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Turin Shroud: a medical forensic study of its blood marks and image

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Abstract
From extensive analytical studies of the Shroud of Turin we know that the image is not man-made, and from medical forensic studies of the blood marks we know that a crucified man was laid out on his back and wrapped in this cloth. But the question still remains as to what caused the shroud image. A forensic evaluation of the blood marks and a study of the effect of gravity on surface anatomy suggest that a natural event is not the most probable cause of shroud image formation.

Keyword: forensic, blood, image, gravity.

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1. INTRODUCTION

The Shroud of Turin, a cloth made of flax, is approximately 14.7 feet long by 3.7 feet wide and contains the blood marks of a crucified man that correspond anatomically to frontal and dorsal negative images of a naked man seen on this cloth [1, 2]. What caused the shroud image has been the subject of much discussion.

The objective of this paper is to decide experimentally if the cause of the image - the image forming event - was a man-made, a natural, or a supernatural event. It is through science, an organized body of knowledge, that we study cause and effect. Many theories (man-made, natural, and supernatural) of image formation have been postulated since the 1350's. At this point, the three categories of cause being investigated should be made clear. (1) A man-made event defines itself. (2) A natural event is one that can be understood or defined through our ordinary understanding of space and time. (3) A supernatural event (one that is not attributable to natural forces [3]) is one that cannot be understood nor defined through our ordinary understanding of space and time.

Shroud scientific literature, medical forensic evaluation of the blood marks, and effect of gravity on surface anatomy are presented in order to better understand the available data and resolve the question of image formation.

2. METHODOLOGY

Method I. Shroud scientific literature was reviewed. **Method II.** Medical forensic evaluation of physical findings related to the trauma contributing to the death of the victim, and medical evaluation of gravity's effect on body form were made. The data collected from these medical studies was organized under the following headings: ***(A) Medical forensic evaluation of two blood mark studies*** *and* ***(B) Medical evaluation of gravity's effect on the surface anatomy of the body.***

3. RESULTS

I. Shroud Literature Review

From chemical and medical forensic studies of the blood marks, we know that a scourged, crucified man with head wounds and a wound to the chest was laid out supine (on his back) and wrapped in this cloth. Blood mark formation occurred when moist blood clots and post-mortem blood simply soaked into the cloth. The transfer of blood from the body to cloth was a contact process and was a natural event [4, 5, 6]. Under the blood marks there is no image. This information tells us that the blood came first and prevented image formation wherever it was on the cloth. Therefore, the **first event** was the formation of the blood marks and the **second event** was image formation [7].

From extensive analytical studies of the image, we know that the image is not caused by paint, stains or dyes [8, 9], and it falls into no known artistic category [10]. It is the yellowed linen fibers (~15 microns in diameter) composed of cellulose that produce the image [11]. Heat, light, and acid can produce this yellowing of linen fibers; the image is the result of a chemical change in the cellulose itself. Most important, the image producing fibers penetrate the fabric only one fiber deep [12]. No one as yet has been able to reproduce the image at this microscopic level. It is unique in the world.

From the information presently available it is evident that the image is not man-made. With regard to the questions, was image formation a natural event or a supernatural event, there are many theories available in the literature, including those that postulate that this is the burial cloth of Jesus. However, no study adequately resolves the issue. The following medical studies address these questions.

II. Medical Evaluations

Please note: for the sake of orientation, the body of a crucified man was placed in the supine position (on his back) on one end of this long cloth and the other end covered the front of the body.

(A) Medical forensic evaluation of two blood mark studies.

Studies of the blood marks demonstrate how an end of this long cloth was draped over the front of the supine body of a crucified man. The cloth was sufficiently wrapped to allow it to absorb the moist blood clots that were on the body. The following two blood mark studies illustrate the cloth-to-body drape and the complexity of frontal image formation.

Blood mark study 1. Blood off the elbow.

Figure 1 shows the off-image blood mark at the left elbow of the image.

Figure 1. Off-image blood mark.

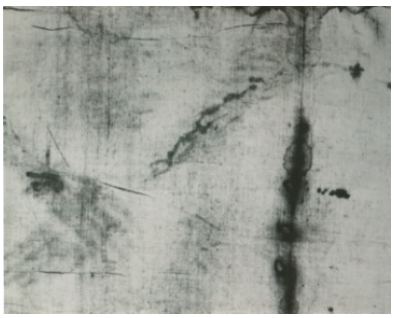

Figure 2. Close up of the off-image blood mark.

Figure 2 is a close up of the same. Note that there is no image here. Figure 3 shows that tracing paper was placed over the image, and the blood mark was traced onto the paper. Figure 4 highlights a person draped by the tracing paper from a frontal view. From this view the off-image blood mark cannot be seen.

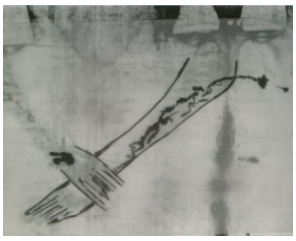

Figure 3. Blood flow on tracing paper.

Figure 4. Frontal view drape.

Figure 5. Side view drape.

Figure 6. Shows how the blood flowed.

Figure 5 shows the tracing paper draping to the side of the volunteer's body. The shroud cloth was sufficiently tucked at the side of the body to soak up the moist blood clot that was at the back of the upper arm. Figure 6 shows that the blood flowed from the wrist, down the arm and around the elbow, and pooled at the back of the upper arm, and then dripped to the ground [13, 14].

What is the significance of the off-image blood mark?

(a) The blood mark is a contact process that occurred

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when the cloth came in contact with the moist blood clot at the back of the upper arm. (b) All the other blood marks tell us something about the first two dimensions, that of height and width. But this blood mark gives us the third dimension: that of depth. It tells us that this cloth draped around a three-dimensional man who was crucified. (c) The image is not a contact process because we know that the cloth came in contact with the back of the upper arm, but there is no image present. (d) Any proposed natural form of energy or organic substance emanating from a body would come from the whole body, and not just from its anterior and posterior surfaces. We know, because of the off-image blood mark, that the cloth was in intimate contact with the back of the upper arm – a lateral surface. In a natural event we would expect to see the image of the back of the upper arm, which would of course distort the frontal view. But no image was formed here which indicates that image formation was probably not a natural event, and suggests that it was intentionally driven.

Blood mark study 2. Blood on the Face.

Figure 7 shows the positive facial image of the shroud, showing that the blood marks are in the hair.

Figure 7. Blood marks in the hair.

Figure 8 is a cutout of the blood marks from the shroud face.

Figure 8. Cutout of the blood marks.

Figure 9 shows the face of the supine volunteer. Figure 10 shows the cutout draped over the volunteer. The cutouts were then filled in with paint. Figure 11 shows that the blood marks originated from the face and not the hair. Figure 12 shows that the blood marks were originally on the temples and cheeks of the man draped by the cloth; however, in image formation the blood marks ended up in the hair (See Figure 7) [15, 16].

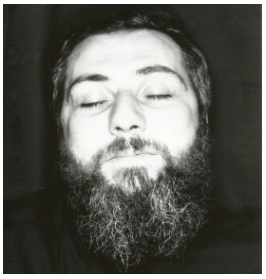

Figure 9. Face of supine volunteer.

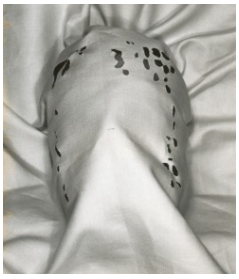

Figure 10. Cutout draped and filled with paint.

Figure 11. Blood marks originated from the face and not the hair.

Figure 12. In image formation the blood marks ended up in the hair.

What is the significance of the blood originating from the face and not the hair? (a) As with the off-image blood mark at the elbow, the shroud cloth draped over a three-dimensional body. The blood soaked into the cloth from the moist clots on the temples and cheeks. Once the image was formed, the blood marks that originated from the temples and cheeks are now seen in the hair that falls

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along the sides of the facial image. (b) The only way to understand how the blood marks on the face (temples and cheeks) moved out into the hair is to imagine that the cloth moved into a flattened position during image transfer. (c) There is no known natural event that can explain image formation of the face.

(B) ***Medical evaluation of gravity's effect on the surface anatomy of the body.***

Before we begin the **Gravity study** it is important to understand that when we are looking at the shroud image, we are looking at two separate events: the **first event**, the blood marks and the **second event**, the image. We will start by attempting to understand what we see when we look at the image. Why do we see this 3-dimensional figure on a 2-dimensional (flat) surface? From an artistic or photographic perspective, an image's form is dependent on variation of value. Variation of value is the variation of shading that causes the eye to decipher form. Figure 13 shows the figures of a rectangle and a cylinder. On the right we have a rectangle that has no form because it contains only one shade of grey. On the left we have a cylinder that has form because it has many shades of grey from white to black. More specifically, the rectangle on the right is flat. It is two dimensional with no depth. It has no form because the entire surface has the same shading. The cylinder on the left looks like a three-dimensional cylinder because it has variation of shading.

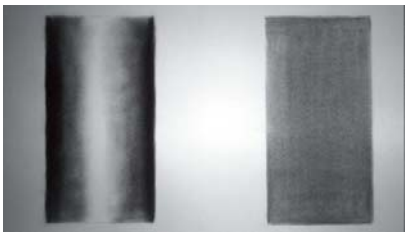

Figure 13. A cylinder and a rectangle.

Next, we need to better understand what we see when we look at the **first event**, the blood marks. Moist blood clots and their accompanying serum exudates soaked into the cloth by contact. The blood marks are simply flat areas as is seen in the flat rectangle. We also know that blood prevented image formation [7]. The more blood on the cloth, the less the image is seen on the cloth, gradually moving on a scale from full image (little to no blood) to some image (more blood) to no image (much blood). In this paper we will use the term masking which means that the image is prevented from forming depending on the amount of blood on the cloth. With this background we can better understand the shroud image that we are viewing.

Now we will study the effect of gravity on the human body in relation to body position and then compare it to the shroud image.

Gravity study. Upright man.

By studying the effect of gravity at the surface contact points of a body lying in the supine position (on his back), we understand how body weight affects anatomic form. From the following study we can appreciate the complexity of dorsal image formation.

Figure 14 is a drawing of a male volunteer who has the anatomic form that we would expect to see of someone in the upright position.

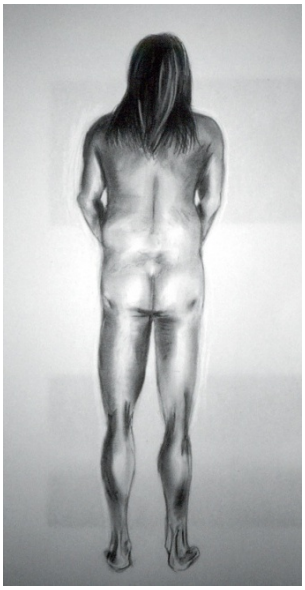

Figure 14. Volunteer in upright position.

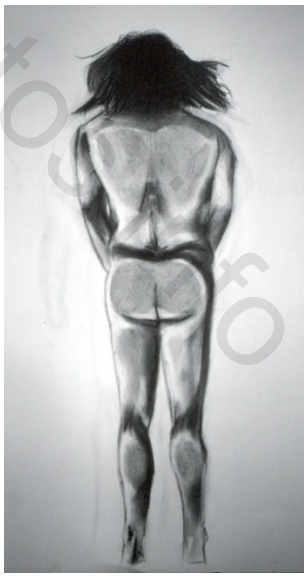

Figure 15. Lying on his back on glass.

Figure 15 is this same man now lying on his back on a large plate of glass and we are looking at him from below. The weight of his body has flattened his backside and

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there are areas of the back and buttocks and calves that have lost their roundness from when he was standing. The flat areas are similar to the flat rectangle that has no form. You would see this same loss of body form if you were to examine bodies in an autopsy room. Note the change of hair position from the upright position to the supine position. In the supine position the weight of the body against the hair caused it to flatten. The hair will be further discussed below.

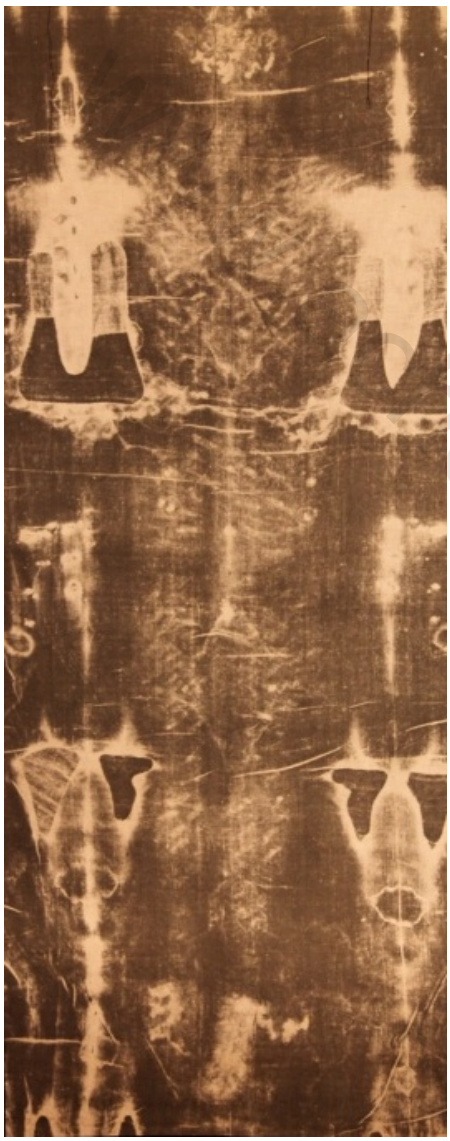

Figure 16. Positive dorsal shroud image (back lighting).

Figure 16 is the back of the shroud image. When looking at this image we will consider it from the point of view of two events. The blood marks **(first event)** are consistent with that of a man who was laid out in the supine position of burial. More than simply documenting the wounds and the blood flows of postmortem blood, the blood marks document body flattening. The blood marks at the area of the buttocks best demonstrate the expected flattening that is seen in Figure 15. Areas of blood at the calves of the legs and parts of the upper back suggest the same. Now the body image (**second event**) is best visualized by back lighting the full size photograph which helps to elucidate the form of the back image. Parts of the back image have been masked by the blood marks (**first event**). As mentioned earlier, the more blood on the cloth, the less image is seen on the cloth. Prime examples of this masking are the right foot and top of the head which show almost no image. With careful observation one can also make out areas where the blood subtlety masks the image and no form is observed; for example, see the partial masking of both calves and the buttocks, more on the right than on the left. Where there is less blood, the image (**second event**) is visible and reveals its form. The image of Figure 16 does not have the flattening that is seen in Figure 15. Rather, the form of the shroud image resembles the form that is seen on the upright volunteer of Figure 14.

Figure 17 now considers the hair, showing a long-haired young woman lying supine. The hair falls to the ground. What if the hair were mixed with blood, oil, or sweat? This may stiffen hair but the added *weight combined with the length* of the hair would simply react to the force of gravity and cause the hair to fall. Moreover, regardless of possible stiffening of the hair, in the supine position the weight of the body against the hair would cause it to flatten. See Figure 15. But as seen in the shroud image, the hair falls downward, front and back, as one would see in an upright person with long hair. See Figures 18-21.

Figure 17. Supine position, hair falls to the ground.

Figure 18 shows the same woman in the upright position; note that her hair falls along the sides of her face down to her shoulders.

Figure 18. Upright position, hair falls along sides of the face down to the shoulders.

Figure 19 shows the hair of the man of the shroud. His

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hair falls along the sides of the face down to the shoulders, just like that of the young woman.

Figure 19. Frontal image, hair falls along sides of the face down to the shoulders.

Figure 20. Upright, hair falls down the back.

Figure 20 shows that the hair falls down the back as one would expect when a person is upright. Figure 21 shows the hair of the dorsal shroud image falling down to his back, just like that of the upright woman.

Figure 21. Dorsal image, hair falls down the back.

Figure 22 is a summary of the Gravity study. In the shroud image, both front and back, the hair falls to the shoulders and down the back. We see that the form of the backside is consistent with that of the upright volunteer (see Figure 14). We see that the feet do not touch the ground. The images of the shroud, both front and back, are consistent with an upright man [17, 18]. With the Gravity study which includes the understanding of masking, we can now better see that the back image has some of the very same three-dimensional qualities as does the frontal image.

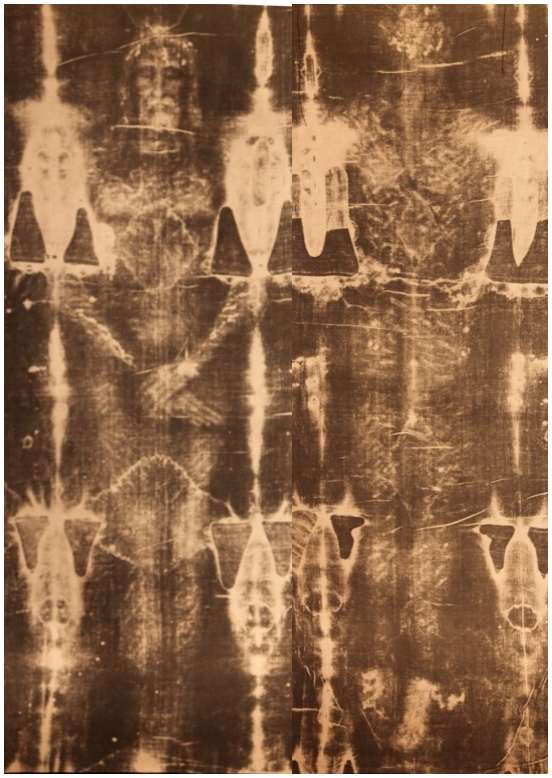

Figure 22. Summary of the gravity study: the shroud image is consistent with that of a man who is upright (back lighting).

What does the effect of gravity on the surface anatomy of the volunteers tell us about the shroud image? (a) We have seen what gravity does to the male volunteer lying on his back. Body weight flattens the backside including the long hair. From the frontal view of the young woman lying supine, we see that the hair falls to the ground. The above outcomes are what we would expect the shroud image to be, considering that the blood marks tell us that a crucified man was laid out on his back. (b) In stark contrast however, the image of the man of the shroud has hair that falls to his shoulders and down his back. The form of the image (excluding the areas masked by blood marks) is consistent with that of an upright man. (c) There is no known natural explanation for the image of the man of the shroud to be in the upright position when the evidence of the blood marks tells us that the man was laid out on his back. Presently there is no known natural mechanism that can explain the body-to-cloth image transfer.

4. DISCUSSION

In keeping with the objective of this paper to decide whether image formation was man-made, natural or supernatural, we can now discuss our results.

Method I. Shroud literature review. In reviewing the shroud literature, we have confirmed that the blood marks are a natural event and that the image is not man-made.

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Method II. Medical observations. In asking the question, was image formation a natural event, the following studies tell us that image formation was probably not a natural event.

(A) Medical forensic evaluation of two blood mark studies. **Blood mark study 1.** The blood mark off the left elbow reveals the following: Image transfer worked in an anterior and posterior direction in relation to the body, but it did not allow lateral body-to-cloth image transfer even though the body was in intimate contact with the cloth as illustrated by the off-image blood mark. Furthermore, there are no lateral images to be found anywhere on this image. If lateral images were included as would be the case in a natural event, the resulting image would not be the fine mirror image that we see but would be distorted. This evidence is not consistent with that of a natural event; however, it suggests that it was intentional.

Blood mark study 2. It is shown from the second blood study that the blood marks in the hair originated from the face. In other words, the direct frontal view of the cheeks and temples of the facial image lies in between the blood marks that were originally on the temples and cheeks of the man draped by the shroud. This study does not allow us to reconcile having the same segment of cloth on two areas of the head simultaneously: First on the temple and cheek areas where it soaked up the blood and second at the sides of the face where the hair is seen. The only way for us to comprehend how the blood marks of the temples and cheeks of the face moved out into the hair is to imagine that the cloth moved into a flattened position during image transfer. But of course the forensic evidence tells us that the cloth was sufficiently wrapped around the face in order to cause the blood transfers that we see. The mechanics of the body-to-cloth image transfer cannot be understood nor defined through our ordinary understanding of space and time. This is probably not a natural event.

(B) ***Medical evaluation of gravity's effect on the surface anatomy of the body***. **Gravity study.** The study of the effect of gravity on body position tells us that the image of the upright man of the shroud is in stark contrast to the blood marks which tell us that a man was laid out on his back. In other words, the blood marks, the **first event**, document some areas of dorsal flattening that took place when the body was laid out in burial. It is the image, the **second event**, which documents the upright man. In postulating any theory of natural image formation, one would have to overcome the anatomical reality of the body having been laid out in a supine position, as is documented by the **first event**, the blood marks. How can a natural mechanism have created the dorsal shroud image, the **second event**, which has the body form of an upright man? For those of us who have attempted to discover a natural event that caused the image, the image of the man lifted up adds another major hurdle to the understanding of the mechanics (body-to-cloth relationship) of the event. Just as was found in **Blood mark study 2**, the mechanics of the body-to-cloth image transfer cannot be understood nor defined through our ordinary understanding of space and time. This is probably not a natural event.

Finally, rigor mortis has often been discussed in relation to the shroud. Rigor mortis is the temporary rigidity of muscles occurring after death. It has no effect on overlying fat and skin. Rigor mortis usually peaks in 4 to 6 hours after death, tapers off thereafter and is mostly gone within 24 hours. It is absent after 36 hours [19]. In rigor mortis the rigidity of the muscles runs on a scale over time from the condition of no rigidity, and increases to full rigidity, then from its peak it scales down through less rigidity that is easy to break, to soft and weak rigidity, to complete resolution. Because of body weight, bodies in autopsy rooms all have some flattening of skin, fat, and muscle resulting in loss of dorsal body form. The force of gravity always dominates. In the case of the man in the shroud who was laid out supine, the blood marks (**first event**) document flattened areas of his backside.

Different types of death and their circumstances greatly alter the onset and longevity of rigor mortis. "Whenever death results from violence preceded by intense physical fatigue (as in the case of those slain at the end of a battle), rigor mortis sets in speedily and disappears quickly. Thus it may last one or two hours only, and even be so slight as to be overlooked" [20]. This statement probably comes very close to describing what happened to the man of the shroud.

5. CONCLUSION

The objective of this paper is to decide if the image forming event was a man-made, a natural or a supernatural event. In reviewing the shroud literature, we have confirmed that the image is not man-made. It is unique. From chemical and medical forensic studies of the blood marks, we know that the body of a scourged and crucified man was laid out supine in this shroud. Blood mark formation occurred when moist blood was transferred from body to cloth by a contact process. It was a natural event. From the data of the two blood studies and the gravity study, we have determined the following about image formation: In **Blood mark study 1**, we found that image formation did not allow lateral body-to-cloth image transfer even though the body was in intimate contact with the cloth. Image formation was probably not natural and was likely intentional. In **Blood mark study 2**, we showed that we do not understand the mechanics of the body-to-cloth position that accounts for the transfer of the facial image from body to cloth. This image transfer cannot be understood nor defined through our ordinary understanding of space and time. It is probably not a natural event. In the third study, the **Gravity study**, we

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found that in stark contrast to what the forensic evaluation of the blood marks reveal -a man laid out supine in burial- the image is consistent with that of a man who is lifted up. Again, just as in **Blood mark study 2**, the mechanics of the body-to-cloth image transfer cannot be understood nor defined through our ordinary understanding of space and time. This is probably not a natural event. In conclusion, the three above studies suggest that a natural event is not the most probable cause of shroud image formation.

Note: The above information clearly increases the statistical probability that this was Jesus' shroud. None of his works can be understood nor defined through our ordinary understanding of space and time. His works were all unique and intended. Furthermore, all that is described in the Gospel of John concerning Jesus' death and resurrection, including the imagery of being lifted up, is seen on the shroud.

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REFERENCES

1. P. Barbet, *A Doctor at Calvary*, Doubleday and Co., Inc., New York, (1953)

2. G. Lavoie, *Unlocking the Secrets of the Shroud*, Thomas More, Allen, Texas, (1998)

3. *Reader's Digest Illustrated Encyclopedic Dictionary*, The Reader's Digest Association, Inc., Pleasantville, New York, page 1661 (1987)

4. Lavoie, *Unlocking the Secrets of the Shroud*, op. cit., 13-29, 89-100

5. J. Heller, and A. Adler, "Blood on the Shroud of Turin". *Applied Optics, pages* 2742-2744 (August 15, 1980)

6. E. Jumper, A. Adler, J. Jackson, S. Pellicori, J. Heller, and J. Druzik, "A Comprehensive Examination of the Various Stains and Images on the Shroud of Turin". *Archaeological Chemistry III*, Editor J. Lambert, ACS Advances in Chemistry, No. 205, pages 447-476 (1984)

7. Ibid., 460

8. J. Heller and A. Adler, "A Chemical Investigation of the Shroud of Turin". *Canadian Society of Forensic Science Journal*, Volume 14, number 3, pages 81-103 (1981)

9. Jumper, Adler, "A Comprehensive Examination of the Various Stains and Images on the Shroud of Turin", op. cit., 447-476

10. Lavoie, *Unlocking the Secrets of the Shroud*, op. cit., 65

11. Heller and Adler, "A Chemical Investigation of the Shroud of Turin", op. cit., 81-103

12. Jumper, Adler, "A Comprehensive Examination of the Various Stains and Images on the Shroud of Turin", op. cit., 450 and 459. (Note: Also see *Unlocking the Secrets of the Shroud*, personal communication with Eric Jumper, page 60)

13. G. Lavoie, B. Lavoie, V. Donovan, and J. Ballas, "Blood on the Shroud of Turin: Part I". *Shroud Spectrum International*, pages 15-19 (June 1983)

14. Lavoie, *Unlocking the Secrets of the Shroud*, op. cit., 79 - 86

15. G. Lavoie, B. Lavoie, and A. Adler. "Blood on the Shroud of Turin: Part III: The Blood on the Face". *Shroud Spectrum International, pages 3-6* (September 1986)

16. G. Lavoie, *Resurrected*, Thomas More, Allen, Texas, pages 111-123. (2000)

17. Ibid., 127-138

18. Lavoie, *Unlocking the Secrets of the Shroud*, op. cit., 127-139

19. C. Henssge, B. Knight, T. Krompecher, B. Madea, and L. Nokes. *The Estimation of the time Since Death in the Early Postmortem Period*, Editor Edward Arnold, London, pages 148-167 (1955)

20. [No authors listed], "Medicolegal contributions of historical interest. The signs of death, second stage. (B). The period of cadaveric rigidity (rigor mortis) from Legal Medicine, Part I. by Charles Meymott Tidy. Published London, 1882". Forensic Science, page 122 (February 2, 1973)

Note: For further information and photographs, see *Unlocking the Secrets of the Shroud* and *Resurrected*, both by Gilbert R. Lavoie, M.D.

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