

SOME CONSIDERATIONS ON THE GENESIS
OF THE BODY IMAGE ON THE TURIN SHROUD

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Extensive investigations, especially in recent years, have shown conclusively that the Turin Shroud is not a work of art or a forgery, but is really the shroud of a crucified man. The genesis of the Shroud image, however, remains a "mystery".¹ As I am neither a physicist nor a chemist, I do not intend to propose a detailed scientific explanation. But having collaborated with scientists and scholars for more than thirty years, I want to call attention to some factors in the genesis of the image that have been, for the most part, disregarded. As a basis for these considerations, a summary of the established investigation results will be given.

I. Preliminary remarks

In many respects, the Turin Shroud is an absolutely unique object. No other image is known, on any cloth, grave cloth or art form, like the body image on the Shroud.²

1. No other complete head-to-head, front and back image is known.
2. No other image lacking contour, like the Shroud image, is known.
3. No other image is known that shows such strange gaps: e.g., the neck area, the upper parts of the legs, only one full foot-imprint on the dorsal image.
4. We know of no other "negative" image.

The strangeness of these features is manifest in art copies of the Shroud. All these are clearly contoured and the gaps are filled in. The negative character was not understood,³ and was detected only by the first photograph, in 1898.⁴

5. Three-dimensional information is encoded in the Shroud image. The most significant result of the VP8 study is the apparent global consistency of the three-dimensional reconstruction.⁵
6. Physicians, especially medical examiners, agree that the Shroud is really the shroud of a crucified man, realistic in all the exceptional details of a crucified body.⁶ Not a single mistake has been detected, even by opponents.⁷
7. Blood marks on the Shroud have been proven to be really human blood and various blood derivatives, such as blood serum.⁸ We know of no image painted with blood.

II. Characteristics of the body-only image

The "body-only" image must be distinguished from other areas of the image which are "contaminated" by bloodstains or have been affected by water stains or scorches.

1. Microscopic studies revealed the body-only image to be highly superficial, lying exclusively on the topmost fibrils of the woven material.⁹
2. The body image is made up of yellowed fibrils.¹⁰
3. The degree of yellowing in the body area is the same all over. The areas of the body-only image which appear darker are not due to the degree of yellowing but to the number of yellowed fibrils per unit area.¹¹
4. No painting material has been applied to color the fibrils.¹² The fibrils in the body-only area are not coated by any extraneous material.¹³ The interstices between fibrils are not cemented together.¹⁴
5. The fibrils did not absorb anything. There is no sign of capillary action.¹⁵
6. The yellowed fibrils in the body-only image show a corroded surface.¹⁶ This advanced decomposition of the linen has been shown to be caused by dehydration and oxidation,¹⁷ the common cause for the aging of linen.¹⁸
7. The linen is yellowed also in non-image areas. These surfaces show corrosion, but in a much smaller degree.¹⁹ In other words: The aging of the cloth is more advanced in the body area than in the non-image areas.
8. The body image appears darker where the cloth seems to have been in direct contact with the body.²⁰
9. In a restricted zone around the contact areas, fibrils are yellowed in an imperceptibly decreasing number. The cloth in these zones was relatively close to the body.²¹ In the zones which seem to be produced "by distance", the cause of yellowing is the most difficult problem in Shroud research. The problem will be discussed here.
10. Since it was possible to compute the third dimension of the body by counting the number of yellowed fibrils using a VP8 analyzer, the number of yellowed fibrils per unit area must be in a certain relation to the distance between the cloth and the body.²²

III. Some characteristics of the blood marks

The explanation of the blood marks has important consequences in the explanation of the body image. Scientists are in accord on the subject of the blood marks, so a concise summary should suffice.

1. There are three types of blood marks:
 - a) imprints of wounds; for instance on the wrist;
 - b) blood flows, as along the small of the back and alongside the right heel;

- c) scourge marks, ubiquitous over the torso and legs.²³
2. Blood color is not uniform (as is the body image) but ranges from brown through red to orange, as would be expected in old bloodstains.²⁴
 3. Unlike the body-only image, the fibrils in the blood areas appear to be coated and cemented together.²⁵
 4. Wound images are located at precise and clearly identifiable parts of the anatomy of the Shroud figure.²⁶
 5. The characteristic yellow that forms the body image does not exist underneath the blood marks, nor under the serum which coats many fibrils in the blood areas. Hence the blood must have come onto the cloth before the body image was produced.²⁷ It is obviously impossible to paint blood marks with any accuracy before painting the body image.²⁸
 6. Works of art commonly depict blood flows, while most of the wound imprints on the Shroud come, correctly, from clotted blood.²⁹
 7. The scourge marks appear more sharply in fluorescence than they do by direct observation.³⁰ The serum halos around many wounds and around the scourge marks are perceptible only in fluorescence.³¹ It seems absurd to maintain that significant portions of a painted medieval image can be seen only in fluorescence.
 8. The blood flows seen on the Shroud (e.g., in the small of the back and the area of the feet) went onto the cloth as viscous liquids, penetrating through to the back of the cloth and seeping along the threads.³²
 9. Optical observation of the blood images is in perfect agreement with the results of chemical and immunological investigations; thus confirming that the "blood" on the Shroud is really human blood.
 10. It is beyond every doubt that the blood was deposited onto the Shroud by direct contact with the body of the crucified man.³³ Consequently, it seems evident that the contact between the cloth and the body was also a factor in the genesis of the body image. The blood imprints, however, are positive whereas the body image is negative; therefore the transfer mechanism must have been different in each case.

IV. Hypotheses on the genesis of the Shroud image: A summary

From the beginning of scientific Shroud research, innumerable experiments have been made and widely differing hypotheses have been proposed to explain the genesis of the image.

A) Artifact hypotheses

It is understandable that, at the beginning of modern discussions, around 1900, many authors took it for granted that the

Shroud image was a painting, like so many other medieval "shrouds" in existence; and all the more because the first document explicitly concerned with the Shroud now in Turin was the *Memorandum* of Pierre d'Arcis, bishop of Troyes. This document, undated but attributed to 1389, claims that the Shroud is a forgery, produced by a painter. It is significant that the writer himself never saw the Shroud.³⁴

Modern research has established that the Shroud is certainly not a painting in the ordinary sense of the word. In the last decade, the painting thesis has been modified in several ways: fabrication of the image by inorganic or organic pigment materials; by printing or rubbing or scorching by means of a hot statue or bas-relief; by an intentionally induced chemical alteration. Scientists of STURP have examined all these hypotheses and have shown them to be invalid.³⁵

B) Hypotheses not involving art forms

The anatomical, physiological and pathological perfection of the Shroud image in all its details; the presence of real human blood; the absence of any trace of painting and pigment materials; convinced scientists that the Shroud image must have originated from the body of a crucified man. The genesis of that image, however, is still a "mystery"³⁶—one of the enigmas of that Cloth.³⁷ Over the years, many and varied hypotheses have been proposed.

1. Contact hypothesis

It would seem to be most probable that the image was caused by contact. The medical examiners G. Judica-Cordiglia (Milan), R. Romanese (Turin), and S. Rodante (Syracuse) in particular were among those who made contact experiments. Imprint images approximately comparable to the Shroud image were obtained, but only in small format, especially the face.³⁸ Finally, Judica confessed that results were far from the intention.³⁹ But the lack of distortion on the Shroud image and the areas of decreasing yellowing around the body image pose the greatest difficulties in all theories based exclusively on contact.⁴⁰

2. Vaporograph hypothesis

The first attempt to explain the Shroud image was developed by the biologist P. Vignon and presented to the French Academy in 1902 by the anatomist Y. Delage.⁴¹ The images obtained from the experiments, however, were blurred, in contrast to the distinct Shroud image. In particular, it would seem to be impossible to explain the correct projection of the body, which is the presupposition of its three-dimensional quality.

The Shroud image certainly cannot be explained by either contact or evaporation acting alone. However, this does not exclude the possibility that both these factors could have occurred in the complex genesis of the Shroud image.

3. Some new hypotheses

In view of the insufficiency of the contact and the vaporograph theories, many other hypotheses have been proposed in an attempt to explain the exceptional Shroud image by exceptional physical causes, for example:

- a) a "flash photolysis";
- b) a momentary electric/electronic discharge or thermal radiation;
- c) an event like ball lightning;
- d) an event like the atomic explosion of Hiroshima, where shadowy images of disintegrated persons or things were imprinted on granite.⁴²

All such hypotheses seem to be farfetched, violent, disastrous. Besides the Shroud, there is not the slightest instance that physical forces ever radiated from a corpse, or that any forces working exclusively in a vertical, upward and downward direction, ever produced a correct projection of a body on a cloth. It is probably impossible to test by any realistic experiment.

4. Transcendent hypotheses

Some Christians believe that the mystery of the Shroud image can be explained by the event of the resurrection of Christ.⁴³ Certainly, there are connections between the Shroud and the Christian faith in the resurrection, and the Passion and Easter accounts. The Rev. John A. T. Robinson gave a remarkable lecture on that subject at the Turin Congress of 1978.⁴⁴ The distinct Shroud image indicated that the body remained in this cloth only a short time. And it is inconceivable that the Shroud should have been preserved without the conviction that Jesus had risen. On the other hand, theologically the resurrection as such could hardly have been the cause of all the physical and chemical characteristics on the Shroud. I propose that the unique peculiarities of the Shroud image are to be explained by the unique circumstances of the death and the burial of Jesus, and especially by the empty grave, a fact which has never been disputed, not even by the opponents of the early Christians.

V. Historical considerations on the genesis of the Shroud image

All hypotheses proposed so far lack sufficient consideration of the certain or probable historical circumstances in relation to the genesis of the Shroud image. There are, indeed, very concrete starting points for such considerations: i.e., supposing the Shroud to be that of a crucified man, numerous and weighty circumstances suggest that this man is Jesus of Nazareth.⁴⁵ The following is a concise conspectus of these circumstances:

1. The puncture wounds around the head suggest a crown of thorns, a historical fact understandable only in the context of Jesus' trial.

2. The side wound with a flow of "blood and water", an unexpected event described by St. John.

3. The exceptional burial. Except in times of war or revolts, the burial of an executed person was in conformity with Roman usage as well as with Jewish Law. The bodies of the executed were thrown into pits owned by the court. After the flesh had decomposed, the bones could be delivered to the family.

The Man of the Shroud, however, was given an honorable burial, in a truly exceptional manner, wrapped in a precious cloth with aromatics. Moreover, the lack of distortion of the body image (except for a few small areas) supposes that the cloth lay flat under and over the body, doubled over at the head—a manner unknown in all the world. This can be understood only in the light of a hasty and provisional burial, as suggested in the Gospel accounts of Jesus' burial.

4. The complete lack of any sign of decomposition, leaving the image intact; which supposes that the body lay in the cloth for a very short time. Rigor mortis is still present.⁴⁶

5. The preservation of the Shroud by early Christians, which is incomprehensible unless for extraordinary motives.⁴⁷

6. The geographical provenance of the Shroud:

a) from the Middle East, as shown by traces of a species of cotton cultivated in Syria since ancient times.⁴⁸

b) from the region of Jerusalem, as proven by pollens found on the Shroud. Of the 58 plants identified, the great majority are not European but fall precisely into the peculiar spectrum of vegetation growing in close proximity to Jerusalem.⁴⁹

c) The "dirt" detected in the area of the feet on the dorsal image has recently been identified as aragonite (CaCO_3) which exactly matches samples from tombs near the Damascus Gate.⁵⁰ The Antonia castle, the first Station of the Cross, is near this gate.

7. On the three-dimensional enlargements of the Shroud Face, small objects like "buttons" have been observed on the eyes.⁵¹ Some numismatists assume that these are traces of copper coins minted by Pilate in A.D. 28/29, or 31 at the latest.

8. The resemblance of the Shroud Face to the traditional type of Christ in art, including also a number of unusual details. Since the Shroud is not a work of art, it cannot depend from an iconographical tradition. Hence the dependence must obviously be the reverse.⁵² The number, clearness and manifold connection of these circumstances is overwhelming. It cannot be purely accidental.

At the New London conference (1981), STURP scientists agreed that nothing in all the findings of three years' research contained a single datum that contravened the Gospel accounts. "The stigmata on the body did not follow art or legend. They

were of life.... All in all, it is a startling medical document of what was described so briefly in the Gospels."⁵³ However, the scientists declined to take a position on the identity of the image. They are right; this is not a scientific question.⁵⁴ But the Shroud is not exclusively a subject of (natural) sciences. It is, as well, in the domain of history. An integral solution of the Shroud problems can be achieved only by serious collaboration.

On the other hand, it is an error of many scientists, as well as of many Christian believers, to suppose that the question, 'Who is the man of the Shroud?' is *ipso facto* a religious one. The question is certainly of religious interest, but it is primarily scientific and historical. To believe in Jesus is a further step. It is worthy of note that the first scientist engaged in the Shroud problem, the anatomist Y. Delage, a declared agnostic, clearly distinguished these essentially different aspects. In 1902, before the French Academy, he maintained that, although he was not a believer, he was convinced that Jesus was a historical person and that the Shroud was Jesus' burial cloth.⁵⁵

It is equally noteworthy that, at the same time, the most famous English opponent of authenticity of the Shroud, the Jesuit Herbert Thurston, wrote: "As to the identity of the body whose image is seen upon the shroud, no question is possible.... If this is not the impression of the Body of Christ, it was designed as the counterfeit of that impression. In no other personage since the world began could these details be verified."⁵⁶ Indeed, it would be hard to find a fact more manifest than this.

VI. Historical circumstances in the death and burial of Jesus with regard to the problem of the Shroud image

The historical authority of the Passion narratives—except, perhaps, for some small details that have no bearing on the Shroud problem—is commonly acknowledged today. Therefore, one is justified in taking into account, at least hypothetically, the circumstances of the death and burial of Jesus. Some extraordinary circumstances, for the most part disregarded, may be of importance in explaining the genesis of the Shroud image.

1. Jesus was crucified about three o'clock in the afternoon of the Friday before the Jewish Passover Sabbath. At six o'clock, the beginning of the Sabbath, all activity on Calvary had to be finished and all men had to be in their houses to partake of the paschal supper, beginning about seven o'clock.
2. Therefore, the Jews requested Pilate to have the legs of the crucified broken, so that the bodies could be removed from the crosses and buried in the grave reserved for criminals. But Jesus was already dead, so his legs were not broken, but a soldier pierced his side with a lance.
3. The burial of Jesus was made possible by an extraordinary

intervention: A member of the Sanhedrin went to Pilate and requested the body of the Crucified.⁵⁷

4. All must be done in great haste. Therefore, Joseph of Arimathea gave his own tomb, "because it was nearby".⁵⁸

5. The body was not washed, not only because there was not time, but also in accordance with the Jewish custom in the case of a body stained with "living" blood.⁵⁹

6. The tomb was in a rock outcropping.⁶⁰ The temperature inside about Easter time was about 10° C. Since the body of Jesus was certainly still warm, probably feverish, there was a sharp temperature difference between the body and the interior of the tomb.

7. Various cloths had been procured, including a *sindon*, according to the custom of burying a blood-stained body in a large linen cloth.⁶¹

8. The body remained in the Shroud for a short time only. On the morning after the Sabbath, only the cloths were found in the tomb.

The empty tomb is a historical certainty. The faith of the first Christians was not based on the empty tomb alone. But the beginning of Christian belief—and specifically in Jerusalem, the place of Jesus' death and burial—is inconceivable without the certain knowledge that the tomb was empty. It is remarkable that even the opponents, whose polemics against the Christians began in the very first days, never contested the fact of the empty tomb, although this would have been a devastating argument against the new sect.⁶²

VII. The problem of the genesis of the Shroud image with regard to the circumstances of the death and burial of Jesus

Preliminary note: Realistic experiments to explain the Shroud image are impossible. We cannot crucify someone to experiment on the corpse. Therefore, all explanations of the Shroud image will remain, in one respect or another, hypothetical.

1. The body of the crucified man was not washed. The unwashed body was in direct contact with the Shroud. This is manifest from the blood imprints of the wounds. *The body of Jesus was unwashed when it was folded in the Shroud.*

2. Consequently, the unwashed body was moist with the perspiration of death. Eyewitness accounts from Nazi concentration camps note that prisoners tortured to a death similar to crucifixion, being hung by the wrists with leather thongs, were drenched with sweat from head to foot.⁶³ This bath of sweat might explain why the wounds of the Man of the Shroud were not dry (as some authors suppose), especially since the burial took place shortly after death. *The moistened wound imprints could thus have been transferred onto the cloth.*⁶⁴

3. Sweat contains some aggressive ingredients, such as fatty acids, urea, etc. Therefore, linen drenched by sweat, if not washed, becomes indelibly discolored. Death sweat, and even more, the sweat of a man tortured to death, certainly contains a greater quantity of such ingredients.
4. Deposited in the cool cave shortly after death, the body of Jesus must have radiated warmth and moisture. The damp atmosphere around the body, which was relatively "closed" inside the Shroud, probably intensified the aggressive ingredients of sweat.⁶⁵
5. The Gospels mention "aromata", probably aloes and myrrh. But we are unable to define the manner of application since such aromatics are not mentioned in other Jewish burial texts.
6. In the fabrication process, the linen had possibly been treated with certain essences. This may have prevented the damaging moisture from penetrating into the threads, which show no signs of capillarity.
7. Presumably, the immediate effect of the aggressive sweat ingredients was not the yellowing of the fabric, but rather a damaging of a number of the uppermost fibrils, as can be seen on their corroded surface.⁶⁶ The increase of yellowing may have been a secondary effect with progressive aging. Since the aging process requires time, the thesis of S. Pellicori seems probable: The image developed in the course of time.⁶⁷
8. I believe that the most intricate problem, the decreasing number of yellowed fibrils around the body-cloth contact area, can be explained by the arrangement of the cloth in the grave—whether a preparation bench or an arcosolium tomb. A precise orthogonic projection, that is, an exclusively vertical radiation from the body, such as many authors assume, does not seem to me to be a sine qua non of the three-dimensional quality. Even if the radiation of warmth and moisture proceeded from the body more or less in all directions, the portions of the body around the contact areas were near to the cloth. Consequently, the damaging effect would be more intensive here than in the farther areas, decreasing in proportion to the distance of the cloth from the body.⁶⁸
9. A clear image could remain on the cloth only if the body had been removed before decomposition set in. The tomb of Jesus was found empty "on the third day" (Friday evening to Sunday morning).
10. The result of these considerations is important on two counts. On one hand, the exceptional circumstances of Jesus' death and burial make it possible to explain (at least with great probability) the still-unresolved peculiarities of the Shroud image. On the other hand, this is *ipso facto* a further argument in answer to the second urgent question: Who is the Man of the Shroud?

NOTES AND REFERENCES

ABBREVIATIONS:

Official Acts of the Sindonological Congresses = Turin (1939), (1950), (1978). Bologna (1981).

Spectrum = *Shroud Spectrum International*, Indiana Center for Shroud Studies, Nashville, Ind., USA.

Barbet = P. Barbet, *La Passion de N.S. Jésus-Christ selon le Chirurgien*, Issoudon (1950); English translation, *A Doctor at Calvary*, New York (1963). The original French text is cited.

Bulst = W. Bulst, *Das Grabtuch von Turin: Forschungsberichte and Untersuchungen*, Frankfurt (1959). The English translation, *The Shroud of Turin*, Milwaukee (1957), is cited here.

Examination = E. Jumper, A. Adler, J. Jackson, S. Pellicori, J. Heller & J. Druzik, "A Comprehensive Examination of the Various Stains and Images on the Shroud of Turin", *Archaeological Chemistry III*, American Chemical Society (1984), pp. 447-476.

Heller = J. Heller, *Report on the Shroud of Turin*, Boston (1983).

Heller & Adler = J. Heller & A. Adler, "A Chemical Investigation of the Shroud of Turin", *Canadian Society of Forensics Journal* 14 (1981), pp. 81-103.

Physics = L. Schwalbe & R. Rogers, "Physics and Chemistry of the Shroud of Turin: A Summary of the 1978 Investigation", *Analytica Chimica Acta* 135 (1982), pp. 3-49.

Proceedings = *Proceedings of the 1977 U.S. Conference of Research on the Shroud of Turin*.

Wilson = I. Wilson, *The Turin Shroud*, London (1978).

1. Heller & Adler, p. 100; *Examination*, p. 474; Physics, p. 45; F. Tribbe, "Enigmas of the Shroud of Turin", *Sindon* 33, Centro Internazionale di Sindonologia, Turin (1984), pp. 39-50.

2. *Examination*, p. 474.

3. L. Fossati, "Copies of the Holy Shroud", *Spectrum* 12 (1984), pp. 7-23, *Spectrum* 13 (1984) pp. 23-39.

4. G. Pia, "La Prima Fotografia della S. Sindone", *Sindon* 5 (1961), pp. 33-58; J. Walsh, *The Shroud*, New York (1963), pp. 12-37.

5. *Proceedings*, pp. 74-94; Physics, p. 7ff.; J. Jackson, E. Jumper & W. Ercoline, "Three Dimensional Characteristic of the Shroud Image", IEEE 1982 *Proceedings of the International Conference on Cybernetics and Society*, pp. 559-575; Heller, pp. 20-40. It should be noted that already in 1902 Vignon had perceived that the image densities appeared to vary inversely with the presumed cloth-body distance.

6. Some renowned physicians who published on the Shroud: Y. Delage (anatomist), Paris; P. Barbet (surgeon), Paris; P. Scotti (physician and chemist), Genoa; L. Gedda, Milan; D. Willis, Litton, England; H. Moedder (radiologist), Cologne; J. Heller (physician and biophysicist), Connecticut. Medical examiners include: G. Judica-Cordiglia, Milan; T. Lerga-Luna, Saragossa; L. Lopez-Gomez, Valencia; R. Romanese, Turin; P. Baima Bollone, Turin; R. Bucklin, California; F. Zugibe, New York.

7. E.g., S. Schafersman claimed to have found an anatomical error on the Shroud, pointing out that the right arm appears too long (cf. W. Meacham, "The Authentication of the Turin Shroud", *Current Anthropology* 24 (1983), p. 301. However, forty years ago Barbet had already shown that this seeming anomaly is precisely correct. The cloth at that place must have been tucked between the arm and the side, otherwise it would not have touched the lance-wound bloodstain (Barbet, p. 153).

8. Barbet, pp. 30-33, 37-45; *Examination*, pp. 458-462; *Physics*, pp. 36-40; Heller & Adler, pp. 87-93; Baima Bollone, *Sindon* 30 (1981), pp. 5-8, *Sindon* 31 (1982), pp. 5-9, *Sindon* 33 (1983), pp. 9-13, *Spectrum* 11 (1984), pp. 2-5, and *Spectrum* 13 (1984), pp. 2-8.

9. *Physics*, pp. 11, 31; *Examination*, p. 450.

10. It is interesting that prior to the 1978 testing, the color of the image was described as a monotonic sepia. However, the perceptual evaluation of color is extremely sensitive to lighting and the distance of the observer from the cloth. It is possible that under low color temperature lighting, the color could be mistaken for sepia. In white light, the color of the body-only image is yellow. *Examination*, p. 453; *Physics*, p. 31; Heller & Adler, pp. 82, 85.

11. *Physics*, p. 11; *Examination*, p. 451.

12. *Physics*, pp. 10-24, 31, 44; *Examination*, pp. 453-455.

13. *Physics*, pp. 12, 14; *Examination*, p. 454.

14. *Physics*, p. 11; *Examination*, p. 451; Heller & Adler, p. 99.

15. *Physics*, p. 11; *Examination*, p. 470; Heller & Adler, p. 99.

16. *Examination*, p. 454.

17. *Examination*, p. 456.

18. *Examination*, p. 456.

19. *Examination*, pp. 464, 467; Heller & Adler, p. 98.

20. *Examination*, p. 451.

21. *Examination*, p. 470.

22. *Physics*, p. 7; *Examination*, p. 470.

23. *Examination*, p. 458.

24. *Examination*, p. 459.

25. *Examination*, pp. 459, 461.

26. *Physics*, p. 40; *Examination*, p. 459.

27. *Examination*, pp. 460, 470f; Heller & Adler, p. 91.

28. *Physics*, p. 40.

29. Heller & Adler, pp. 90, 96; Barbet, p. 29f.

30. *Examination*, p. 460.

31. Heller & Adler, p. 96.

32. *Physics*, p. 36; *Examination*, p. 458f.

33. *Examination*, p. 470; Heller & Adler, p. 96.

34. In his *Memorandum*, Bishop Pierre d'Arcis complained to the Pope that the canons concealed the Shroud from him. They had good reason to, since the Bishop had appealed to both King and Pope in his efforts to obtain the Shroud for a church in his cathedral town (Bulst, pp. 6-14).

35. *Physics*, pp. 9-32.

36. Heller & Adler, p. 100; *Physics*, p. 45.

37. F. C. Tribbe, *Sindon* 33 (1984), pp. 39-49.

38. Turin (1939), pp. 37-62, fig. 19-27.

39. Turin (1950), p. 23.

40. The pharmacist J. Volckringer described astonishing negative images produced by plants placed between the pages of a book. Barbet (pp. 48-51, fig. 22 & 23) notes that these plants had lain in the book for about a hundred years. According to other observations, such images of plants appeared after a relatively short time. In any case, there are important differences between plants lying in a book and a body wrapped in a linen cloth, especially in relation to the problem of the Shroud image's three-dimensionality.

41. Y. Delage, "*Le Linceul de Turin*", *Revue Scientifique*, 4 ser., 17 (1902), pp. 683-687; Walsh, *l.c.*, pp. 92-111.

42. Cf. Wilson, pp. 208-212; F. Tribbe, *Portrait of Jesus?*, New York (1983), pp. 205-213. Also some of the arguments in *Physics* (p. 24ff.) are to be regarded here.

43. A complete and detailed survey of the hypotheses on the genesis of the Shroud image, especially hypotheses that pertain to the resurrection of Christ, has been proposed by K. Stevenson & G. Habermas in *Verdict on the Shroud*, Ann Arbor (1981), pp. 143-200. The hypotheses of an instantaneous heating radiation as the cause of the Shroud image are generally founded on the similarity of the body-only image to the yellow of the light scorch marks from the 1532 fire. But recent investigations have shown that this similarity exists only in visible light. The yellow of the body image and that of the scorch marks differ essentially under fluorescence (*Examination*, pp. 455f.). The explanation of this partial similarity is not difficult. The yellowing of linen is a characteristic aging effect. It can be accelerated by moderate (non-destructive) heating. Heat, of course, is not the sole cause of aging.

44. Turin (1978), pp. 265-276.

45. P. Vignon, *Le Suaire de Turin*, Paris (1939), p. 61ff.; G. Judica-Cordiglia, *L'Uomo della Sindone è it Cristo?*, Milan (1941); Barbet, *passim*; Bulst, pp. 77-101; E. Wuenschel, *Self-Portrait of Christ*, New York (1954); Wilson, p. 31ff.; Stevenson & Habermas, *l.c.*, p. 33ff.; T. Zeuli, "Jesus Christ Is the Man of the Shroud", *Spectrum* 10 (1984), pp. 29-33; Tribbe, *l.c.*, p. 81ff.; F. Zugibe, *The Cross and the Shroud*, New York (1982), *passim*. It is remarkable that in the long discussions on the Shroud before the recent scientific research, no one, neither advocate nor opponent of authenticity, ever raised doubts about whether the Shroud represents Jesus.

46. G. Caselli, Turin (1939), p. 21f.; Barbet, p. 205; Bulst, pp. 55, 107; Zugibe, *l.c.*, pp. 148-153; Bucklin, *Spectrum* 14 (1985), pp. 2-6.

47. Bulst, p. 107.

48. G. Raes, "Rapport d'Analyse du Tissu", *La S. Sindone: Ricerche e Studi della Commissione di Esperti nominata dall'Arcivescovo di Torino...nel 1969*, Turin (1976), pp. 79-85.

49. M. Frei, "Il Passato della Sindone alla Luce della Palinologia", Turin (1978), pp. 191-200, photos pp. 370-378; "Identificazione e Classificazione dei nuovi Pollini della Sindone", Bologna (1981), pp. 277-284; "Nine Years of Palinological Studies on the Shroud", *Spectrum* 3 (1982), pp. 2-7; Bulst, "The Pollen Grains on the Shroud of Turin", *Spectrum* 10 (1984), pp. 20-28.

50. *Proceedings*, p. 89f.

51. F. Filas, "The Dating of the Shroud of Turin from Coins of Pontius Pilate", MS. (1980); A. Whanger & M. Whanger, "Polarized Image Overlay Technique: A New Image Comparison Method and Its Application", *Applied Optics* 24 (1985), p. 766; R. Haralick, *Analysis of Digital Images of the Shroud of Turin*, Virginia Polytechnic Institute and State University (1983); N. Heutger, "Prokuratormiizen auf dem Turiner Grablinnen", *Biblische Zeitschrift* 28 (1985), p. 105f.

52. Vignon, *l.c.*, pp. 115-191; Bulst, p. 38ff.; Wilson, p. 78ff.; G. Egger, "L'Icona del Pantocrator e la Sindone", Turin (1978), p. 91ff.; H. Pfeiffer, "The Shroud of Turin and the Face of Christ in Paleochristian...Art", *Spectrum* 9 (1983), pp. 7-20, *Spectrum* 10 (1984), pp. 2-19.

53. Heller, p. 217.

54. Heller, p. 216; *Examination*, p. 474.

55. Delage, *l.c.*, pp. 638-687; Walsh, *l.c.*, pp. 92-111.

56. H. Thurston in *The Month* 110 (1903), p. 19f. Cf. Wilson, p. 37f.

57. Matthew 27:57ff. par. Mark 15:45, (Pilate) gave the body of Jesus to Joseph.

58. John 19:42.

59. B. Lavoie, G. Lavoie, D. Klutstein & J. Regan, "In Accordance with the Jewish Burial Custom the Body of Jesus Was Not Washed", *Sindon* 30 (1981), pp. 19-29; *Spectrum* 3 (1982), pp. 8-17.

60. Matthew 27:60, par.

61. Bulst, pp. 82-88.

62. Still worth reading is the fascinating (though not strictly scientific) book, *Who Moved the Stone?* by F. Morrison, London (1949).

63. Barbet, p. 96f. It is noteworthy for our context that even in winter, persons tortured to death had temperatures above normal.

64. Barbet, p. 39ff.

65. Barbet, p. 39ff.; *Physics*, p. 33f. (Pellicori). Heller & Adler (p. 95) emphasize that now, after two millennia, such acids, fats or oils, for instance, will not necessarily be detected.

66. It must be underlined that the similarity of the yellow of the body-only image to the yellow of the light scorch marks from the 1532 fire does not prove that the body image was produced by heat. The similarity is only partial. Cf. n. 43.

67. *Physics*, p. 33 (Pellicori).

68. J. German has suggested that the body image density might vary in proportion to the time of cloth-body contact. He assumes that the Shroud was originally rather stiff, either from pressing or possible starching. When it was laid over the body, it initially contacted only the high parts of the profile. Over time, water vapor either from the body tissues or from the damp atmosphere of the tomb was slowly absorbed into the cloth, causing it to gradually lose its stiffness and droop, much like a starched shirt on a damp day. Eventually, the cloth touched all parts of the body where an image is observed (*Physics*, p. 34). This interesting explanation, however, does not seem to be acceptable for the underneath part of the cloth, which lay directly on the stone.