

## EVIDENCE IS NOT PROOF: A RESPONSE TO PROF TIMOTHY JULL

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### Introduction

In late 2010 the scientific journal *Radiocarbon* published a paper entitled “Investigating a Dated Piece of the Shroud of Turin” by Prof Timothy Jull of the University of Arizona and Rachel Freer-Waters. In this paper they described how they had microscopically examined a sample cut from the Shroud of Turin and found no evidence for any contamination, particularly in the form of coatings or dyeing, in the material of the sample. They concluded that they could find no reason to dispute the original carbon-14 measurements which, in 1988, had shown the Shroud to be dated between 1260 and 1390.

The radiocarbon measurements of the Shroud were carried out at three laboratories – in Zurich, Oxford and Arizona – and reported in a paper published in February 1989 in the journal *Nature*. The results of these tests had previously been announced at the British Museum in October the previous year, with some fanfare and a statement from the scientists involved that “These results... provide conclusive evidence that the linen of the Shroud of Turin is mediaeval.” One of the scientists, Prof Edward Hall of Oxford University went further and declared that “There was a million pound business in making forgeries during the fourteenth century. Someone just got a bit of linen, faked it up and flogged it.” He went on to describe anyone who continued to believe the Shroud to be a genuine relic of the death of Jesus Christ as being a “Flat Earther” and “on to a loser”. He neglected to provide an explanation of how the piece of linen in question had been “faked up”.

Since the results of the radiocarbon testing were announced there has been vigorous debate on the subject, with a number of hypotheses being advanced to explain why the results were incorrect. One thing is certain, there is a large amount of both scientific and historical evidence that suggests that the Shroud is far older than the dates given by the radiocarbon testing. The results of the radiocarbon testing can only be seen as one piece of evidence among many other pieces. Evidence is not proof and the radiocarbon tests prove nothing. To definitely prove that the Shroud is of mediaeval origin would require the following:

- Undisputed rebuttal of all the evidence showing it to be older than mediaeval.
- A scientifically valid and rigorously tested explanation of how the Shroud was produced in the middle ages.
- Replication of the Shroud, using materials available in the middle ages, to a standard where the replicated image exactly matches the image on the Shroud in every physical and chemical detail.

None of this has been done.

### The Radiocarbon Dating

Unfortunately the importance of the radiocarbon dating and its potential to give an unambiguous result was built up over a number of years. Eventually it was seen as a method that would provide definite proof of the genuineness or otherwise of the Shroud. The Shroud of Turin Research Project carried out a detailed scientific examination of the Shroud in 1978. A summary of that investigation, published in *Analytica Chimica* in 1982 under the title “Physics and Chemistry of the Shroud of Turin”, written by L .A. Schwalbe and R. N. Rogers of the Los Alamos National Laboratory, included the following statement in its conclusion, “Given the unique nature

and complexity of the problem, the only unambiguous means to establish (the age of the cloth) is by the carbon-14 method.”

There were those who gave warnings of the uncertainties involved. In March 1986 Prof William Meacham, an archaeologist at the University of Hong Kong presented a paper entitled “Radiocarbon Measurement and the Age of the Turin Shroud: Possibilities and Uncertainties” at a symposium on the Shroud. In this he noted that the first proposal to use the radiocarbon method to date the Shroud was made in 1979. He considered that proposal seriously flawed by the lack of consultation with archaeologists and experts from other fields. He went on to warn against contamination of samples, particularly by carbon from other sources. He also made the point that a radiocarbon dating result would merely be “one further piece of evidence to be evaluated in the light of the total complex of data about the Shroud.” He gave a number of examples of anomalous dates given by various radiocarbon examinations of bones, clays and pottery. He warned that a number of factors could affect the reliability of a radiocarbon dating of the Shroud, including the transfer of cellulose pyrolysis products from the 1532 fire, carbonization of contaminant material and isotopic exchange. He proposed that at least five samples should be taken from the Shroud for the purpose of testing, to minimize such potential errors. In fact, when the testing was eventually done, only one sample was taken.

He also recommended that the samples taken should be subjected to elaborate pretreatment, scanning electron microscope screening and testing (microchemical, mass spectrometry, micro-Raman) for impurities or intrusive substances such as higher order hydrocarbons and inorganic and organic carbonates. Although the actual samples tested were subjected to mechanical and chemical cleaning procedures, the elaborate screening and testing procedures recommended by Prof. Meacham were not carried out.

Over the years since the radiocarbon results were announced, numerous explanations have been advanced as to why the results should be considered incorrect, ranging from conspiracy theories to bioplastic coating of the Shroud fibres and including frequent and usually unscientific explanations involving different forms of nuclear radiation.

### **The Patch Hypothesis**

In 2000, a paper entitled “Evidence for the Skewing of the C-14 Dating of the Shroud of Turin due to Repairs” was presented by Joseph Marino and Sue Benford at an international congress on the Shroud in Italy. This suggested that the sample taken from the Shroud for the radiocarbon testing had contained 16<sup>th</sup> century material spliced into it for the purpose of repairs. This had therefore altered the overall date of the sample to make it appear more modern than the original Shroud material. The authors also suggested that a section of the Shroud had been removed in 1531 and an invisible patch carefully woven into the material. They described in detail anomalies in the cloth in the area from which the sample was taken, including more pronounced discoloration in the area and the presence of starch. Further papers from Marino and Benford developed this hypothesis and produced more evidence to support it. In a paper published in 2002, “Textile Evidence Supports Skewed Radiocarbon Date of Shroud of Turin”, Marino and Benford described an unauthorized radiocarbon dating test that had been carried out in 1982 using a single thread from the sample cut from the Shroud by Dr. Gilbert Raes in 1973. This thread was provided by Prof. Alan Adler, one of the STURP scientists, who noted that one end of the thread contained what he described as appearing to be a “starch contaminate”. The dating was carried out by Dr. George Rossman, a mineralogist at the California Institute of Technology, who cut the thread in half and tested each end separately. He found that the non-contaminated end of the thread dated to 200 AD and the starched end to 1,200 AD. *[Editor’s Note: Years later, Rossman and the California Institute of Technology officially and vigorously denied any such test was ever performed and stated the facility did not have the technology necessary to perform such testing].*

This hypothesis was supported by Ray Rogers and Anna Arnoldi in a paper published in 2002, entitled “Scientific Method Applied to the Shroud of Turin: A Review”. This paper included a report from Rogers on examinations that he had carried on Raes threads that he had received in 1980 from Prof Luigi Gonella at the Turin Polytechnic. He reported that:

- All the Raes threads show colored encrustations on their surfaces. He suggested that Madder root dye was a highly probable contributor to the color of the coating.
- The Raes samples show a unique splice. One thread, a photograph of which was included in the paper, showed distinct encrustation and color on one end while the other end is nearly white.
- Photographs of the Shroud carried out by STURP in 1978 using low energy X-rays at high resolution, a pure ultraviolet source and by transmitted 3200 degrees K illumination had shown anomalies in the area from which the radiocarbon sample was taken and suggested that the radiocarbon area has a different chemical composition to the main part of the cloth.

Rogers concluded that “The combined evidence from the chemistry, cotton content, technology, photography and residual lignin proves that the main part of the Shroud is significantly different from the radiocarbon sampling area. The validity of the radiocarbon sample must be questioned with regard to dating the production of the main part of the cloth.”

Further and previously unpublished photographs of the Shroud, taken by STURP using Quad-Mosaic Photography (state-of-the-art NASA technology) at the time, were published in the scientific journal *Chemistry Today* by Marino and Benford in 2008 in a paper entitled “Discrepancies in the Radiocarbon Dating Area of the Turin Shroud”. These also showed anomalies in the radiocarbon sample area, leading the authors to conclude that “The Quad-Mosaic images (together with other evidence they referred to) support Roger’s assertion that a surface dye was added to the Shroud in the area of the 1988 radiocarbon sampling to disguise an undocumented repair.”

They also made the very important point that the weaving technique that they postulated was used in the patch required an “overlap and intermixing between the newer patch material and the existing material via the integration of frayed edges into the damaged textile and vice versa. The unavoidable interweaving required of this invisible mending technique would, most assuredly, have created heterogeneity in the C-14 sample area.” In other words, there would not have been one part of the sample being of 16<sup>th</sup> century origin and a separate part being older. The entire sample would have included both new and old material. An estimate based upon weave-pattern changes had suggested that 60% of the radiocarbon sample consisted of 16<sup>th</sup> century thread. If it is assumed that the remaining 40% were of 1<sup>st</sup> century origin, this would have yielded a radiocarbon date for the Shroud of the early thirteenth century.

A retired microscopist from the Georgia Technical Research Institute in Atlanta, John Brown, published a paper entitled “Microscopical Investigation of Selected Raes Threads from the Shroud of Turin” in 2005. He reported on microscopic examinations that he had carried out on Raes threads using a scanning electron microscope. He noted cotton fibres that had been found by previous investigators and clearly identified encrustations in the fibres in particular. His paper included photographs taken at high magnification that clearly showed the encrustations.

The Patch Hypothesis of Marino and Benford has been criticized by other researchers, notably the textile expert Mme Mechthild Flury-Lemburg, who maintains that the weaving technique described by Marino and Benford did not exist in Europe in the mid-sixteenth century and that there is no reweave in the Shroud. However, the

examinations carried out by Rogers and Brown, as well as the photographic studies cited, provide strong evidence (but not proof!) in support of the hypothesis.

### **An Alternative Method for Dating the Shroud**

Ray Rogers published a paper entitled “Studies on the Radiocarbon Sample from the Shroud of Turin” in the journal *Thermochimica Acta* in 2005. In this he described how the age of linen could be estimated through the rate of loss of vanillin from lignin in the linen. He produced a chemical-age predictive model and estimated that, if the Shroud had been stored at a constant 25 degrees C during its history, it would have taken approximately 1,320 years to lose 95% of its vanillin. Lower temperatures would result in slower vanillin loss. If the Shroud had been produced between 1260 and 1390, as the radiocarbon tests had suggested, it should have retained 37% of its vanillin in 1978.

Rogers tested a number of threads for vanillin – a simple chemical test. The Raes threads from the Shroud, the Holland cloth attached to the Shroud (of mediaeval origin) and other mediaeval linens gave the test for vanillin wherever lignin could be observed on growth nodes. A sample from the main part of the Shroud, as well as samples from the Dead Sea Scrolls did not give the test. On this basis Rogers suggested that the Shroud must be between 1 300 and 3 000 years old, far older than indicated by the radiocarbon tests.

In this paper Rogers also reported that he had examined both Raes threads and threads taken from the radiocarbon sample that he had received from Prof. Luigi Gonella. He stated that a gum/dye/mordant coating is easy to observe on these yarns, whereas no other part of the Shroud shows such a coating. His chemical analysis of the coating on the threads led him to conclude that it was a pentosan, most likely in the form of gum Arabic. This has been used over the centuries in tempera paints and would suggest that the radiocarbon sample had been dyed, probably intentionally, in his view, on pristine replacement material to match the colour of the older sepia-coloured cloth. This gum is water soluble and would have been removed by the cleaning procedures used on the dated samples. Rogers concluded that “The radiocarbon sample was... not part of the original cloth and is invalid for determining the age of the Shroud.”

Rogers’ paper attracted the attention of the international media. On 27 January 2005 the BBC News carried a report on the paper under the heading “Turin Shroud ‘older than thought’” and quoted Rogers as saying “The radiocarbon sample has completely different chemical properties than the main part of the Shroud relic.”

### **A Robust Statistical Analysis of the Radiocarbon Results**

Yet further doubt on the validity of the radiocarbon tests has been cast by a paper published in May 2010. Entitled “Carbon Dating of the Shroud of Turin: Partially Labelled Regressors and the Design of Experiments” it was written by three Italian scientists and a British statistician, Marco Riani, Anthony C. Atkinson, Giulio Fanti and Fabio Crosilla. This is a highly technical paper but the conclusion is unambiguous. The authors referred to the fact that twelve tests had been run at the three laboratories carrying out the radiocarbon testing and that they were presumably all testing the same thing – the age of a single sample of cloth cut from the Shroud. They concluded that “Due to the heterogeneity of the data and the evidence of strong linear trend the twelve measurements of the age of the Turin Shroud cannot be considered as repeated measurements of a single unknown quantity. The statement of Damon, Donahue, Gore and eighteen others (1989) that ‘The results provide conclusive evidence that the linen of the Shroud of Turin is mediaeval’ needs to be reconsidered in the light of the evidence produced by our use of robust statistical techniques.”

Or, to be put it in blunt language, statistically, the radiocarbon results from the three laboratories don’t add up.

## What Went On in Turin?

When Jull published his paper and announced that he had examined a portion of the radiocarbon sample retained by the University of Arizona, some eyebrows were raised among Shroud researchers, as it was not known that a portion of the sample had been kept. Indeed, the paper by Damon *et al* published in *Nature* in February 1989, "Radiocarbon Dating of the Shroud of Turin", gives the firm impression that the entire sample received by Arizona was used for dating purposes. The paper stated that "The Arizona group split each sample (the Shroud sample and control samples) into four sub-samples" and went on to describe the cleaning process undergone by each of the four subsamples.

The paper also described the process of cutting the samples from the Shroud and their packaging as follows:

"The Shroud was separated from the backing cloth along its bottom left-hand edge and a strip (approx. 10 mm x 70 mm) was cut from just above the place where a sample was previously removed in 1973 for examination. The strip came from a single site on the main body of the Shroud away from any patches or charred areas. Three samples, each approx 50 mg in weight, were prepared from this strip. The samples were then taken to the adjacent Sala Capitolare where they were wrapped in aluminium foil and subsequently sealed inside numbered stainless-steel containers by the Archbishop of Turin and Dr. Tite."

This is also misleading. Four pieces were cut from the strip, of which two were sent to Arizona. This is clearly shown in the diagram of the cutting made by Dr. G. Riggi, who removed the sample from the Shroud. (Fig 1).

At a symposium in Paris in September 1989, Prof Testore of the Turin Polytechnic stated that the original piece cut from the Shroud was 16 x 81 mm and that "The first half was cut in three pieces: 52,0, 52,8 and 53,7 mg." He did subsequently correct this and stated that the three samples were taken from the smaller half of the piece, weighing 52,0, 52,8 and 39,6 mg. As this was not sufficient a small piece of 14.1 mg was cut off from the other part.

The cutting was recorded on video and photographs were taken, so there could have been no doubt as to exactly what was done. It just seems strange that there seems to have been an attempt to create an impression that only three pieces were cut.

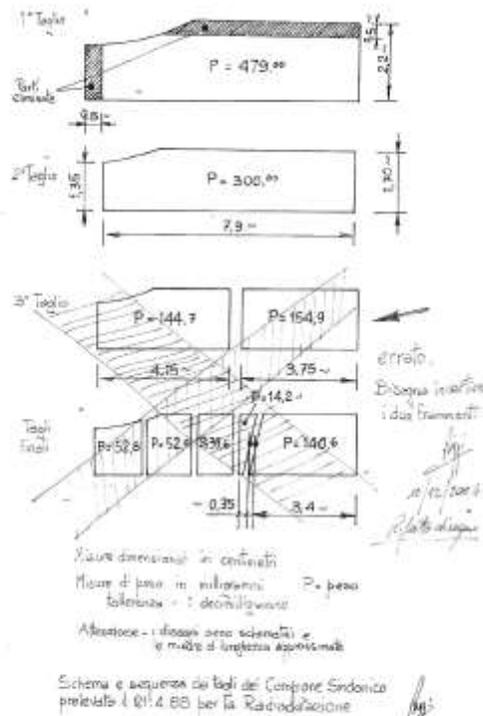


Fig 1. Original diagram by G Riggi of how the radiocarbon sample was cut, with his subsequent retraction

Even stranger was the process of wrapping the samples for dispatch to the respective laboratories. In a book entitled “Deception on the Turin Shroud: The Manipulated Carbon Test”, published in Germany in 1990, Fr. Werner Bulst, SJ, described how after the cutting Dr. Tite and the Archbishop of Turin took the samples, together with control samples, to a neighbouring room (as described in the *Nature* article), where they wrapped them in identical sealed containers. Each laboratory then received three identical containers. The purpose of this was supposedly to ensure that the testing would be truly “blind”, but the Turin Shroud samples were easily identifiable on arrival at each laboratory. What this procedure did, however, was to break the chain of evidence. The wrapping was not recorded in any way, unlike the cutting.

To add to the confusion, Riggi subsequently retracted his original diagram of how the sample had been cut and provided an amended diagram.

It is hardly surprising that these less than transparent procedures subsequently gave rise to conspiracy theories that the radiocarbon tests were deliberately manipulated to give a false result.

### What Went On in Arizona

In a letter dated 5 December 1989 to Dr. Claude de Colntet in France, Prof. Douglas Donahue, who had brought the samples from Turin, stated that “when we arrived in Tucson with the samples from Turin, we immediately cut the Shroud sample into four pieces.... Our records do not indicate whether or not the Shroud sample was in two pieces.”

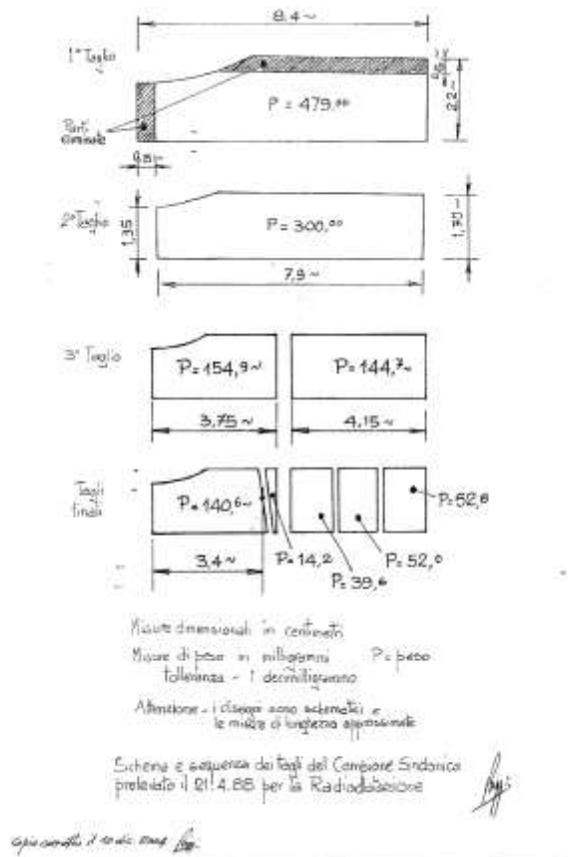


Fig 2. Riggi's subsequent amended cutting diagram

This is a strange admission. A university laboratory tasked with carrying out a procedure of some importance did not even properly record what it had received. Prof. Donahue gave the masses of the four pieces into which the sample was cut as being 13,86 mg, 12,39 mg, 14,27 mg and 11,83 mg. He subsequently changed the first and third figures to 13,85 mg and 14,72 mg in a hand-written alteration to the letter. This also reflects an alarming lack of scientific precision.

In a letter dated 9 February 2010 to Prof. Giulio Fanti, Prof. Jull of the University of Arizona stated that the sample vials were opened on Sunday, 24 April 1988, and that they received a sample in two pieces labeled "53,8 mg". However they measured the weight to be 52,8 mg. The larger sample was cut into three pieces, weighing 12,39 mg, 14,72 mg and 11,83 mg. Only the last two were used for radiocarbon dating. The piece weighing 12,39 mg was retained and appears to have been the sample used by Prof. Jull for the examination reported in his paper in *Radiocarbon*. What happened to the separate smaller piece is not made clear, although Prof. Jull stated that it was not used for measurements.

In 1997 Abbe Georges de Nantes and Brother Bruno Bonnet-Eymard published a document entitled "The Holy Shroud of Turin, Silent Witness in Preparation for a Centenary (1898 – 1998)." This was published by the Catholic Counter-Reformation in the 20<sup>th</sup> Century, a conservative Catholic group, and the authors openly accuse Dr. Tite of orchestrating a substitution of the samples in order to obtain a false result. For this reason this

document has to be treated with some caution. However there is no reason to doubt their description of some of the meetings and discussions they had with scientists involved in the radiocarbon testing.

In October 1990 they travelled to Arizona to speak to Prof. Donahue and his colleagues. Again Prof. Donahue stated that they had no photograph and no written record of the sample they had received. However, when they subsequently spoke to the head of the laboratory, Prof. Damon, he told them that “the sample was in the form of a rectangle. Not a square, a rectangle. I have my notes and I have my photographs.” He went on to say, “Actually, our procedures were videotaped by our public broadcast people.... We did save a piece which is in a safe.”

If this piece was the one subsequently used by Prof. Jull, the question still remains, what happened to the smaller of the two pieces received at the University of Arizona?

### **Further Questions on the Radiocarbon Dating Procedures**

Shroud researcher Jack Markwardt has raised an interesting question regarding the size of the samples tested. Prof. Harry Gove stated in his book “Relic, Icon or Hoax? Carbon Dating the Turin Shroud?” that for a standard dating like the Shroud, 5 – 10 mg of carbon would be required. He seems to have suggested that this was a requirement per sample, as he made no mention of multiple samples or multiple tests. A consensus was reached at a workshop in Turin in 1986 on the proposed testing that the carbon weight of each tested sample should be 5 mg.

The conversion factor between the weight of the Turin Shroud cloth and its carbon weight is 24%. The weight of cloth to be tested must therefore be a minimum of 20,83 mg. However the Arizona laboratory only used two samples for testing, weighing 14,72 mg and 11,83 mg respectively, and these were themselves divided into two. The carbon weights of the tested samples would therefore have been approximately 1,77 mg in the case of the larger piece and 1,42 mg in the case of the smaller piece, well below the agreed threshold for an acceptable result.

The same applies to the other testing laboratories in Zurich and Oxford. None of the samples tested would have met the 5 mg threshold.

In their publication Bro Bonnet-Eymard and Abbe de Nantes comment on the fact that the paper by Damon *et al* on the radiocarbon dating was published in *Nature* rather than in a scientific journal such as *Radiocarbon* that only publishes peer-reviewed papers. They suggest that the paper was not peer-reviewed, which would be a surprising omission for such an important report. *[Editor’s Note: In 1998 Barrie Schwartz made a similar comment on [www.shroud.com](http://www.shroud.com) when he reprinted the Nature paper and received the following comment from Dr. Jull: "I looked at the Shroud website recently and noted... some of the editorial remarks - I have a comment on one at this time. It is TOTALLY INCORRECT to state that Nature is not a peer-reviewed journal (I realize your comments attribute this remark to others...). This is not true. All papers for Nature are reviewed in the normal way for scientific publications. You can confirm from the editors of Nature this is correct. I think you should note this assertion is wrong on your web page. Otherwise, I find your site very interesting."]*

No official report on the testing, apart from the paper in *Nature*, has ever been published and it has been reported that the Church authorities in Turin never received such a report.

Finally, although there is no evidence of any substitution of samples or fraudulent behavior on the part of any of the scientists involved, there are clearly a lot of unanswered questions and it is equally clear that at least some

of the scientists involved, particularly Dr. Tite and Prof. Hall, discarded any sense of scientific detachment and seemed determined that the results of the tests should show the Shroud to be of mediaeval origin.

### Questions about Prof Jull's Paper

Prof. Jull's paper includes a startling error. He states that the warp fabric count of his sample is 30 yarns per cm and the weft is 40 yarns per cm. The following are yarn counts recorded by other researchers on different Shroud samples:

Timossi	warp 40, weft 27
Raes	warp 38,6, weft 25,7
Vial	warp 37,6, weft 25,8
Vercelli	warp 36, weft 24

Prof. Giulio Fanti has reported his own count of threads using photographs of Jull's sample and gave a figure of warp 38, weft 27,5. It would seem clear that Jull and his co-worker, who was the textile expert, have confused warp and weft. This is not a good start in a peer-reviewed paper.

They also describe the thickness of the textile as being approx. 250 microns. In a paper commenting on Jull's textile measurements, appositely titled "Own Goal in Tucson", the Italian writer Gian Marco Rinaldi also states that the researcher Vercelli had made 10 measurements of the thickness of the Shroud and had found an average of 390 microns, with a minimum of 340 microns and a maximum of 430 microns. Dr John Jackson had reported values between 318 microns and 391 microns. Either Jull and Freer-Waters made an error in their measurement or their sample has different physical characteristics in terms of thickness to other parts of the Shroud.

Jull and Freer-Waters merely report that they found no evidence for any coatings or dyeing of the linen. As has been stated in the past, absence of evidence is not evidence of absence, and this must surely apply to this paper. The work of Rogers, Brown and others has clearly shown coatings and other discrepancies in the area of the radiocarbon sampling. Prof. Jull cannot just dismiss it all in a few short sentences, without explanation. Their conclusion from their studies is that they find no reason to dispute the original carbon 14 measurements.

It is noteworthy that the results of the radiocarbon tests were diametrically opposed to a mass of other evidence indicating that the Shroud is much older than a mediaeval date, and that the results of Jull and Freer-Waters' study are diametrically opposed to the results of other studies on the same material. Even if the results of the radiocarbon tests could be seriously accepted as being scientific evidence of a mediaeval date for the Shroud, evidence is not proof and pieces of evidence must be weighed in the context of all the available evidence in order to be judged. The same applies to Jull and Freer-Waters' results.

It has to be concluded that the opaqueness of the procedures regarding the cutting and wrapping of the samples in Turin in 1988, the many unanswered questions surrounding the samples, not least the whereabouts of the smaller piece sent to Arizona, the questions about the tests themselves, notably the small sizes of the samples used and the failure to make use of detailed screening and testing procedures, and the subsequent studies that have called into question the dates given by the tests all combine to deliver a fatal blow to the credibility and validity of the radiocarbon test results. They should be consigned to the scientific dustbin, where they belong. Science relies on precision, attention to detail, accurate record-keeping, proper reporting of results and impartiality on the part of scientists. All of these have been lacking in this sorry episode.

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