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A Simple, Natural Mechanism for the Transfer of Dry Bloodstains onto the Shroud of Turin

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Abstract: The Shroud of Turin is a large linen cloth that bears the faint image of a crucified man containing bloodstains corresponding to scourging and crucifixion. Although the Shroud has been heralded as the most studied archaeological object in the world, the nature and origin of the image remains enigmatic, with explanations ranging from the natural to the supernatural. The bloodstains have been demonstrated to contain authentic blood components including hemoglobin, albumin, and immunoglobulin, although the species of origin remains to be determined. Controversy exists regarding the proposed blood transfer from a body to the cloth, particularly if certain bloodstains occurred in a dry state. The suggestion has been made that dried blood was thrust onto the cloth by a brief radiation burst emitted from the body, although demonstration of such a process is lacking. Here, a simple, natural mechanism is shown that could account for the imprinting of dried bloodstains onto the Shroud. Specifically, these studies examine the idea that temperature and humidity conditions like those described for a cave tomb environment are sufficient for the rehydration and transfer of dry blood stains. Moreover, these data demonstrate that high humidity imprinting faithfully represents the original patterns of dried blood and dried serum stains on skin.

Keywords: Turin Shroud, Blood, Humidity

1. Introduction

The Shroud of Turin is an approximately fourteen feet long linen cloth that has been suggested to represent the burial cloth of Jesus or alternatively, a clever, medieval hoax [1-3]. Carbon-14 dating tests performed in 1988 assigned the Shroud a medieval date of origin [4], although such results have recently been questioned, both in terms of data homogeneity and representation of the whole cloth [5-7]. Throughout the faint ventral and dorsal images of a man are various bloodstains, many of which have soaked through to the reverse side of the cloth. Current evidence indicates that the blood was likely transferred from a body and not just added to the material [1, 8, 9]. It has been suggested that certain bloodstains may have been transferred by direct contact while existing in a moist, gelatinous state, whereas others were somehow transferred from the skin in a dried form. Antonacci and Rucker have proposed that dried blood was thrust onto the cloth by an extremely brief radiation burst emitted from the body [10, 11], although no demonstration currently exists by which such a process might occur. Others have proposed that dried clots were re-moistened during a washing of the body; however, Jewish burial practices under such circumstances of death would have prohibited such actions [12]. Moreover, it is difficult to reconcile the presence of serum associated with many bloodstains on the Shroud with this scenario, as serum would have most likely not remained after washing of the body.

According to tradition, Jesus was buried on a stone platform hewn out of the wall of a cave. Although the precise location remains undecided, it is widely believed that the tomb exists underneath the Church of the Holy Sepulchre, also known as the Basilica of the Resurrection. Nitowski measured the conditions over a ten-day period in an adjacent site in Jerusalem, sharing the same cave wall, and reported a temperature of 13-15°C with an approximate humidity of 93% [13]. These temperature and humidity values are typical of many caves throughout the world, though the humidity may be slightly lower and the temperature a few degrees higher as one approaches the entrance to the outside.

It has been shown that increased humidity results in delayed drying times of fresh blood due to an increase in the surface area of the blood pool [14, 15]; however, little information exists on the effect of humidity on dried bloodstains, particularly those on skin. Here, the influence of humidity on the transfer of dried blood stains to linen cloth was evaluated. The data in the current report demonstrate that bloodstains were effectively transferred onto linen under temperature and humidity conditions approximating that of a cave tomb environment within twelve-to-fifteen-hours. These results provide a natural mechanism by which dried bloodstains could have been imprinted onto the Turin Shroud.

2. Materials and Methods

2.1. Blood and Porcine Skin

Human blood was obtained from healthy volunteers by the finger stick method using a Health Lancing device (CVS pharmacy, USA) fitted with a micro lancet (CVS Pharmacy, USA). Human blood serum was obtained from Innovative Research (Innovative Research Company, Novi, MI), purchased as pooled human serum off the clot. Blood was dropped onto Parafilm® M Laboratory Film (Bemis Company, Inc., Oshkosh, WI) and approximately 10-80 microliters transferred to another piece of parafilm or a 3 x 3 cm^2 piece of porcine skin. Porcine skin (with fat removed) was obtained from Animal Technologies (Tyler, TX), a leading supplier for skin utilized in medical schools for human surgery practice.

2.2. Humidity Chambers and Incubation

Skin was placed on a piece of parafilm, blood added, and allowed to dry for 3-5 hours. To ensure that the blood was sufficiently dry such that no transfer initially occurred, a test blot (control transfer) was performed each time with a piece of filter paper. The paper was removed and skin overlayed with a piece of natural linen (Rawganique, Blaine, WA). Electrical tape was used to secure the edges of the linen to the humidity container, a black plastic square box (21.5 cm x 21.5 cm x 4.5 cm) with locking lid, obtained from a local restaurant. A paper towel was folded in four, placed in the upper region of the box and saturated with water. All excess water was removed before the sample was added. Humidity was measured using a Antoki (Shanghai, China) humidity gauge placed inside the container which gave a value of approximately 88-91% in this system, referred to as high humidity. For low humidity samples (room temperature humidity), the setup was the same, except that the saturated paper towel was omitted, giving a value of approximately 41-42%. Samples were placed inside of a 25L incubator (Happybuy Store, San Paulo, Brazil) set at the desired temperature for 12-15 hours. Multiple incubators were used in these experiments and samples under different conditions were run in parallel. Linen was then carefully removed and photographed. In certain experiments, blood was placed directly onto parafilm instead of skin; and Whatman® 1 mm filter paper (Whatman, Maidstone, Kent, UK) was utilized for imprinting instead of linen (see below).

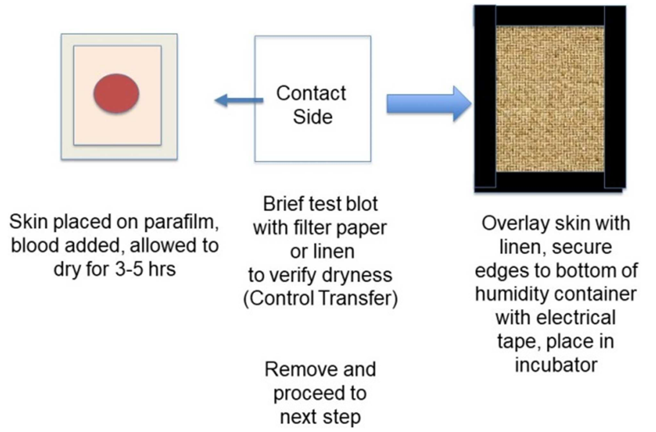

Figure 1. *Flow diagram of experimental set up. See the Materials and Methods section for specific details.*

2.3. Ultraviolet Light Sources and Photography

For uv photography two LED portable 3 watt UV light bulbs, 365 nm, were used, UV-3W-365UV-E27-AC (Golden Gadgets, South El Monte, CA) positioned at a ~ 45° angle from the subject and fitted with a NUV M55.0 x 0.75 filter (Edmunds Optics, Barrington, NJ). All uv photographs were taken using a Sony RX100 digital camera, and a 425 nm long pass filter (Edmunds Optics, Barrington, NJ) was placed in front of the camera lens. Photographs of samples under visible light were taken using a Sony RX100 digital camera without any additional filters.

Filter paper was used instead of linen in experiments involving ultraviolet light photography as serum is not easily visualized on many types of modern linen, due to the fluorescent background [16].

3. Results

A general flow chart of the experimental system used in these studies is presented (Figure 1). Briefly, blood is placed onto a piece of skin, allowed to dry for several hours, then overlayed with linen and incubated for 12-15 hours with varying temperature and humidity (see Materials and Methods for specific details). Conditions were chosen to approximate those of a cave tomb environment, with relatively low temperature and high humidity. As demonstrated in Figure 2, blood was effectively imprinted onto linen under high humidity conditions at both temperatures examined; no transfer was observed under low humidity settings (Figure 2A). Imprints had relatively sharp edges and were in good agreement with the original size and shape of the bloodstains on skin (Figure 2B). Similar to what has been observed on the Shroud, bloodstains soaked through to the reverse side of the linen under such conditions (Figure 3). Several major representative bloodstains on the Shroud were chosen for an approximate reproduction of their appearance using this system. The “epsilon” bloodstain on the forehead and two separate mimic imprints are presented in Figure 4. As is evident, the outline and edges of each bloodstain were preserved with fidelity during imprinting (Figure 4, right-hand side). Next, a bloodstain toward the base of the arm was selected as this is an area which Rucker proposed would have certainly dried on the skin [11]. As demonstrated, transfer of previously dried blood was successful under high humidity conditions (Figure 5).

The bloodstains on the wrist region of the Shroud are particularly interesting as they appear to exhibit directional flow due to gravity and resulting serum separation; the presence of blood serum is revealed using ultraviolet light (Figure 6A), [17, 18]. To approximate this situation, blood was added to skin in the general shape of the wound, allowed to dry, and then purified serum added in the same region as observed on the Shroud (Figures 6A and 6B). Filter paper was used as the overlay instead of linen because serum is not effectively visualized under ultraviolet photography on many types of modern linen [16]. These results show that blood and serum both effectively imprint under high humidity conditions and maintain their separation similar to the original dried stain.

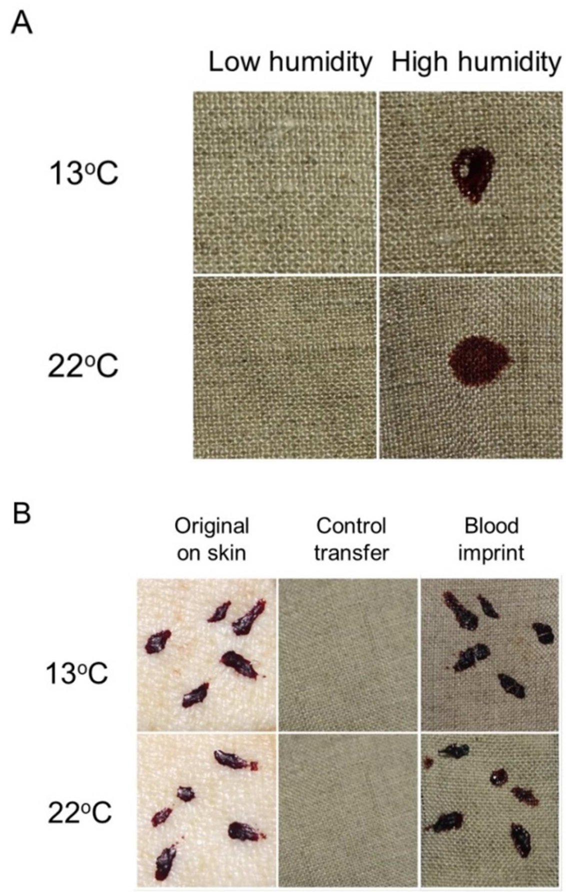

Figure 2. *(A) Blood was added to porcine skin and after drying, overlaid with linen and incubated under the indicated temperature and humidity conditions for fifteen hours. After this time, the linen was removed and photographed. (B) Similar to (A) performed under high humidity conditions, except that a photograph of the original bloodstains on skin is shown, and a picture of a control transfer is included to demonstrate that the bloodstains were dry prior to overlay with new linen and overnight incubation.*

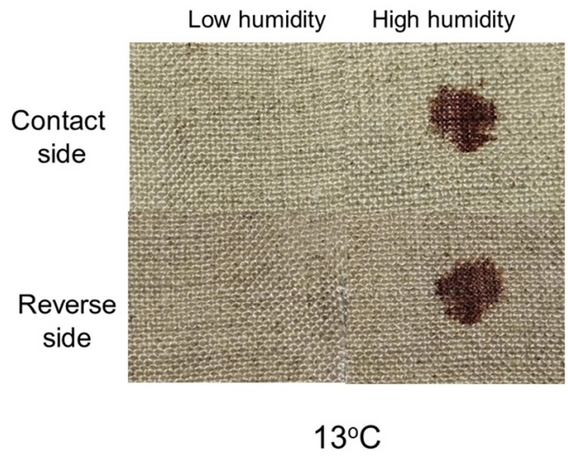

Figure 3. *Blood was added to porcine skin and after drying, overlaid with linen, and incubated for fifteen hours in the indicated conditions. The linen was then removed and photographed. Both the contact and reverse sides are shown.*

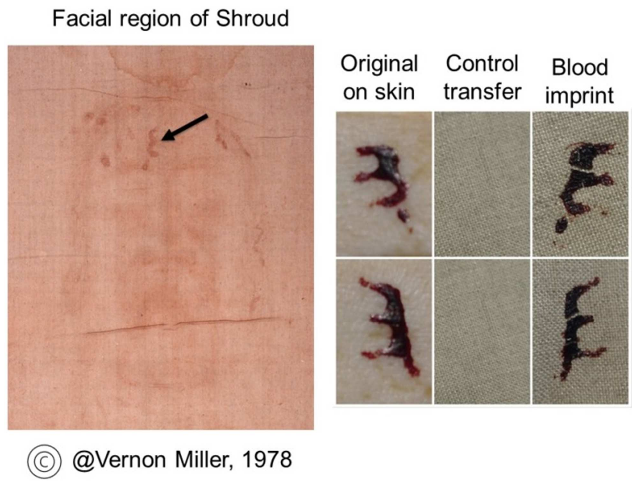

Figure 4. *(Left-hand side). Photograph of the facial region of the man on the Shroud. The position of the "epsilon" blood stain is indicated with an arrow. (Right-hand side). Blood was added to porcine skin and after drying, overlaid with linen, and incubated at 22°C with high humidity for twelve hours. After this time, the linen was removed and photographed. A photograph of the original bloodstains on skin is shown, and a picture of a control transfer is included to demonstrate that the bloodstains were dry prior to overlay with new linen and overnight incubation.*

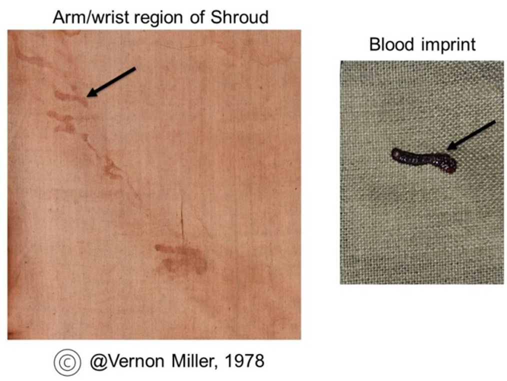

Figure 5. *(Left-hand side). Photograph of the arm/wrist region of the man on the Shroud. The position of the selected blood stain is indicated with an arrow. (Right-hand side). Blood was added to parafilm and after drying, overlaid with linen, and incubated at 13°C with high humidity for twelve hours. After this time, the linen was removed and photographed.*

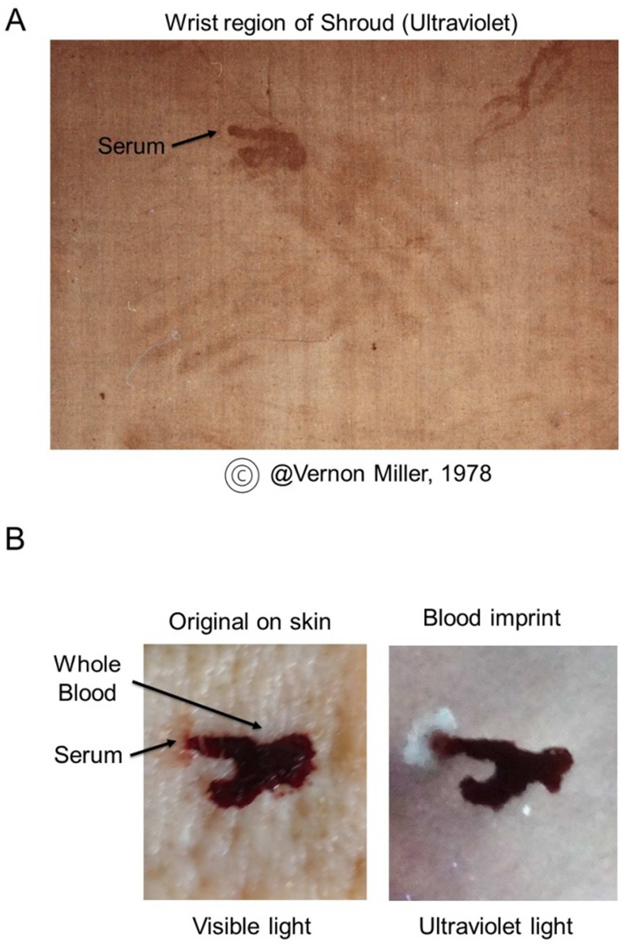

Figure 6. *(A). Ultraviolet photograph of the wrist region of the man on the Shroud. The position of serum is indicated (B). Blood was added to porcine skin and after drying, serum was added, and allowed to dry for two additional hours. The sample was then overlaid with filter paper and incubated at 22°C with high humidity for twelve hours. A photograph of the original bloodstains on skin under visible light is shown (left-hand side) as well as an ultraviolet light photograph of the imprint on filter paper (right-hand side). The position of whole blood and serum are indicated.*

4. Discussion

The current report has evaluated the possibility that environmental conditions (specifically high humidity) could result in rehydration of dried blood sufficient to result in transfer to linen, analogous to the bloodstains on the Turin Shroud. Settings were chosen to approximate that which would have likely existed within the interior or near the opening of a cave tomb. Importantly, these results provide an alternative explanation to enigmatic processes of blood transfer involving bursts of radiation that have recently been proposed [10, 11]. These findings also indicate that other artifacts containing blood may transfer to surrounding materials under the appropriate conditions. It would be interesting in future studies to determine if such transfer occurs effectively to or from other archaeological objects, such as those made of wood, leather, pottery, or bone.

It is currently unknown if some, or all, of the Shroud bloodstains were transferred to the cloth in a typical fashion, i. e., while originally wet. The findings in this report are not meant to suggest that all bloodstains on the Shroud were originally dried and imprinted on the cloth due to high humidity, but, rather, to demonstrate a potential transfer mechanism for certain bloodstains that may have existed in this condition. Future efforts will involve a more detailed (microscopic) evaluation of freshly wet versus rehydrated bloodstains and their imprints to determine if distinct characteristics exist that allow these two possibilities to be differentiated. Understanding more fully the specific characteristics of the features of the Shroud is important in the preservation of this article for future generations.

Barbet proposed that dried blood clots on the Shroud may have become rehydrated in the tomb, although his thought was that moisture emanated from the body after death [19]. The data in this report show that neither a body (nor skin) is required for this process to occur as successful imprinting took place using isolated skin or parafilm. The most likely candidate for providing sufficient moisture in the case of the Shroud is the external environment, e. g., the cave tomb that was used for burial. Finally, it should be noted that rehydration and transfer via exposure to high humidity gave a much different result than exposure of bloodstains to water in simulated washing; in the latter scenario, the blood borders were much diffuse and irregular, and serum was easily removed (K. P. Kearse, unpublished observations). As demonstrated in this report, immersion in a high-humidity environment results in a more gradual exposure to moisture over time, resulting in an accurate representation of the original bloodstain.

5. Conclusion

In summary, the current study has evaluated the concept that environmental conditions may have contributed to transfer of dried bloodstains to the Shroud of Turin. These results demonstrate a simple, natural mechanism for the transfer of dried bloodstains to cloth.

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References

[1] Schwalbe LA, Rogers RN. Physics and chemistry of the Shroud of Turin, a summary of the 1978 investigation. *Anal. Chim Acta.* 1982; 135: 4–49.

[2] Culliton, B. A., The Mystery of the Shroud of Turin challenges 20th-century science. Science 201, (4352), 235-239 (1978).

[3] Jackson, J. Critical Summary of Shroud Observations, Data and Hypotheses. Colorado Springs, CO: Turin Shroud Center of Colorado Publishing; 2019.

[4] Damon, P., Donahue, D., Gore, B. et al. Radiocarbon dating of the Shroud of Turin. Nature 337, 611–615 (1989).

[5] Rogers, R. N., Studies on the radiocarbon sample from the Shroud of Turin. Thermochimica Acta 425: 189-194 (2005).

[6] Casabianca, T., Marinelli, E., et al. The radiocarbon dating of the Turin Shroud: New evidence from raw data. Archaeometry 5 (61): 1223-1231 (2019).

[7] Marino, J. G. G., The 1988 C-14 dating of the Shroud of Turin: A stunning expose', J. G. Marino Publishing (2020).

[8] Jumper E. J., Adler A. D., Jumper E. J., et al. A comprehensive examination of the various stains and images on the Shroud of Turin. Archaeological Chemistry III, *ACS Advances in Chemistry* 205, 22, American Chemical Society, Washington DC; p. 447–476 (1984).

[9] Kearse, K. P. Ultraviolet 365 as an Alternative Light Source for Detection of Blood Serum. J Forensic Sci. Sep; 65 (5): 1716-1721 (2020).

[10] Antonacci, M. Test the Shroud: At the Atomic and Molecular levels, LE Presss, LLC (2015).

[11] Rucker, R. The Mysteries of the Shroud of Turin. *Materials Evaluation,* (80) 2: 24-36 (2022).

[12] Lavoie, G. The Shroud of Jesus, Sophia Institute Press, Manchester, NH, (2023).

[13] Nitowski, E. Environmental study of the Shroud in Jerusalem field and laboratory report (1986), available at www.shroud.com Environmental Study of the Shroud in Jerusalem Field and Laboratory Report - Sept. 14, 1986.

[14] Benabdelhalim, H. and Brutin, D. Phase separation during blood spreading. Sci Rep., Jun 3; 11 (1): 11688 (2021).

[15] Laan, N., Smith, F., et al. Morphology of drying blood pools. Forensic Sci. Int. 267, 104-109 (2016).

[16] Kearse K. P. Environmental influence on blood serum detection using ultraviolet 365. J Forensic Sci Res., 5: 030-036 (2021).

[17] Miller V. D. and Pellicori SF. Ultraviolet fluorescence photography of the Shroud of Turin. J Biol Photographers Assoc. Jul; 49, (3): 71-85 (1981).

[18] Pellicori, S., UV fluorescence imagery of the Turin Shroud-digitally revisited. Int. J. of Archaeology, 8 (2): 32-36 (2020).

[19] Barbet, P. A doctor at Calvary, Roman Catholic Books, Ft. Collins, CO (1953).