

## COMPELLING DATA INDICATING AN INVISIBLE REWEAVE IN THE C-14 CORNER OF THE TURIN SHROUD

by Joseph Marino

When the 1988 C-14 dating results on the Turin Shroud (TS) were announced by the British Museum, after samples were tested by the University of Oxford, University of Arizona and the Swiss Institute of Technology in Zurich, those who believed that the accumulated data pointed toward authenticity considered various reasons why the dates came out medieval instead of first century. Some archaeologists and researchers believed that area may have been repaired. There are various pieces of evidence that support that idea.

Enzo Delorenzi, a member of the Turin commission that studied the Shroud in 1969 and 1973, wrote, “...*I should like to mention the impression I received during the course of my examination, namely, that more pairs of hands have carried out the darning than is suggested in the historical records*” (Delorenzi, 1976, pg. 111).



**1973** – Mendings by Nuns of S. Giuseppe, Turin.  
**1868** – Mending and lining. Princess Clotilde of Savoy-Bonaparte.  
**1694** – Various restorations. Venerable Seb Valfré.  
**1534** - Mending, patchwork and lining. Nuns of Chambery.  
**944/1204** Taking away cappings of relics and restoration.  
**1..?** Fire and repairs?  
**2<sup>nd</sup>/9<sup>th</sup> centuries** Secret conservation, folding square. Jerusalem, Pella, Edessa.

*From Archaeologist Maria-Grazia Siliato's 1998 book: Counter-Inquiry on the Holy Shroud. (Written prior to the 2002 "Restoration").*

Textile expert Gilbert Raes, who in 1973 was given a small sample of the Shroud for analysis, wrote in his report that he found cotton. He also noted (Raes, 1976:85), “The thread used for sewing the two pieces [designated —Piece 1 and —Piece 2] together is [...] twisted in an S-direction, whereas the individual threads are twisted in a Z-direction.” Later research by Shroud of Turin Research Project (STURP) chemist, the late Ray Rogers, revealed each piece exhibited different characteristics, such as cotton content, lignin content at the growth nodes, and thread size, suggesting two different

origins of the yarns. The continuous, fully-observable sewing thread represents a significant change of technique, and suggests this section of thread, which incorporated the Raes sample and C-14 sample areas, was applied from the top instead of the reverse of the cloth. This further implies the two sections of sewing threads (C-14 region versus main Shroud) were applied at different times and by different artisans. According to Swiss textile expert Mechthild Flury-Lemberg, the Shroud stitching is possibly from the same time period as a cloth from Masada in Israel, dated to BC 40 to AD 74 (Flury-Lemberg, 2001:56, 60).

Dr. Michael Tite of the British Museum and who was the overseer of the testing, wrote the following entry on April 27, 1988, regarding the sample taking on April 21 (actually giving incorrect or imprecise measurements for the weights of the sample):



*The late Giovanni di Numana*

The sample was removed from the shroud by Riggi using scissors from above the edge where the Raes sample had been taken. Any material surviving from the side strip was removed. Sample was weighed (400 mg.) Material which was possibly contaminated by later stitching was removed from the left-hand side and bottom edge of this strip. This strip was then re-weighed (approx. 300 mg). It was decided to give 150 mg to the laboratories and retain the remainder of the sample for possible subsequent measurements in Turin (Tite, 1988).

Giovanni Riggi di Numana, who, as noted above, cut the sample in 1988, wrote, “*I was authorized to cut approximately 8 square centimeters of cloth from the Shroud [ . . . ]. This was then reduced to about 7 cm because fibres of other origins had become mixed up with the original fabric*” (Riggi di Numana, 1988, pg. 182).

Riggi di Numana, while discussing how for public exhibitions a pole was inserted in the side from which the C-14 sample was taken, wrote: *This wear and tear made major repairs necessary*, which can still be seen today in the upper corners both left and right – *repairs which required the addition of new fabric by skilled seamstresses to reinforce the shreds of material from the original* (my italics) (Riggi di Numana, 1988, pp. 59-60).

Although no documentation has been found regarding the claim about the pole supposedly used for exhibitions, there is absolutely no doubt that the side from which the sample was taken was always held by bishops, etc. when the cloth was exposed. And while discussing the stitching that joined the Shroud to its backing cloth, Riggi commented: *But what is certain, is that the colour of the thread used for this stitching blends in perfectly with the threads of the Shroud itself, and being no thicker than warp or weft, it cannot be detected with the naked eye [...]. It would have been interesting to know more about these – whether for example they were unraveled from the Shroud*

*itself, or from the fragments cut off from the edges during repairs and adjustments, or how, in the case of a different origin, a thread was found that blended so well with the fibres of the Shroud, changing colour as a result of the ageing process in such a way as to be completely invisible.* (Riggi di Numana, 1988, pp. 66-67).

When Oxford looked at their sample, the late Edward Hall noticed fibers that looked out of place. A laboratory in Derbyshire determined that the rogue fibers were cotton of “a fine, dark yellow strand” (“Rogue Fibres found in the Shroud,” 1988:13).



Left: How the upper left edge of the Shroud appears today after removal of the samples for examination. It is easy to single out: 1) The Holland backing applied in 1534. 2) The darkening of the area where the fragment was removed on which Raes did his analyses. 3) The sector from which the C14 sample was taken. 4) The seam between the Shroud and the Holland cloth.

Belgian chemist Remi Van Haelst noted that to pass the Chi Square test, which determines comparability of two or more disparate samples, statisticians tell us that the calculated value should be lower than six. The Chi Square test value for the Shroud is 6.4, meaning that the subsamples cannot be considered identical, or rather, from the same representative sample.

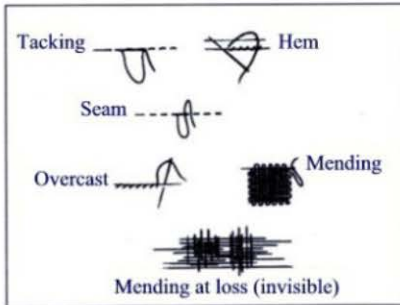
The late STURP blood chemist, Al Adler, stated in an interview published in 1996: *"So, you can talk all you want about how reproducible the date is, but you can't talk about how accurate it is. You have no way of knowing if the area you took the C14 sample from represents the whole cloth. That's an area which has obviously been repaired. There's cloth missing there. It's been rewoven on the edge. They even cut part of it off, because it was obviously rewoven on the edge. The simplest explanation why the date may be off is that it's rewoven cloth there. And that's not been tested (Case, 1996:73).*

But Adler was apparently not aware of some significant historical research regarding this. In 1993, Swiss archaeologist Maria-Grazia Siliato made a presentation at the Rome conference. She stated, “The Shroud of Turin carries with it a centuries old dramatic history. *IT WAS MANIPULATED MANY TIMES FOR MENDING AND RESTORATION WORKS.*” She also wrote, *The quantity and variety of mending stitches observed on the Shroud from the Middle Ages to date, from Edessa to Constantinople, Lirey, Chambery and Turin, is impressive: tacking, hemming, whipping, stringing and mending stitches, and many others. Add to*



*this an amount of parts, invisible to the naked eye, which were reinforced and maybe remade with the invisible mending technique. The Shroud's Mediterranean cloth, because of its very ancient handcrafted structure, the significant caliber and the thick weaving perfectly absorbs an intervention of this kind (Siliato, 1993:2).*

Notice that she uses the term “invisible mending.”



Siliato also made a minute analysis of data pertaining to the weight of “medium weight per square centimeter of the Shroud’s cloth” compared to weights of the C-14 samples. I won’t go into the details here—this five-page article is available to read on [www.shroud.com](http://www.shroud.com)—but she concluded:

“AS A RESULT, WHAT EMERGES IS THE PROOF THAT THE SAMPLE WAS IRREGULARLY LOADED WITH FOREIGN, UNDETERMINED TEXTILE

MATERIAL - in other words, MANY THREADS WERE ADDED FOR ITS MENDING with various techniques IN DIFFERENT, MUCH LATER AGES” (*bolding mine*) (Siliato, 1993:4.)

If in fact there are cotton fibers in the C-14 area, one would expect to find evidence of chemical differences. Dr. Adler, in a 1996 paper, showed a graph that illustrates the absorbance patterns of image, non-image, radiocarbon warp, waterstain, scorch, and serum single-fiber samples and made the following statements: “The patterns [...] are all distinguishably different from one another, clearly indicating differences in their chemical composition. In particular the radiocarbon samples are not representative of the non-image samples that comprise the bulk of the cloth” Adler, 1996:225).

Piero Savarino, the scientific advisor to Cardinal Poletto of Turin, stated in a 1998 booklet, “that the 1988 C-14 testing might have been erroneous due to ‘extraneous thread left over from ‘invisible mending’ routinely carried out in the past on parts of the cloth in poor repair.” Savarino went on to emphasize: “[. . .] if the sample taken had been the subject of ‘invisible mending’ the carbon-dating results would not be reliable. What is more, the site from which the samples actually were taken does not preclude this hypothesis” (Savarino and Barberis, 1998: 22).

My late wife Sue Benford and I started to seriously look at that hypothesis in early 2000. We looked at a high-quality photo of the C-14 area and noticed possible indications that the area had been manipulated. We concluded that based on the evidence we found, the sample dated was a combination of 1<sup>st</sup> century cloth and 16<sup>th</sup> century cloth. While it has been very popular and has its share of proponents, including the late Ray Rogers, chemist of the Shroud of Turin Research Project (STURP) that studied the Shroud in

1978, many others disagree with it. But we were not textile experts. We needed to find individuals who were.

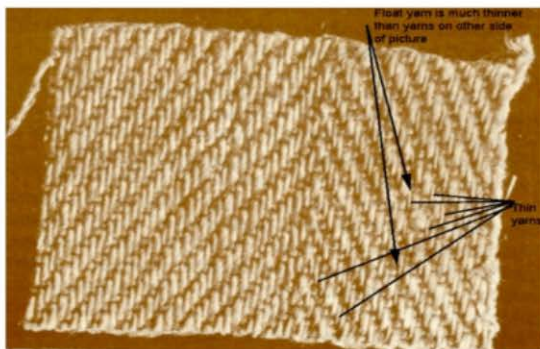
We brought or sent high-quality pictures to three textile experts without telling them they were looking at the Shroud. One said the area was a “patch.” The second said it “touched up to prevent unraveling.” The third said “the float is different on either side of the sample. It forms a thick/thin, thick/thin pattern on the right side, whereas the left is much more consistent throughout” (French Tailors, 2000), (Ferguson & Co., 2000), and (Albany International Research Company, 2000) respectively.

*Zurich C14 sample*



*Below: Weave pattern inconsistencies noted in blinded review of the Zurich C14 sample by Albany International Research Co.*

We made a presentation on the reweave hypothesis in Orvieto, Italy in August 2000. The paper was subsequently published on [www.shroud.com](http://www.shroud.com). Rogers, who had first accepted the findings of the 1988 testing, had considered Sue and me to be part of the “lunatic fringe” and wasn’t shy about telling the media, including in an interview on a Discovery Channel



documentary from December 2008 called “Unwrapping the Shroud: New Evidence.” In the program, STURP photographer Barrie Schwartz recounts that Rogers called him after it was published on the former’s site and said, “What the hell is this?” (Schwartz admitted to me the language was a little saltier!) Rogers told him that he could prove us wrong in five minutes. “Well Ray,” Schwartz replied, “go for it.” He goes on to say that less than an hour and a half later, Rogers called him back and lamented, “I can’t believe it--I think they’re right.” Rogers rolled up his chemist’s sleeves and started doing serious research on the TS again. As a result, he soon warmed to Sue and me to the degree that we started to communicate with him often by email.

It was around 2002 when Sue and I were doing further research on textile repairs when we discovered reference to a specific technique called “French reweaving” or “French

invisible reweaving.” When the phrase “invisible reweaving” surfaced in conjunction with our hypothesis, many questioned whether such a technique even existed. I now own three different manuals, titled “Invisible Mending” (1951); “Invisible French-Re-Weaving Simplified” (two vols.) (1954); and “The Frenway System of French Reweaving” (1962).



According to the Frenway manual of invisible reweaving:

*“Probably the reason this art of reweaving has gone relatively unnoticed is the great **secrecy which has heretofore kept all but a few people in the world in ignorance of the techniques involved.** These secrets have been closely guarded and handed down from generation to generation to a select few. The only exceptions were people who paid huge sums in order to receive knowledge of the art. Every novice reweaver had*

*to spend years as an apprentice” (bolding mine.) (Frenway System of French Reweaving, 1962:2).*

In “The Final Word” section on the last page of the book: *“If you do your work well, very few people will ever be able to detect what you have done. In your case, to have your workmanship invisible is the test of your craftsmanship”* (Frenway System of French Reweaving, 1962:71).

Robert Buden, former President of Tapestries & Treasures, which produced, imported, exported, and distributed high-quality, historical tapestries to clients throughout the world, including 16th Century pieces, was asked about the possibility of the Shroud having an invisible reweave:

*“Is there such a thing as an “invisible repair?”* Yes - I have seen it, or more appropriately, not seen it, in several types of textiles. *“But was this skill known to weavers in the 16th Century? [...]. Did weavers of the 16th Century possess the skill to ‘invisibly repair’ textiles?”* Most definitely. *“Would the restoration of a Holy Relic like the Shroud of Turin be assigned to a novice or the finest craftsmen in the land?”* I think the latter. *“Was budget a concern for the Church or its noble owner at the time?”* Most likely not (Benford and Marino, 2002:5-6).

The possibility of an invisible reweave into a linen textile in the 16th Century was brought to the attention of Dr. Thomas P. Campbell, Associate Curator, European Sculpture and Decorative Arts, The Metropolitan Museum of Art. Dr. Campbell, primary author of Tapestry in the Renaissance: Art and Magnificence (April 2002), wrote us:

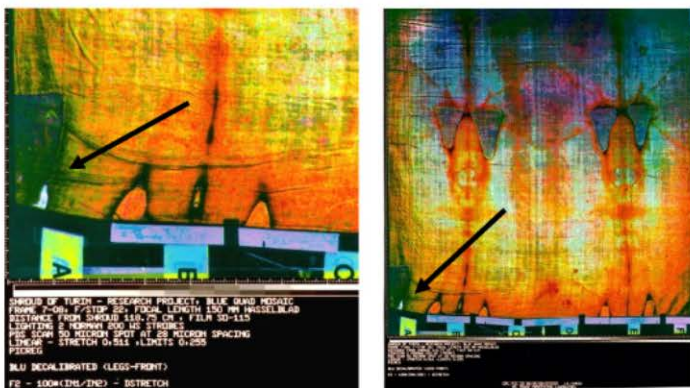
*“All of the major European courts had teams of skilled weavers and embroiderers who were employed in the repair of high-quality textiles [...].*



*Identifying sixteenth century repairs is not easy (eighteenth and nineteenth century repairs are much easier)."*

Campbell also told us, "...the sixteenth-century weavers were magicians..." (Campbell, 2002).

In 1978, STURP had taken some pictures now known as the Quad Mosaics, which included the area from which the C-14 sample had been taken. They surfaced again in 2003 in light of all the research that was going on regarding that corner of the cloth. STURP member imaging specialist, the late Jean Lorre was asked about these photos, on which Lorre said different colors represent different chemical compositions. Barrie Schwartz wrote "[...] [N]otice that the area adjoining the patch (where the c14 sample was taken from, and ostensibly part of the actual Shroud) is also mostly the same color of green. This is further convincing, supportive, scientific evidence that this area is inherently different in composition than the rest of the Shroud" (Schwartz, 2003-2011).



*1 "Quad mosaic" view of Raes' Corner - the area from which the C14 sample was taken. Notice the green discoloration in the sample region (Arrowed.) This is an indicator for a different chemical composition.*

Rogers received in December 2003 a documented leftover sample from the 1988 dating. He found the same chemical characteristics that he did on the Raes samples. Rogers wrote in *Thermochemica Acta*:

*The presence of alizarin dye and red lakes in the Raes and radiocarbon samples indicates that the color has been manipulated. Specifically, the color and distribution of the coating implies that repairs were made at an unknown time with foreign linen dyed to match the older original material [...]. The radiocarbon sampling area is uniquely coated with a yellow-brown plant gum containing dye lakes. Pyrolysis – mass – spectrometry results from the sample area coupled with microscopic and microchemical observations prove that the radiocarbon sample was not part of the*

*original cloth of the Shroud of Turin. The radiocarbon date was thus not valid for determining the true age of the shroud (Rogers, 2005:189 and 192).*

Rogers found an encrustation of plant gum on the outside of the C-14 sample fibers. Chemical and microscopic analysis showed embedded Madder Root dye particles. Rogers also enlisted the help of the late microscopist John Brown, who did his own analysis on Rogers' fibers from the Raes sample. Brown also found gum and dye encrustations and agreed with Rogers' conclusions.



Cotton fibers were found interwoven with the linen in the Raes and C14 samples. No cotton was observed anywhere else on the Shroud except for some surface fibers that came from STuRP's cotton gloves.

In a 2005 paper by the late Dr. Alan Whanger and his wife Mary, they concluded:

*On studying the radiographs of the Shroud made in 1978, details of the seams and threads can be seen. It appears that the side seam was put in as a tuck, and that near the two missing corners there are variations in weave patterns and in thread densities which suggest that these two areas had been damaged and then repaired in some way. Examination of the site of the C14 single sample indicates that at least part of the sample was taken from one of these repaired or altered areas (Whanger, 2005:5).*

The tuck they refer to is a fold or pleat in fabric that is sewn in place.

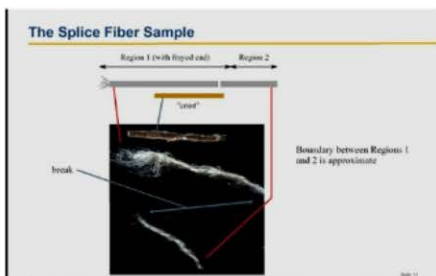
Michael Erlich, owner of "Without a Trace" ([www.withoutatrace.com](http://www.withoutatrace.com)) in Chicago, began invisible mending services in Chicago around the mid-1990s and said in a book published in 2007:

*Today, there is a modern, time-saving technique called "inweaving" that would be invisible from the surface, but easily recognizable from the back. However, the technique used in sixteenth century Europe called "French weaving" is an entirely different matter. French weaving involves a tedious thread-by-thread restoration that is indeed, invisible. Sixteenth century owners of the Shroud certainly had enough material resources and weeks of time at their disposal to accomplish the task as cited by Balsiger and Minor, 2007:159.)*

Ray Rogers also sent some Raes sample fibers, ones that had been right next to the C-14 samples, to the late Los Alamos chemist Bob Villarreal, who confirmed Rogers' findings of a splice in 2008. Villarreal wrote, "The many strands of fibers from the three threads analyzed gave FTIR (Fourier-transform infrared spectroscopy) signature (spectra) of cotton and definitely did not give evidence of linen (flax fibers). Villarreal agreed with Rogers that the samples were not representative of the main Shroud.



Villarreal also enlisted the help of other scientists at Los Alamos, who concluded, using various spectroscopic methods, that there had been repairs in that area.



Original image courtesy Robert Villarreal

In August 2008 Robert Villarreal and a team of 8 researchers from Los Alamos National Laboratory analyzed Roger's samples and presented their results at the Columbus, Ohio Conference. Their data further corroborated Rogers' conclusions.

French physician Thibault Heimburger, who was given access to several of the Raes threads that Rogers had studied, emailed Sue, Barrie Schwartz and me after

examining Raes thread #7 in a polarizing light microscope that it was a thread intentionally spun with linen and cotton. Heimburger also wrote a three-part article on analyses of the Raes samples that Rogers had and said about the Villarreal microphotograph shown previously:

*This discovery is obviously of paramount interest for the following reasons: first, the splice is not at all obvious if we look at the photograph. Raes did not see it. Rogers ...did, looking carefully at the sample with his microscope. Second, the brown resin-like crust described as "a micro-sized circular cocoon-shaped brown crust" could not be seen under the microscope. This is very surprising. Third, this shows that this part of the Shroud has been "managed" thread by thread, contrary to the main part of the Shroud (Heimburger, 2009).*

The main part of the Shroud is a 3 to 1 herringbone weave. Archaeologist Paul Maloney presented at the same 2008 conference in Ohio as Villarreal. He presented a list of those who had found cotton inside of the fibers in the Raes corner (Maloney, 2008:10):

\*Gilbert Raes, (1973-1974)

\*STURP's 1981 early analyses reported by STURP spokeswoman, Joan Janney.

\*Investigators at Precision Processes (Textile lab) Ltd in England, (1988)

\*Ray Rogers' 2004 investigations

\*John Brown at Georgia Tech (2004) and

\*Robert Villarreal & team, LANL (2008).

In this same paper (2008:7-8), Maloney laid out all of the various components based on Rogers' research that seem to indicate a repair in the form of linen-cotton spun yarns spliced into the Shroud cloth and showing coatings of: starch, aluminum mordant and other metallic salts, gum arabic binder, and madder rose dye.

In 2012, John M. Morgan III of the Geospatial Research and Education Laboratory at Towson University, wrote a highly technical paper detailing the analysis of an ultraviolet Shroud photo, and the author concluded that there is evidence of cotton in the C-14 sampling area (Morgan, 2012).



Barrie Schwartz recently sent to the private Internet Shroud Science Group a communication that included a picture of a transmitted light image of the C-14 corner. He said, “... when I examined the C14 sample site at higher magnification in Photoshop, there seemed to be a darker area to the right of the seam that could be interpreted as a positive indication of manipulation.”



Schwartz also showed a white-light image of the area and wrote: “Most notable...is the very obvious darker coloration of the c14 sample site area adjacent to the seam, which fades gradually into the lighter color of the rest of the Shroud. This is NOT a shadow. The Shroud was definitely a different (darker) shade in this area.”

The Savoy family archivist, Carlos Evaristo wrote (per 2014 English translation) that King Umberto, who owned the Shroud before willing it in 1983 to the living Pope, asserted that the C-14 area had been *repaired and rewoven* (Evaristo, 2014:218).

Textile expert Donna Campbell of Thomas Ferguson Ltd in the U.K., one of the three entities that had told Sue and me in 2000 that they found indications of a repair, examined some photos of the sample used by Oxford for their Shroud C-14 dating. She observed: “Yarns break during weaving. The success in identifying these breaks and fixing depends on the skill of the hand weaver. However, there are signs in the Shroud sample that direct the notion of *mending or reweaving* of the actual woven fabric” (my italics) (Campbell, 2016:16).

Given all the evidence that has been presented, I maintain that the C-14 sample area having been rewoven is possibly, and likely probably, the most plausible explanation of why the C-14 dating resulted in a medieval date. It also fulfills Ockham’s Razor, which is the problem-solving principle that the simplest solution tends to be the correct one. Ray Rogers, who wasn’t even aware of all the data I’ve collected, was convinced pre-2005 by the chemical evidence alone that repairs had been made to the Shroud. He

did not readily use the word “prove” when talking about the Shroud. But he did use it in his *Thermochimica Acta* paper (Rogers 2005:192). It is the only hypothesis or theory for which there are several papers in the peer-reviewed scientific literature.

There is a law dictum that states, “Against the fact there is no argument.” Rogers posed before his death in 2005 a question to the Shroud Science Internet Group, to whom he patiently communicated with for several years and presented the data he found: “HOW MUCH EVIDENCE IS NEEDED?”

Perhaps in 2020, possessing much additional compelling data gathered since Rogers’ time, we should consider asking whether Rogers’ question should be turned into the statement: “Against the facts there are no arguments.”

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### **A Major Change of Mind – Ian Wilson**

The Reweave Theory long promulgated by Joe Marino and his late wife Sue Benford had never attracted me, mostly due to my not having found the slightest sign of any such restoration work when I was closely looking for such anomalies during my examination of the Shroud in 1973. This scepticism has, however, now greatly diminished due to the very convincingly presented Joe Marino conference paper above, buttressed by a 'French Reweave' demonstration - specifically performed on a Shroud-like herringbone weave - that can be viewed on <http://bit.ly/35uuaBf>. Whilst I still cannot yet describe myself as fully convinced by any one theory, I can now commend Joe's presentation unreservedly.