A NEW LOOK AT THE VALIDITY OF THE CARBON-14 DATING OF THE SHROUD

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In 1988, a Carbon14 dating process was conducted to determine whether or not the age of the linen cloth, known as the Shroud of Turin, was compatible with the tradition which identified this cloth as the burial cloth of Jesus Christ. This was conducted as a part of a major shroud study by a team of top notch scientists, The Shroud of Turin Research Project (STURP).

The C-14 dating was conducted by three separate highly regarded Scientific Laboratories, the University of Arizona in Tucson, Swiss Federal Institute of Technology, and the University of Oxford, each with capability to conduct C-14 dating with an Accelerator Mass Spectrometer in accordance with excellent procedures and reference standards. The results of the age dating measurements ranged from AD 1260 to 1390 and seemed appropriate for the type of samples analyzed. This range of dates places the age of the Shroud as a medieval relic rather than a cloth with a date near AD 33 and therefore ineligible to be the burial cloth of Jesus.

However, later research conducted primarily by Sue Benford and Ray Rogers, strongly suggests a different conclusion. There seem to be significant problems with the age dating, not from the accelerator mass spectrometer precision, but with the overall accuracy of the results particularly the location of the samples taken. The three samples submitted were taken adjacent to one another from the same corner of the Shroud and there is uncertainty that the sample corner was representative of the whole Shroud.

A visual examination of the Shroud shows several anomalies between the body of the main cloth and this particular corner. Further scientific tests have significantly expanded the reasons for being suspicious of this location.

The work initiated by Sue Benford centered on the fact that Sue believed that this corner was added to the main shroud cloth via “invisible stitching” techniques perfected in medieval times.

Sue and Joe Marino published their work and Barrie Schwortz championed their results to Ray Rogers. Ray was highly skeptical, indeed, irate and set out to prove their new concept totally wrong. Much to his surprise his research and experimentation seemed to prove them absolutely correct. Ray, being not only a brilliant but a totally objective scientist, at this point began working with Sue and the results were astonishing.

A fire in 1532 had caused several severely burned areas in the main body of the Shroud. They were at that time mended with very obvious patches. About the same time, a backing cloth known as the Holland cloth was added to stabilize the Shroud. With a few small exceptions, this was the Shroud the STURP team set out to examine.

To take the C-14 sample, the corner which seemed shabbiest was separated from the Holland cloth and a strip cut just above the place where Professor Gilbert Raes had previously sampled in 1975. Rogers had access to fibers from the Raes sampling area, the Holland Cloth and the radiocarbon-

sampling area. He also had samples which he had taken from various locations on the Shroud with gently applied sticky tape. Benford and Rogers compared the appearance of the body of the Shroud and corner in question.

There had been previous studies which in retrospect were suggestive of what they would later determine. The specific area where the radiocarbon samples were obtained was photographed in 1978 with visible light, low-energy X-rays of high resolution, transmitted light, and a pure UV source. The results of these techniques showed that the radiocarbon area was anomalous to the main Shroud.

Examination of the Shroud, patches and backing shows a certain homogeneity between the patches and the Holland cloth, not shared by the main Shroud.

1. The cloth is much less fluorescent in the radiocarbon sampled area.
2. A ultraviolet fluorescence photograph shows a different chemical composition in this area.
3. The Raes sample and the radiocarbon threads show colored encrustations on their surfaces; There were absolutely no encrustations on the Holland cloth or main Shroud fibers.
4. Raes thread #1 shows distinct encrustations and color on one end and the other end is nearly white. The fibers from the two ends point in opposite directions. This thread sample was obviously and end-to-end splice of two different threads of yarn. No splice was observed on the main cloth.
5. There is a gum coating on a radiocarbon dating sample which is found no where on the main shroud cloth.

The three samples that we looked at have cotton and were taken from the carbon dating area. The main shroud is linen. Ray Rogers identified cotton in the Raes thread and the radiocarbon fibers. Cotton fibers can easily be identified because of their flat tape-like shape and presence of several reversals and twists, about 1.2 millimeters apart and the absence of bamboo-like growths as evidenced in linen. In general, flax fibers vary in length from 20-350 centimeters while cotton is about 1.5 to 5.5 centimeters. Clearly there is no cotton in the main body of the Shroud cloth.

Other tests initiated or continued by Ray Rogers attempted to use scientific methods or explore different areas of interest in the Shroud. Some of these tests are well-known and some are little-known, and perhaps virtually unknown. Some were designed to promote the notion that the age dating on the Shroud is flawed and new plans should be devised to re-analyze the age dating process in more scientific manner.

My involvement with the Shroud came very near the end of the work of Sue Benford and Ray Rogers. Ray first asked my help in acquiring a hot alpha-particle source which he needed for one of his image formation experiments. After I provided him with a strong alpha-source he needed that source calibrated for activity. With the help of an expert at Los Alamos National Laboratory, I was able to provide that calibration. He began to suspect that this collaboration might have greater use and asked if I had access to the full analytical potential of the Laboratory. It happened that at that moment in time I was in a unique position and did have that access. He first asked for an XPS analysis of a single piece of thread from the Raes area of the Shroud. We analyzed it and the results showed that the thread had different ratios of constituents along its length, especially at the two ends. Ray and Sue were quite excited with that result and he asked what other equipment I had quick access to. I provided him with a list of high technological equipment that I thought we could

provide. Before he could look at the list, he passed away from cancer. Now I was living with a fiber from the Shroud of Turin. Unfortunately, it didn't seem to make me any holier.

Eighteen months later Barrie Schwortz gave me a call and asked if I knew where that particular fiber was. When I told him I had it, he said that fiber was the missing link. In fact, he said I was the missing link! So now I was really involved. After the X-ray Photoelectron Spectroscopy (XPS) analyses, we began a series of tests with the list I made for Ray but now gave to Barrie and Sue.

That single piece of thread was to be analyzed by the following list:

1. X-ray Photoelectron Spectroscopy
2. Tube Excited and Radioactive Source Micro-spot Energy Dispersive X-Ray Fluorescence (MXRF) Spectrometry
3. High and Low Powered Magnification with a High Resolution Photo-Microscope
4. Fourier Transform Infra-Red Spectroscopy (FTIR) with Reflectance Mode Capability
5. Time-of-Flight Secondary Ion Mass Spectrometer (TOF-SIMS)

We made measurements with the these five instrumental systems. The TOF-SIMS analyses system brought the analytical measurements to a halt when the "spliced thread" separated into 3 pieces after the high vacuum it was under was neutralized. The three distinct pieces were 1) a fuzzy end that was white (Region 1), 2) a tight woven end that was yellow (Region 2) and 3) a micron-sized circular cocoon-shaped brown crust that seemed to be connecting the two ends. This appears to be the same as the brown encrustations on the Raes and radiocarbon threads.

A most important finding was that the sample showed that cotton was a major constituent. I did not expect this result – was quite in fact- shocked by it and did not at the time understand why Barrie and Sue were so pleased.

The MXRF provided scans and maps of the presence of elemental impurities beyond Calcium in the Periodic Chart. This is in retrospect more important than once thought. The High Resolution Microscope yielded some quite astounding photos at different wavelengths and at different sources of light and high magnifications provided data on cotton and linen fibers. We did not understand the difference between flat fibers with reversals and rounded stalks with growth nodes. The FTIR analysis gave very definite peaks showing the functional groups of cotton and linen. These FTIR analyses are what Sue and Barrie were really interested in. The TOF-SIMS instrument system was complex but gave some excellent scans of the Raes sample #1 from one end of the spliced fiber relative to the other end. The spliced fiber was 10 millimeters in length and weighed 0.202 milligrams.

The presence or absence of vanillin may help determine the age of the Shroud. Flax fibers have about 2.5% lignin and oxidation of the lignin yields up to 25% vanillin. (vanillin is the "imitation" or "artificial vanilla flavor).
Vanillin is evolved from cloth by heating or time elapsed as per an Arrhenius model. According to Ray Rogers, linen from medieval times showed a positive test for vanillin whereas linen from the dead-sea scrolls showed no vanillin. The shroud samples showed no vanillin. This is an example of the influence of age or heat. Ray Rogers tests with ancient cloths (pre 33 AD) gave negative tests for vanillin, however medieval cloths (post 1000 AD) gave positive tests. Hence the vanillin evidenced shroud had to be older than medieval.

The finding of pure iron in the cloth also helps date the making of the cloth. Iron, calcium and strontium are distributed throughout the cloth of the shroud. Before it was used as a burial cloth, it traditionally would have been treated by a wet retting process, to make the cloth white and supple. This unintentionally resulted in an ion-exchange process that gave at least 90% of the iron in a chemically pure form (>99%) without contamination from natural manganese, nickel, or cobalt. Iron in nature always has these impurities. The presence of pure iron has apparently been there since before the cloth was used as a burial cloth. I will discuss the bleaching process in a moment.

One of the first tests performed directly on the Shroud by the STURP team during the 1978 study of the Shroud was Reflective Spectroscopy conducted by Roger and Marty Gilbert. They seemed to be having analytical difficulties when the spectra they were obtaining changed when they reached the area of the heel. The problem seemed to resolve itself only to reappear when they reached the knee area where they obtained spectra different from the rest of the cloth except for the problem area of the heel. Again the problem resolved itself only to reappear eventually at the nose.

They called on the Sam Pellicori, an Optical Spectroscopist, who via a vertical mounted sliding macroscope looked at the heel area and declared the reason for the "abnormal" readings was "dirt." In retrospect, Eric Jumper who was the lead person for that experiment concluded that it was appropriate that the man on the Shroud would have dirt on selected parts of his body, especially the heel, and particularly if he had fallen.

In 1982, Ray Rogers sent a sticky tape microscope slide with a speck of an undetermined composition from the heel area to Dr. Joseph Kohlbeck, an Optical Crystallographer at the Hercules Aerospace Center in Utah for analysis to determine if there was anything interesting in the slide. Dr. Kolbeck identified the dark speck as Travertine Aragonite, a rare form of calcite. Dr. Kohlbeck completed his analysis and his results were received with great interest. He eventually passed the slide with the speck to Dr. Ricardo Levi-Setti, Scientist at the Enrico Fermi Institute at the University of Chicago. His analysis also showed that the speck was Aragonite. I called both scientists on March 11, 2012 to verify the results. Cesar Barta of Spain now has the speck.

As a follow-up to this, limestone samples were taken from at least 9 tombs throughout the Jerusalem area but only a separate sample taken from near the Damascus Gate near Golgotha contained Aragonite.

The fact that Aragonite, a rare form of calcite, was the identified species of limestone on the foot of the man on the Shroud and was also found at on the ground at Golgotha near the Damascus Gate points to a connection between the man of the Shroud and the Biblical Jesus.

One of the more intriguing qualities of the Shroud is the presence of blood stains---red blood stains. Fresh blood applied to an untreated linen cloth will begin turning dark within a few days and will be quite black in a matter of a few weeks. Why then is the blood on the Shroud still red? Ray Rogers suggested the possibility of an interaction between the blood and the solution used to bleach the cloth.

There is on-going controversy over whether the "struthium" mentioned by Pliny The Elder in his history, written in the 1st Century, is common soapwort technically known as *Saponaria officinalis*. But this position is supported by Samuel Kurinsky who maintains that the name of fuller or one who

bleaches-that is fulls-the cloth is actually taken from the Akkadian name for soapwort. This is a plant known to be used as a gentle bleach in the manufacture of textiles. The Akkadians were the most advanced civilization at the time of Abraham renowned for their manufacture of textiles. It is believed that Abraham spent his formative years in that area. The occupation of fuller is well documented throughout the early Middle East and in fact there are passages in the Old and New Testaments referring to fullers. There is ample evidence to suspect that the Shroud may have been subjected to *Saponaria officinalis* during its manufacture.

Saponaria solutions are hemolytic; that is they release red hemoglobin from blood cells with which they come into contact. If the Shroud cloth had been bleached and washed with Saponaria that would provide a possible reason the blood on the cloth is still red.

Rogers initiated tests with Diane Soran in which they obtained some soapwort plants and made a solution of Saponaria. They then added blood to Saponaria-washed and non-Saponaria washed home-made linen. After 25 years, the blood on the Saponaria washed cloth was still red while the blood on the non-Saponaria-washed cloth became black. The black color began to set in after a few days. The linen cloth of the Shroud retains the blood in a red color that is so fresh looking that the 1978 STURP team was quite surprised at the intensity of the color. This seemed to indicate that the Shroud cloth had been washed with a mild ancient washing and bleaching technique that preserved the red blood color.

The Pray manuscript, named after a Jesuit priest, shows a painting of the shroud including the known 3 to 4 “poker” holes. This manuscript was known to be written between AD 1192 and 1195 which is 67 to 197 years prior to the Carbon 14 dating of AD 1260 to 1390 made in 1988.

The combined evidence from chemistry, cotton content, technology, photography, ultraviolet scans, history, residual lignin, and vanillin should be sufficient to conclude that the radiocarbon sample area was not representative of the main shroud cloth and was a poor choice to date the shroud.