

BLOOD ON THE SHROUD OF TURIN: PART II*
The Importance of Time in the Transfer of Blood Clots
to Cloth as Distinctive Clot Images

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Introduction

The suggestion that the blood-like marks on the Shroud of Turin were mirror images of blood clots was first made by Barbet¹. Utilizing this information along with the position of the clots, Barbet and others^{2,3} deduced that the cloth covered a man who had died in the vertical position of crucifixion. Recently others^{4,5} have verified that these blood-like marks are indeed blood. Furthermore, the observance of blood on the Shroud of Turin was found to be consistent with the Jewish burial custom of not washing the blood from a victim who had died by violence.⁶

The purpose of this paper is to study blood clots of similar size to the clot images on the head and arms of the Shroud image (specifically the epsilon clot image on the forehead) in order to determine the importance of time and other environmental variables in the transfer of blood clots to cloth as distinctive clot images. Also, if we know the status of the clots when the cloth was placed on the body, we might gain more insight into the burial procedure itself.

Other blood marks, such as the scourge marks and the bloodflow on the dorsal image, fit into a different category regarding their formation and moisture content. Therefore, they should be evaluated separately; they go beyond the scope of this paper.

Definitions

For the purpose of this study, the following definitions are given:

1. Clot formation

Clot formation is a complex biological mechanism that changes liquid blood into a solid, soft, moist jelly-like substance in 5 to 10 minutes after blood is taken into a glass tube from the body. Certain physiological situations can influence this clotting time.

2. Clot retraction

Through a complex biological mechanism, the original size of the clot retracts slightly to a smaller size and the serum (a clear yellow fluid) separates from the clot. This occurs 20 to 45 minutes from the time of blood withdrawal.

* Part I of this two-part study appeared in SPECTRUM #7, June 1983.

3. *Clot drying*

This is a physical mechanism whereby a clot eventually loses its moisture and becomes hard and crust-like. The time in which this takes place is dependent on physical factors such as clot size, temperature, air currents, moisture, etc.

Study

Since the environmental and physiological circumstances which prevailed at the time of death of the man covered by the Shroud are not known, a set of circumstances which should extend the clot drying time was established. A non-absorbent surface, saran wrap, was chosen on which to clot the blood. The size of the blood pools were made to resemble the epsilon image; their depths were made large enough so as not to influence surface drying time. (Preliminary studies on clots of greater depth than those used in these procedures demonstrated similar surface drying times.) These blood pools were allowed to approach room temperature. As a control experiment, blood clots were also placed on the skin of a healthy volunteer.

Standard red-top glass 10cc vacutainer tubes were used to remove blood from a healthy donor. The blood samples were immediately placed on either skin or saran wrap at room temperature (70-80°F, 60-65% relative humidity). Four procedures were performed, differing in the position of the blood, the surface material on which the blood was placed and the moisture added to the blood. These procedures are described as follows:

Procedure 1: Blood on saran wrap—vertical position—no moisture added.

In an attempt to simulate a clotted bloodflow, nine drops of blood were placed on saran wrap, forming a small, slightly angular pool of blood about the same size as the epsilon clot image on the forehead. Eight such pools were created.

One half hour after the clots were placed on the saran wrap, the specimens were placed vertically. In this vertical position, the following observations were made:

- a. The clots retained their shape but could easily be smeared.
- b. Clear serum dripped down from these stable clots from the time they were placed in the vertical position at 30 minutes after blood was drawn: it continued to drip for another 40 minutes.

In order to study the effect of time on the ability of a clot to transfer its image to cloth, samples were taken in the following manner. Eight 3 X 5 cm. pieces of herringbone linen, similar to the Shroud cloth, were taped in succession to each clot in the vertical position starting at ½ hour and continuing at ½ hour intervals until the last one was taped 4 hours after the time of withdrawal of blood. After four hours these clots were then placed in the horizontal position. Twenty-four hours after blood withdrawal, the saran wrap was removed, leaving a

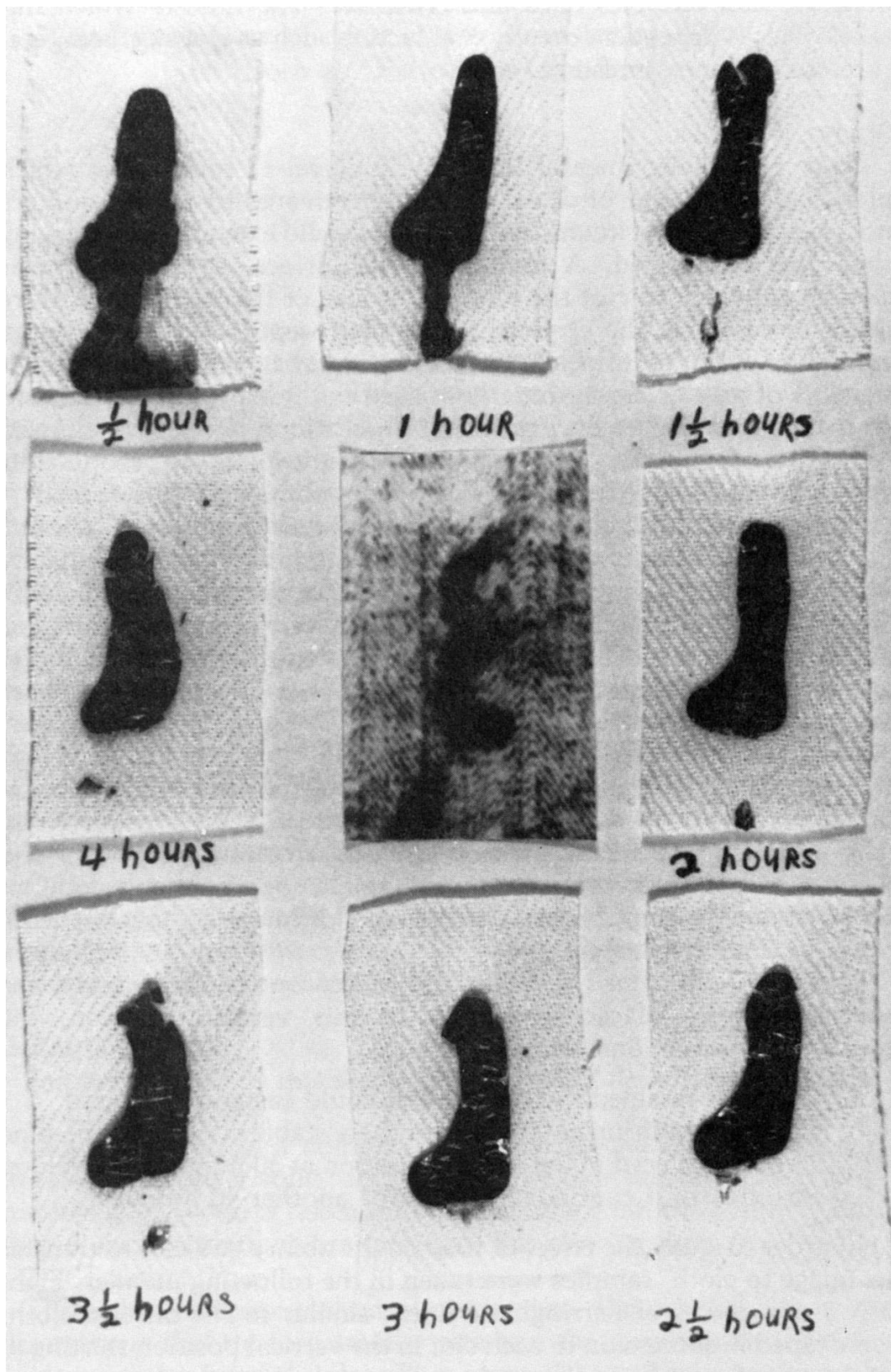


Fig. 1: A crusty dried clot is seen on each cloth sample after 24 hours of drying. Each is compared to the epsilon clot image (center) seen on the forehead of the Shroud image. (Procedure 1)

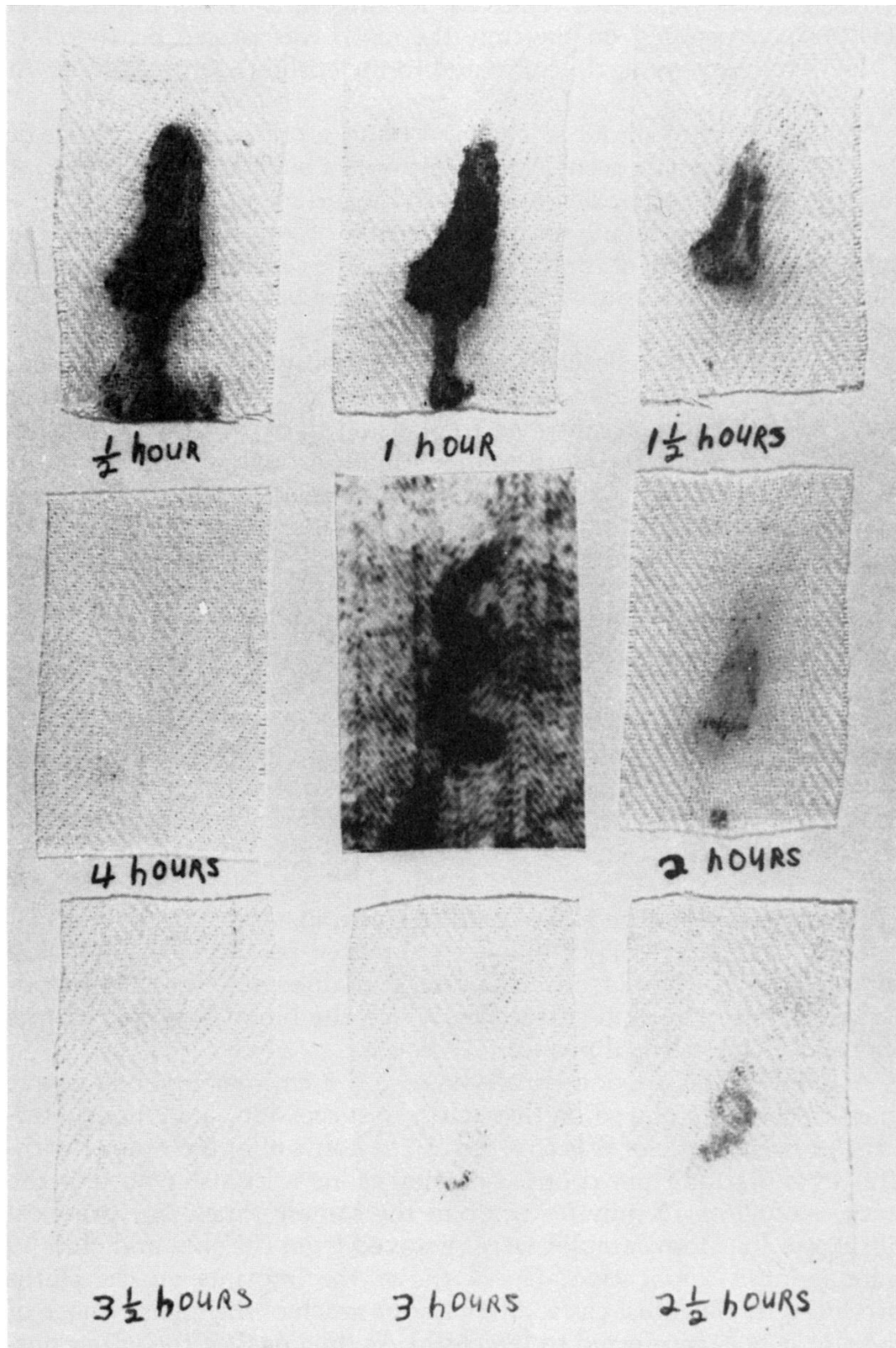


Fig. 2: These are the same cloth samples of Fig. 1, but here the crusty clots have been removed, leaving various size imprints on the samples. Their size depends on the time the cloth was placed on the clot. Again, these samples are compared to the epsilon clot image. (Procedure 1)

crusty dried clot on each cloth sample, as seen in Fig. 1. For comparison purposes, the epsilon image is seen in the center of all Figures.

These crusts were then removed, leaving various size imprints on the cloth, depending on the time the cloth was placed on the clot. These samples were again compared to the epsilon clot image seen in the center of Fig. 2.

Note that from $\frac{1}{2}$ hour to at least 1 hour, a precise mirror image of the clot can be easily seen. After $1\frac{1}{2}$ hours a substantial clot imprint can no longer be seen, due to loss of clot surface moisture.

Therefore, for total mirror image transfer of a clot of this size in the vertical position and at room temperature, the cloth must be placed on the clot within $1\frac{1}{2}$ hours after blood withdrawal.

Procedure 2: Blood on saran wrap—vertical position—moisture added.

To simulate a moist environment, Procedure 1 was repeated except that 3 drops of normal saline were placed on all of the clots 15 minutes prior to each of the $\frac{1}{2}$ hourly sample times throughout the four hour period. However, once the cloth was placed on a clot, no further saline was placed on that clot. The results can be seen in Fig. 3. Here one can see no substantial clot imprint after $2\frac{1}{2}$ hours.

Procedure 3: Blood on saran wrap—horizontal position.

Procedure 1 was repeated, but the blood was left in the horizontal position, allowing the serum to remain around the clot. Mirror images were produced up until $2\frac{1}{2}$ hours. After this time, any semblance of a mirror image was lost. The image outlines were less well-defined than those obtained using Procedures 1 and 2. The difference is attributable to the presence of the serum, which does not drain from the clot in the horizontal position.

Procedure 4: Blood on skin—vertical position—moisture added.

Three rounded pools of blood were placed on the horizontal skin surface of a healthy person. Each pool contained nine drops of blood. After $\frac{1}{2}$ hour, the skin surface on which the blood had clotted was changed to the vertical position.

As done in the previous procedures, 3 X 5 cm. herringbone weave linen cloths were placed on these clots in succession, at $\frac{1}{2}$ hour intervals, until the last clot was covered at $1\frac{1}{2}$ hours after the time of withdrawal of blood. Three drops of normal saline were also placed on the uncovered clots 15 minutes prior to the sample times. For practical purposes, the cloth samples were removed from the skin and clots 10 minutes after application. Fig. 4 shows the imprints on the cloths produced by the moist clots. After 1 hour much of the mirror image of the clot is not transferred to the cloth. As time passes, the upper portion of each clot dries faster than the lower, allowing only the lower portion of the clot to be imprinted. It should be noted that very little serum drained from the clots in the vertical position since the normal skin temperature hastened serum drying.

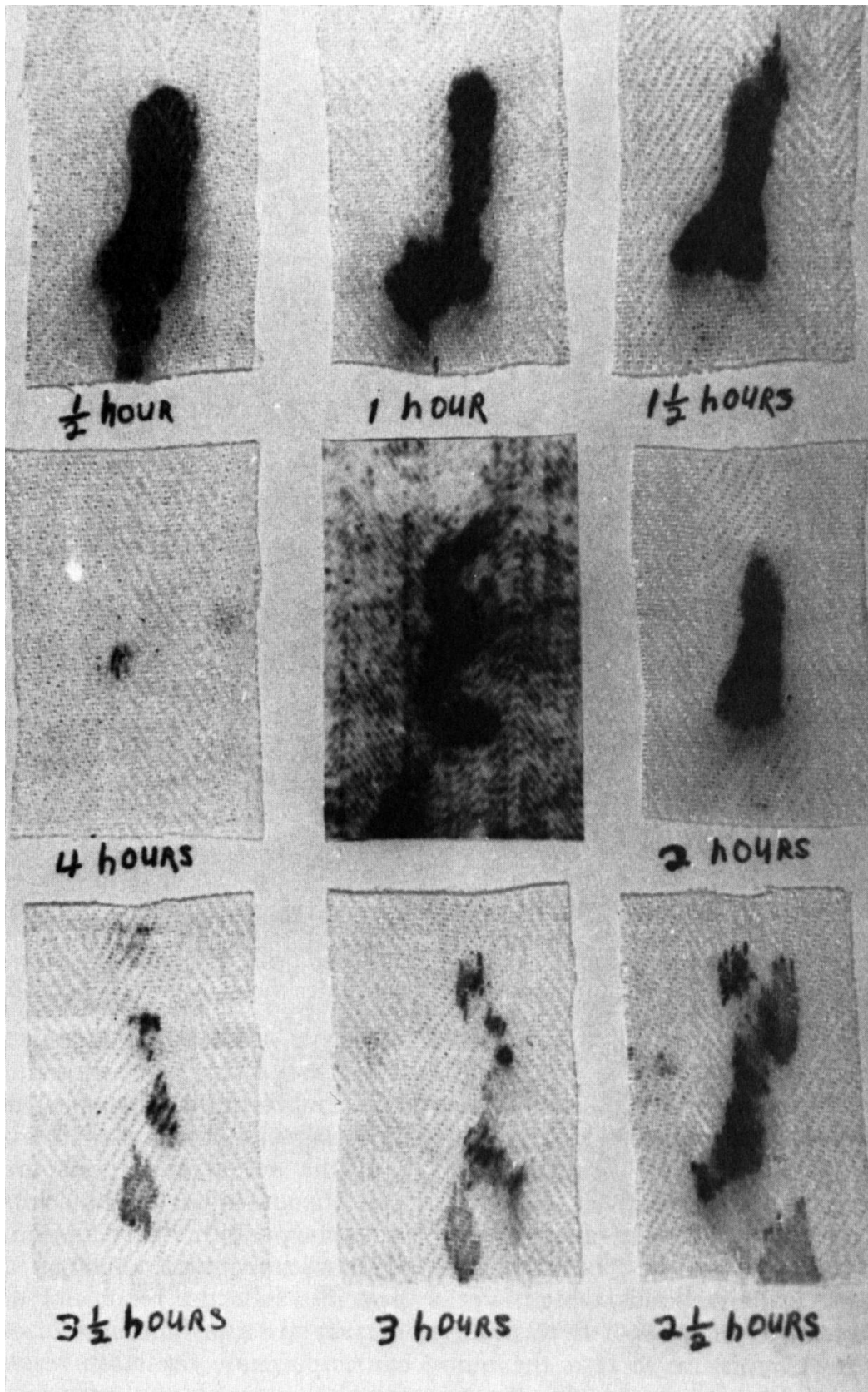


Fig. 3: With the addition of saline, the time-period whereby a substantial clot imprint is transferred from clot to cloth is extended. (Procedure 2)

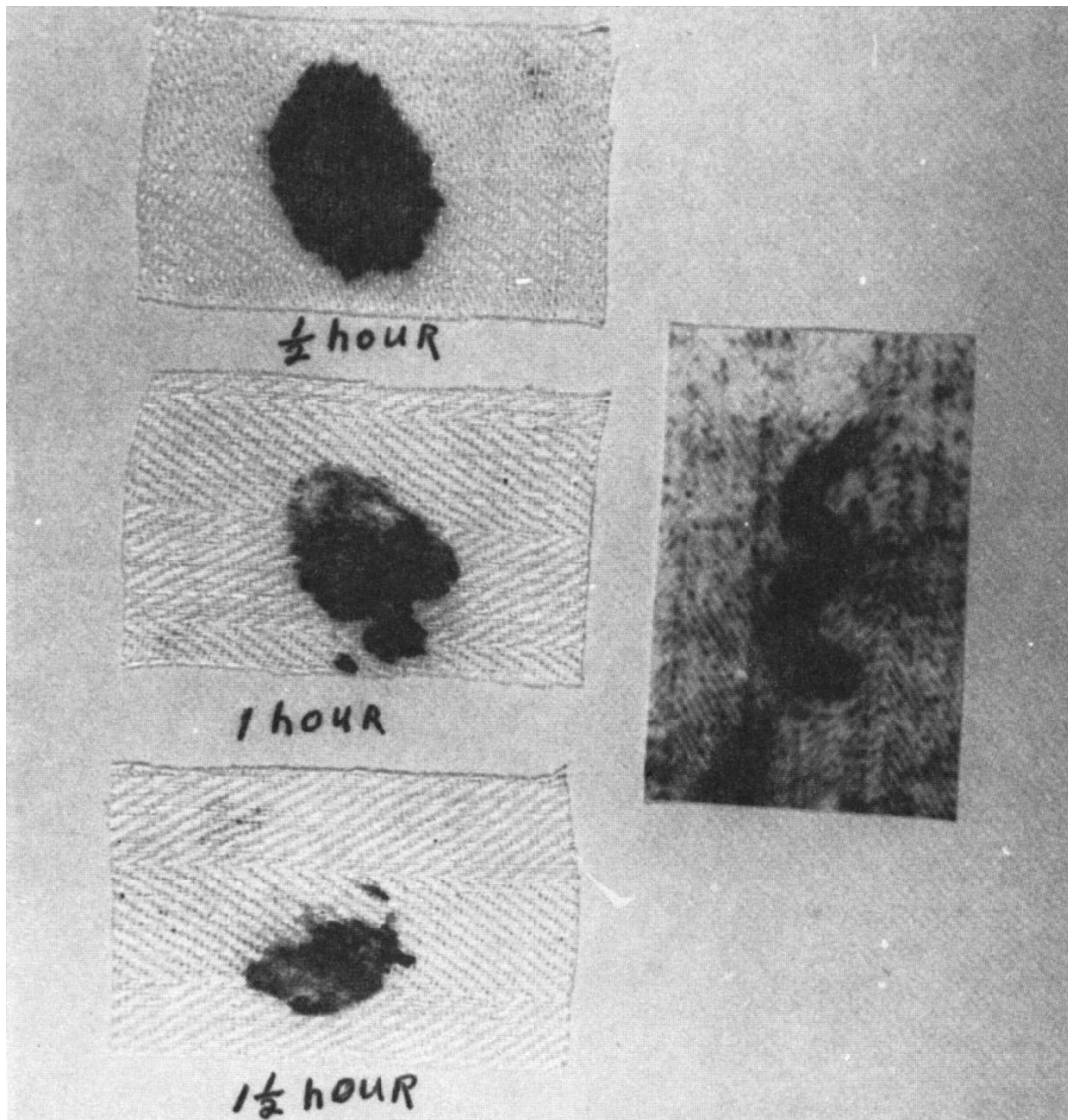


Fig. 4: Clots placed on normal skin and moistened prior to sample time transfer their image to cloth for a period of 1 hour after the withdrawal of blood. (Procedure 4)

Discussion

One could speculate about the crucified man's physiological state (shock, cold clammy skin, prolonged clotting time, increased fibrinolysis, etc.) at the hour of death, but the actual conditions are unknown. However, all evidence on the Shroud indicates that clots did form on the body of a man who died in the position of crucifixion.

Clotting and clot retraction are known to be dependent on a biological time-clock which is fairly specific. In order for a clot to transfer its image to a cloth, the clot must retain a certain amount of surface moisture so that the blood can impregnate the cloth fiber. Understandably this moisture makes the clot susceptible to smearing.

The moisture of the clot itself is dependent on physical parameters such as position, temperature, environmental moisture, etc. The

physical environment at the time of the crucifixion of the man whose image is on the Shroud cannot be reconstructed. However, in the above study, several environmental situations have been constructed that may maximize clot surface moisture, in order to prolong its ability to transfer to cloth. In doing this, we could then estimate a theoretical time frame within which the cloth was probably placed on the body after death.

The epsilon clot image on the Shroud is compared to other clot image transfers. The precision of these transfers is studied in relation to the clots' surface drying time under variable environmental conditions. Clots in the vertical position necessitate different transfer periods, depending on added moisture; with no moisture a fairly good mirror image can be transferred to cloth within 1½ hours after blood withdrawal; with moisture it is within 2½ hours. In the horizontal position the transfer period is 2½ hours, but the images are less well-defined due to the additional moisture in the form of serum which has not drained away.

For a good mirror image transfer to take place, moistened clots on normal skin have to be transferred within 1 hour. It is important to note that after the clots dry, there is no evidence of transfer, even with additional moisture added at a later time (Procedure 2). Therefore, one should not assume that dried clots can be remoistened by environmental moisture and then leave an imprint on cloth.

Many of the blood clot images on the arms and head of the Shroud image are as dark and distinct as the epsilon clot image on the forehead. It is possible that these clots were bloodflows which accumulated on the skin at various times, but one can infer from this time-study that they all had one thing in common: all were actively flowing near the time of death.

As has been demonstrated in this study, in order for the image of the clot to be transferred to cloth, the clot must be moist. In this state, the clot can be very easily disturbed. It is important to note that the clots seen on the Shroud have not been disturbed. Therefore, extreme care had to be taken in the removal of the body from the vertical position to its subsequent horizontal placement in the Shroud. This corresponds to the concern that the Jews had for life's blood, which is the blood that flows from wounds at the time of a violent death.

Conclusion

From this study, one can make the following two conclusions:

1. Assuming environmental conditions similar to those elucidated in this study, for a clot to transfer its mirror image to cloth by contact, a cloth would have to be placed on a moist clot no later than 2½ hours after bleeding stopped.
2. The fact that the clot images seen on the Shroud are intact and well-defined adds further evidence that this burial was performed in accordance with Jewish custom.

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* Or see the expanded version: "The Shroud of Turin: Viewpoint of a Forensic Pathologist", in SPECTRUM #5, Dec. 1982.

† Republished in SPECTRUM #6, Mar. 1982

‡ Republished in SPECTRUM #3, June 1982.