threads have been darned in as invisibly as possible, and they are practically imperceptible; nevertheless the woven fabric looks different here – compared with the surrounding area – thereby disclosing that an operation has taken place on this spot. On the reverse in fig.12 the threads are clearly visible, for they have to go somewhere.

13.) and 14.) Top: Detail of the Dutch cloth with basting stitches. The long stitches have seized only a few threads of the original material on the back of the shroud, as can be seen in fig. 14. This has caused a small depression on the front of the shroud, or it is only the tiniest of stitches which has become visible here. Both marks could lead the untrained person to a misinterpretation; but they do not stem from any kind of mending.

15.) The bust reliquary of St. Pantalus (after 1270) from the Basle cathedral treasury. The rubbed off shoulder areas of the gilded reliquary are indicative of the frequent manipulations which highly estimated relics were exposed to in the past.

16.) Manipulations too have caused these clearly visible dirt deposits on the shroud.

17.) and 18.) Detail of the shroud, front and back, showing the area where the sample was taken. The woven material displays the irregularly spun threads of the warp and the weft – well-known features of an antique textile -, but **not the slightest hint of a mending operation**.

Foto: Abegg-Stiftung Bern, Christoph von Viràg,
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