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Authors' Response

Sir,

We are very grateful for the opportunity to reply to the second letter that Dr. Hermosilla is writing, this time with a different co-author (Mr Rucker), regarding our paper, *A BPA Approach to the Shroud of Turin* (1).

Even if we appreciate that Hermosilla and Rucker try to briefly summarize the studies that allegedly prove not only the authenticity of the Shroud of Turin but also that "*the body was probably that of Jesus,*" we do not think that these arguments are relevant for a review of our experimental Bloodstain Pattern Analysis.

The Condition of the Body

It is true that "*it is probably not possible to adequately model the blood flow from a crucified body*"; however, in our experiment, we replicate all the possible positions of the arm (from horizontal to vertical) to allow a better understanding of the possible directions of the blood flow. This represents a first experimental test, never tried before, that achieved significant results that can be re-evaluated only if a similar experimental test will point to a different direction. Speculations on the "unique conditions of the blood and body" are not only mere conjectures but also lacking any scientific basis.

At the same time, it is important to remember that it is not universally accepted that a crucified man was "*pushing up and down to breathe for hours while hanging*" or presented a "*probable outward bow of the body.*" These are hypotheses not supported by robust data and they do not seem to be relevant in order to influence the direction of the blood flowing from the wounds that we analyzed in our experiments. As an example of the discussion about the issue of the crucifixion, the reader can refer to our first reply to Dr Hermosilla (2) particularly to the references from number 4–13. However, we are more than open to compare our results with future similar BPA studies that will replicate these conditions if supported by relevant evidence.

In this respect, assertions such as "*the conditions of the body are far from that of a normal man*" should be scientifically supported. It is important to underline how some of the details on the image on the Turin Shroud are debated and not unanimously accepted. More than one time, the findings on the Shroud turned out to be more like a Rorschach test rather than indisputable facts.

It is also relevant to remember that there is no evidence of "*accumulation of dirt, sweat, dried blood, and swelling of the body*" as suggested by Hermosilla and Rucker. If this situation was present, the image would be very different from the "*full size good resolution image*" described by the same authors a few lines above. We already pointed out in our reply (2) to the previous letter of Dr Hermosilla that if the Man of the Shroud (henceforth MoS) "*was actually a scourged individual, his body should have been completely covered with blood that would have left an imprint on the linen, but there is no evidence of this on the fabric.*" If instead we accept the opinion of Zugibe (3) that the body would have been washed before being covered with a shroud, we must notice that his hypothesis of postmortem bleeding for all the stains was not based on any real scientific BPA experiment. In addition, our experiments demonstrate that the direction of the blood flowing on the forearm and on the chest are not compatible with a postmortem bleeding in a supine position.

Use of Anticoagulant and Synthetic Blood

Hermosilla and Rucker seem to forget that blood with anticoagulant was used only in one part of the experiment. However, our experiments were focused on the direction of the flow that is due to gravity and to the body's position. If we have to assume that the red rivulets on the forearms of the MoS are from bleeding (on the cross or in the grave) and not from a painting, it is necessary to assume that the blood was not coagulated, since clotted blood would not be able to come out from the wound and run along the limbs.

As already replied in our previous response to Hermosilla, the viscosity of the blood, that behaves like any other liquid (4), can influence the speed of the dripping and bleeding but not the direction of the rivulets that follows the law of gravity. Consequently, any criticism regarding the use of anticoagulant or synthetic blood is specious and not scientifically supported. In addition, it is also important to remember how the use of synthetic blood is a well-known and accepted practice in BPA (5).

Use of the Mannequin and Influence of Hairs

As in his first letter, Hermosilla points out again the use of the mannequin and the lack of hairs on it that would affect the results of our experiments. We already explained that the use of mannequins is a recognized practice in BPA tests and it was adopted to make the experiment more practicable in the laboratory. It is true that "*the plastic mannequin torso had no arms";* however, the blood flows in the direction of the armpit, where the arm seems not to be involved. However, even if we would assume that "*the arms could have affected the blood flow from the side wound,*" there is no evidence on the Shroud of any stain corresponding to that area of the arm. Regarding the fact that the MoS "*was wrapped in the Shroud,*" it is important to remember that the way in which the linen should be arranged on the cadaver to obtain the "*full size good resolution images*" is very controversial and far from being understood. For example, a recent study (6) that reconstructed a life-size statue from the Shroud image claimed to have achieved a perfect correspondence between the body and its print. However, it lacks the main counter-evidence of using the obtained model to create an image on a fabric placed on it. As a matter of fact, the *real* print of a *real* body on a linen sheet turns out (7) to be quite different and badly distorted.

The presence of hairs on the MoS and their possible influence on the direction of the blood rivulets is a specious and wrong assumption: as we already explained in our previous reply, hairs can only modify the general shape of bloodstains but not their general trajectory that is directed by gravity (4). Our experiments and the related conclusion were focused on the direction and the position of the rivulets and not on their shape.

Use of the Sponge

In the same way that the flow from the wrist was replicated with a transfusion cannula, a sponge was used to replicate bleeding from an area of the same size and shape of the wound on the chest of the MoS. This methodology allowed us to analyze the direction of the blood flowing from this area while the individual was in different positions (vertical on the cross, supine in the grave). Hermosilla and Rucker seem to ignore that the blood flow rates were not relevant for this experiment, while the direction of the rivulets are.

Tests on the Wrist

It is not clear what Hermosilla and Rucker are questioning regarding the BPA on the wrist. Naturally "*only blood flow from the back or exit wound was considered"* since it is the only one visible on the Shroud. If the MoS was a real crucified person that left his imprint on the linen, there is no evidence of a "*flow from the front or entrance wound.*" Also, the test with the "hand flat on a table" aimed to demonstrate that the contact between the skin and the surface of the *patibulum* (the horizontal branch of the cross) alters the shape of the stain in this area. Consequently, any hypothesis on the exact location of the exit wound of the nail should be avoided.

Now that we have replied to the points risen by Hermosilla and Rucker, it is mandatory that we clarify why their alternative hypothesis needs to be entirely rejected. First of all, trying to "resolve" the supposed contradictions in our experiments seems to be not exactly a scientific attitude, but only a way to maintain alive a theory (the authenticity of the Shroud) that some authors are attached to.

Regarding their statements, there is no evidence on the Shroud that *"the blood on the left forearm may have come from the front of the left wrist combined with a body posture that is bowed out from the cross.*" Also, there is no trace of any "*dried blood*" or "*clotting*" that "*directed to that location*" the blood on the lumbar region. Moreover, there are no stains that could suggest any "*blood dripping off the elbows.*" They go as far to suggest imaginary postmortem massages "*to overcome rigor mortis to bring the arms down into position over the groin.*"

To conclude, we firmly believe that our Bloodstain Pattern Analysis was not only performed according to the best practice of the discipline, but also demonstrated the unrealistic appearance of the alleged blood stains on the Shroud of Turin. As scientists, we are open to compare our results with data obtained from similar experiments, while we are less interested in theoretical speculations. We believe that the *Journal of Forensic Sciences* is not the appropriate place to open a debate on the evaluation of historical documents. Finally, we want to clarify, once more, that the scientific experimental conclusions of our BPA point to the artificial nature of the alleged bloodstain on the linen; these conclusions are consistent with the medieval origin of the Shroud of Turin, in accordance with scientific (7,8) and historical (9–13) research and as confirmed by the Roman Catholic Church, owner of the linen (14).

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