Letter to the Editor
Comments on "Life-Size Reproduction of the Shroud of Turin and Its Image" by L. Garlaschelli

The main characteristics of the double body image on the Turin Shroud (TS) are widely described[1–3] and are so unique that they seem not yet all together reproducible. The article published by Garlaschelli[4] describes his reproduction of the TS in this way: "…the authors were able to obtain a good replica of the Shroud of Turin at a 1:1 scale that possesses all the above-mentioned features and the same visual and spectroscopic properties as the original." The features of the TS image considered by Garlaschelli are the following: the image is faint, superficial, and pseudonegative with three-dimensional (3D) information and consists of a discoloration of the most superficial fibers of the fabric.

In agreement with Ref. 5, a misunderstanding arises which seems due to the fact that Garlaschelli considered only some aspects of the TS image but not all. Particularly, Garlaschelli does not consider the important facts detected through the microscope on the TS as described in Ref. 1. For these reasons the present authors do not agree with Garlaschelli's conclusions which state, "The most likely explanation, in our opinion, is that the image, as it can be seen today, is a chemical etching of the cellulose of the linen fibers." First of all, according to Fanti et al.[1] the cellulose of the TS fibers is not colored; the color does not penetrate into the fiber but it is found only as a 0.2 μm thick thin layer at the surface of the fiber. Second etching colors the whole cellulose of a linen fiber, and it is for this reason that, in agreement with Ref. 6, etching seems not to be a reliable hypothesis for the explanation of the body image formation on the TS.

There are many statements in Garlaschelli's paper[4] that seem not in agreement with the present authors' understanding of the TS. Some of them are commented on below.

1. "[In 1973] …Standard forensic (both chemical and microscopic) tests for *blood* were all negative; instead, particles of a red pigment, …were found." It should be stated that, according to the final report itself, these tests were "not positive" but not "negative" in the sense that no definitive proof could be given because of the lack of solubility of the red material. A few years later instead, during the STURP examinations, the blood was found to be real human blood by about 15 tests including spectroscopy, microchemistry, and immunology.[7,8]
2. "The results of *STURP's* work were published…" and the following list should be right if properly improved by newer data; for example,[8] "The image resides in the topmost fibers of the flax threads and does not show on the underside." is a sentence that should also consider the more recent data of 2002.[9]
3. Regarding the C14 dating, "…the linen used to make the Shroud had been harvested somewhere between 1260 and *1390 C.E.*[10]" Garlaschelli should also consider a more recent result[11] that put in discussion, from a statistical point of view the results published in Ref. 10, as well as the published papers showing strong anomalies in the C14 dated "corner."[12,13]
4. "… it is a physical *impossibility for blood oozing from the scalp* to flow at the outer surface of the hair…."
   In agreement with Refs. 6, 14, and 15, it is physically possible if two different events, the production of the blood marks and the formation of the image, are considered.
5. "…*long hair* …could not possibly leave the kind of imprint one can see in the Shroud."
   Other publications[6,14] explain just how such an image of hair can be obtained using corona discharge.
6. "…apparent lack of the wrap-around *distortions*…."
   Some small lateral distortions, consistent with a cloth draping a body, have been evidenced by various researchers.[16,17]
7. "…the *fingers* look so puzzlingly unnatural and anatomically unconvincing…."
   In agreement with Ref. 6, this is just the result of wrapping.

Garlaschelli's first experiment (ochre dry powder) has one major advantage: it is, according to Garlaschelli himself, the only way to obtain a fuzzy image even if the fuzziness of the TS image is difficult to obtain,[18] especially for smaller human parts such as the fingers. However, it is unlikely that a medieval artist could use dry powder. Without some kind of binder, most of the powder would have fallen off quickly.[19] Thus, as the TS was rolled and folded many times, we should also observe some colored spots outside of the

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Figure 1. Detail of the TS face on the left and of the Garlaschelli face on the right (contrast enhanced).

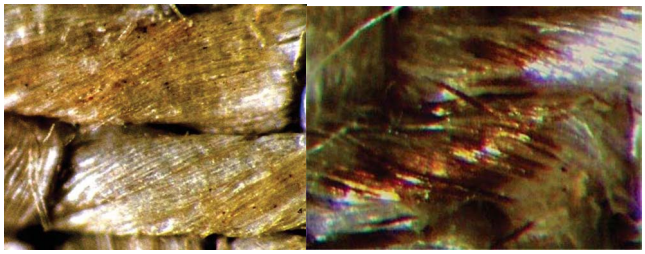

Figure 2. Typical TS image color distribution of threads on the left (© B. Schwortz) and typical Garlaschelli image color distribution on the right (both contrast enhanced).

image area, and the image itself should not be continuous, as it is on the TS.

Most importantly, Garlaschelli himself has shown that no image at all could be obtained, after artificial aging, by any kind of sensitizing substance in the solid state, although the same acidic substances in the liquid state easily discolor the cellulose. This alone seems sufficient to eliminate this "dry powder" hypothesis.

In reference to Garlaschelli's second experiment (rubbing with acidic pigments in the form of a "slurry"), we read, "…the image is not as *fuzzy* as the one generated previously by rubbing with a dry powder, but it is still acceptable." Figure 1 shows the contrary. The image is not continuous and has no fuzzy contour. There is no color at all in noncontact areas. The image/nonimage spatial variation (image resolution) in Garlaschelli's experiment is less than 1 mm while it is 4.9 mm for the TS.[20] From our point of view, this result is not "acceptable," and the reason is the technique itself.

Garlaschelli states, "Microscopic photographs at ca 50× magnification showed that the image was indeed made up of several discrete *discolored spots* on the top fibers," but on the TS, the color covers the main part of the surface of the exposed thread (no spot) and shows a clear tendency to follow the direction of the fiber (striation) (see Figure 2).

At the fiber level, contrary to TS fibers that circumferentially show uniform color[1] around the fibers, tests similar to Garlaschelli's second experiment show that the color is only on the side of the fiber's surface exposed to the acid (see Figure 3). Therefore, the properties of the Garlaschelli image are very different from the amazing and *critical* properties of the TS image with respect to color distribution.

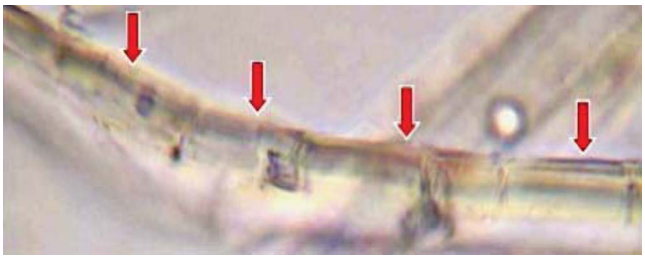

Figure 3. The color is only found on one side of the surface (arrows) in a test similar to Garlaschelli's second experiment.

The second experiment provides an image which has some of the properties of the TS image, but careful examination shows that many *fundamental* properties of the TS image are not verified: the Garlaschelli image has no fuzzy borders; it is not continuous (discrete dark spots) and it has no image in noncontact areas; and, consequently, its 3D properties are far from the extraordinary precise and realistic 3D front and back body images of the TS. The distribution and properties of the color at the surface of the threads and of individual fibers is also very different.

Finally, the proven fact that there is no image color under the blood stains on the TS, which demonstrated that the blood was first on the linen and prevented the formation of the image in those areas, remains very difficult to understand in any hypothesis involving a forger (including Garlaschelli's hypothesis).

Incidentally, from Garlaschelli himself (personal email to the second author), there is, as expected, no fluorescent halo around his "blood stains" made of pigments, contrary to the serum haloes present on the TS.

We therefore conclude that the TS image was not produced by the technique proposed by Garlaschelli and still remains not reproducible.

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