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A SCIENTIFIC PROPOSAL FOR STUDYING THE SHROUD OF TURIN

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Historical Perspectives

There has been increasing interest during the entire twentieth century in using the techniques of science to study the Shroud. This interest is the result of a natural and healthy disposition of our modern, technically sophisticated world which, in addition to asking important religious and philosophical questions of meaning, asks complementary questions of scientific content.

Modern scientific investigations of the Shroud can be said to have begun in May 1898, when the Italian photographer, Secondo Pia, took the first photographs of the Shroud. For the first time, scientific information resident in the image discolorations was extracted from the Shroud and recorded onto film. This meant that the Shroud image patterns could be studied anywhere in the world without the necessity of making the Shroud available for direct examination. Better photographs were later made by the Italian photographer, Giuseppe Enrie in 1931. Generally speaking, initial studies were made by private individuals, for example Paul Vignon and Pierre Barbet in France. But in the 1950s, as individual studies began to mature, the International Center of Sindonology in Turin (followed by other groups) began to bring individual efforts into open and formal communication. In 1969, and again in 1973, a scientific commission was appointed to examine the Shroud using the techniques of science. The importance of these studies cannot be overstated; scientific investigations of the Shroud had matured to the point where a collective body, rather than independent individuals, sought to extract and analyze various scientific information from the Shroud. The members of the commission, however, published their results as essentially independent papers comprising a single report. In 1978, along with other investigators, a new group from the United States known as STURP was allowed to examine the Shroud. Like the 1969/1973 Commission, STURP conducted its investigations as a multidisciplinary group. But unlike previous investigations, all publications were refereed first by peer members of STURP and then by outside representatives of authoritative science via the normal peer-review process of established and

* Board of Directors, STURP (President, Vice-President, Secretary).

recognized scientific journals. This has afforded the international scientific community with the opportunity to critically examine and evaluate the Shroud as a scientific object. In other words, the data gathered in 1978 has become the property of mankind through its permanent, globally disseminated and respected scientific literature. This is an important and essential step for twentieth century society to evaluate the proper philosophical and religious significance of the Turin Shroud.

Thus, scientific research on the Shroud has been continuously active and maturing since 1898. The trend has been to move from individualistic to multidisciplinary team efforts with a peer-review character, important as a check against error in scientific research. This has been nourished by an ever-increasing scientific awareness and interest by the general public to its present worldwide proportions (most of which seems to have occurred over the past six years since the 1978 Exposition).

A review of scientific articles and papers from 1898 to the present shows significant increases in new scientific knowledge concerning the Shroud following each examination. For example, the photographic imagery of 1898 showed the positive/negative characteristic of the Shroud image. The excellent photographs by Enrie in 1931 served as the basis for the well-known medical studies of Barbet. The 1969/1973 examination indicated that the Shroud image resided on the surface of the cloth and the removed fragments allowed important textile evaluations to be performed. Finally, the 1978 examinations determined the first-order chemistry of the body and blood images. Although considerably more knowledge has been acquired from the various examinations of the Shroud beginning in 1898, these examples illustrate how each occasion of scientific examination has increased the body of knowledge concerning the Shroud. Thus, it can be anticipated that such would be the case in any future examination, such as the one we now describe.

STURP Proposal

On October 16, 1984, The Shroud of Turin Research Project, Inc. (STURP) formally submitted a proposal to the proper church authorities for performing additional studies on the Shroud. STURP presented and regards this proposal as a logical and natural follow-up to the work it was allowed to begin in 1978.

In receiving this proposal, the church authorities made it clear that an answer will be given at the proper time after proper evaluation, and that this does not preclude taking into consideration other proposals by responsible scientists, independent or coordinated; a position with which STURP fully agrees. Such proposals should be presented directly to the proper church authorities.

In announcing this initiative, we want also to make clear that STURP accepts the decisions of the church authorities, owners, and custodians of the Shroud, to accept or reject this proposal presented to them prior to the publication of this announcement. We note further that STURP reserves the right to amend the contents of this proposal at any time. STURP will, of course, inform the church authorities of such changes, but regrettably will not be able to do so to the general public owing to the lack of a responsive editorial format; this paper therefore may not accurately describe the STURP proposal as it will eventually evolve in its particular details.

This proposal is the product of nearly, six years of intense work by members of STURP. Following the 1978 examination, STURP members met at six-month intervals over a period of three years to exchange information, data and results, as well as to evaluate each other's scientific research. Representatives of other Shroud groups were invited to some of the major workshops. During this period, papers detailing specific techniques and results were submitted and published in scientific journals. In May 1981, STURP, as a courtesy, formally presented a summary of results to His Eminence, Cardinal Archbishop Ballestrero. On May 13, 1981, STURP was also to make a similar presentation to the Pope at a brief meeting following his usual Wednesday audience in St. Peter's Square; but this was rendered impossible by the most regrettable attack on the Holy Father. Two days later, STURP gave a similar review of its studies to King Umberto, then owner of the Shroud.

In October 1981, STURP made a formal public presentation of its results at a symposium held in Connecticut (to which representatives of the British Society, Turin Centro, and Roman Centro were invited; and some made presentations of their own). During the next year-and-a-half, STURP published summary/status papers of its investigations in scientific journals. Since 1978, members of STURP have also made over 1000 invited scientific presentations to interested universities, laboratories, civic and church groups (of all denominations), scientific/engineering societies, industry, and organized Shroud groups. These Scientific Presentations have been given in many countries such as the United States, Italy (Turin and Rome), England, Portugal (to King Umberto), and Canada.

In July 1983 and again in October 1983, STURP members convened to assess the status of their previous five years of study. It was determined that, considering the 1978 examination was only five days long, the project was successful, but in a preliminary sense. Although many scientific papers had been published by STURP, it was recognized that a responsible, conclusive report could not be issued without further examination of the Shroud by STURP. Critical, unresolved issues were first discussed and then experiments proposed which could address them. It was then decided that STURP should again petition the

church authorities for access to the Shroud to perform these experiments so as to responsibly complete the studies begun in 1978. This proposal is the result of thirteen months of preparation and consolidation of these ideas. STURP has also sought out additional investigators, many among the best in their fields, to perform the proposed program.

The proposal preparation process has changed significantly the constituency of STURP. For example, approximately 53% of the STURP membership consists of new scientists, leaving a slightly lower fraction of 47% comprising past members, thereby providing a complementary mix of experienced and new personnel. The educational level within STURP consists of approximately 53% Ph.D. (or M.D.), and 35% M.S. degrees, covering such diverse scientific disciplines as chemistry, biology, microbiology, physics, forensic medicine, and computer science. Most members are employed professionally in recognized scientific institutions including universities, national laboratories, scientific industries, and conservation/museum centers.

Description of STURP

Before discussing the STURP proposal, it is perhaps appropriate to discuss STURP's approach to Shroud research as well as how STURP is organized. In certain respects, STURP's philosophy and structure are unique in science and this is directly related to the uniqueness of the object being studied, and likewise to STURP's desire to conduct a scientifically responsible series of interrelated studies on a complex and sometimes emotional subject.

STURP has evolved into a formal, multidisciplinary relationship between individuals who are interested in performing scientific studies on the Shroud of Turin. The single goal of STURP is to perform and enter those studies into the permanent scientific literature of mankind. While everyone in STURP is free to have whatever religious opinion of the Shroud he or she wishes, the sole intent of STURP is to conduct unbiased scientific investigations of the Shroud as per classical scientific method.

The STURP relationship is based on a formal agreement which is voluntarily executed by all its members. Every STURP investigator will have entered into this agreement prior to any investigation of the Shroud which might be permitted. STURP believes that the multidisciplinary approach is the best vehicle, by virtue of internal collaboration balanced with peer-interaction and internal criticism, for achieving responsible scientific inquiry regarding the 'Shroud. To achieve such a level of coordination, given the strong public interest in the Shroud and our desire to have a responsible group, an agreement understood in writing by all members is believed necessary. This agreement covers basic issues which collectively are intended to provide for responsible investigations of the Shroud and responsible reporting of those investigations. These issues covered in the agreement are:

1. *Membership* — The first clause of the agreement defines that a member of STURP is anyone who has executed the basic STURP Agreement Form (for full membership) and which is subsequently approved in writing by the President of STURP, acting on behalf of the Board of Directors. (There is also an affiliate or supporting membership status in STURP which is not the same as, the full membership status discussed here.) It is important to recognize that STURP is not a society but a project dedicated solely to, the scientific study of certain aspects of the Shroud. Accordingly, membership is restricted to those individuals who, by virtue of special qualifications, are able to fulfill specific functions (e.g. scientific, administrative, logistic, etc.) which support directly the basic STURP mission. Accordingly, STURP must necessarily be selective in its membership, and all members are required to execute the basic STURP agreement. (It should therefore be noted that the membership of STURP may change according to specific requirements.)

2. *Duties* — It is important to note that all members of STURP are volunteers and none is paid a salary of any kind by STURP for his/her research efforts. Indeed, STURP is registered in the United States as a non-profit corporation. All work is performed primarily on personal time. Thus, all members are involved because of a genuine interest in the Turin Shroud. Accordingly, in clause 2, .STURP acknowledges that every member is free to proceed with his or her studies to the extent permitted by constraints of family, job, and life-style. Thus, it should be anticipated that the proposed studies will take longer than if performed professionally as a salaried research program.

3. *Academic Freedom* — Every member of STURP is recognized as being able to pursue scientific truth as he or she sees it. No one in STURP or STURP collectively will interfere with this fundamental right of all members. However, this does not mean that, as a scientist, one does not have the responsibility of being critical of or to disagree with the conclusions of another insofar as correct scientific understanding is the goal.

4. *Data Sharing* — The STURP agreement provides for a communal as well as an individual access to all STURP generated data. This is a manifestation of the internal collaborative quality within STURP and is the basis for important exchanges of ideas and information.

5. *Confidentiality* — In general, STURP wishes to conduct its studies in an atmosphere of openness and is willing to cooperate technically with other groups (or individuals) which might be allowed to examine the Shroud. Indeed, we have indicated ways of cooperation in the proposal. However, STURP also recognizes its responsibility to the custodians of the Shroud, the interested public, the scientific community, and its own membership to insure that only responsible and accurate

information about the Shroud is released in the name of STURP. Accordingly, the STURP agreement includes a requirement of confidentiality. It should be noted that confidentiality pertaining to any area of research can be removed by STURP (e.g. in order to participate with other responsible groups or individuals as discussed below), and the entire confidentiality clause expires completely after three years from the date of the next examination of the Shroud by STURP. It is not the intent of the confidentiality clause to restrict Academic Freedom (which is guaranteed in another clause of the agreement) nor to be an impediment to creative research or the dissemination of that research. Rather, the intent is merely to coordinate and regulate the manner in which STURP-sponsored studies are placed into the public domain in the name of STURP. It is noteworthy that most of STURP's previous studies (see reference list at the end of this paper) were performed under a similar condition of confidentiality (which expired after three years in October 1981).

Confidentiality impacts public relations and publication procedures. Accordingly, it is appropriate to discuss how STURP intends to manage these public information channels.

a. *Public Relations* — So as not to allow misinformation concerning STURP's research program to be disseminated to the general public, all members of STURP are required not to speak as the official STURP spokesperson. Any member of STURP, however, is free to openly discuss personal views or opinions concerning the Shroud as long as these are not presented as coming officially from STURP or do not conflict with existing confidentiality requirements. The only member of STURP who will speak officially in the name of the group is the public relations coordinator who serves at the pleasure of the Board of Directors of STURP. The reason for this policy is to ensure that the scientific activities of STURP are presented fairly, accurately, and responsibly to the general public and scientific community which STURP regards as the proper and rightful recipients of all STURP studies.

b. *Publication* — The internationally accepted and responsible format for placing scientific information into the public domain is the peer-reviewed scientific journal. It is intended that this procedure be continued by STURP. However, since STURP is a multidisciplinary research project, each scientific paper from the STURP membership will be peer-reviewed by, STURP prior to its being submitted to a journal where the paper will be reviewed a second time. This review process is intended to help the author(s) achieve the highest level of scientific excellence and to bring critical issues into focus. In no case will any paper be censored by STURP (because of academic freedom); however, STURP will reserve the right not to sponsor or endorse the paper if irreconcilable differences arise. In that case, such a lack of sponsorship

will be made clear in the publication; otherwise the paper will bear the name of STURP. Thus, STURP will attempt to ensure that only well-thought-out studies will be published in its name so as to make a contribution to the credibility and excellence of studies regarding the Shroud.

Questions Addressed by Proposal

STURP recognizes that other groups or individuals may wish to submit proposals of their own to the church authorities. A detailed discussion of the technical aspects of the STURP proposal is beyond the scope of this paper; however, in order to provide some input to those who may be planning such proposals or who may wish to collaborate with STURP, we think it most meaningful to provide a list of questions which the STURP proposal has been designed to address. It is not suggested that these questions exhaust all those which may be asked about the Shroud in light of current knowledge, but they do represent those which STURP thinks are fundamental in a physical/ chemical sense and which STURP believes it has the resources (personnel and experimental) to address.

The 85 questions can be arranged in three broad categories: conservation, authenticity, and image formation. At the beginning of each question is a code, based on the first letter of each category, which designates the category(s) to which the question belongs.

Of the 85 questions, 32 (38%) have conservation implications, 39 (46%) authenticity, and 51 (60 %) image formation, It is likely that additional questions which can be addressed by the data would become apparent after the proposed examination is conducted. It should be noted that many of the questions are addressed by more than one examination procedure, thereby providing an internal corroboration character to the proposed studies. It should be further noted that many of the proposed examination techniques are different from those used during the 1978 examination.

1. C What is the pH of the Shroud and how does it affect aging of the Shroud?

2. C What is the tensile strength of the Shroud threads?

3. C What effect do the old mends, patches, have on the state of the Shroud?

4. C What effect do the charred regions have on catalyzing further cellulose degradation?

5. C How adequate are the current storage conditions for the Shroud?

6. C What are the effects of humidity on the Shroud?

7. C What are the degradation effects in the waterstain regions?

8. C What are the effects of Turin's urban industrial air pollution environment upon the Shroud and image?

9. C What are the effects of inorganic elements, known since 1978 to exist on the Shroud, upon the degradation rate of the Shroud cloth?

10. C What are the effects of creases on the integrity of the blood images?

11. C What is (are) the cause(s) of the wrinkle structures on the Shroud?

12. C What is the temperature distribution of the Shroud while it is stored and being unrolled?

13. C Are there any conservation issues regarding possible microbiological degradation of the Shroud fabric?

14. C What varieties of dust (including pollens) and small animalicula exist on the Shroud?

15. C Can the Shroud image be restored by computer analysis to the original state?

16. C How do chemical/physical environments-past, present, and future-influence the spectra of the body image?

17. C What predictions can be made from the spectra relative to conservation issues?

18. C Can we obtain absolute spectra on defined areas to serve as reference data to track temporal degradation effects in the future?

19. C What are the microscopic effects of stress on the Shroud fabric, particularly on the foldmarks?

20. C Is sodium chloride responsible for helping to preserve the Shroud from deterioration?

21. CA What was the relative effect of the 1532 fire with respect to natural aging discolorations?

22. CA What further discoloration (degradation) effects can be expected on the Shroud?

23. CA What is the fibre content of the Shroud (e.g. linen, cotton, etc.)?

24. CA How old is the Shroud?

25. CA What is the structure of the edges of the Shroud?

26. A What is the nature of the features in the eye region which have been suggested to be Pilate Lepton coin inscriptions?

27. A Are there any subtle discoloration features which might be associated with historical display or storage configurations (e.g. an oval around the face as suggested in the Mandylion hypothesis)?

28. A Are there foldmarks on the Shroud which are consistent with its being once folded as the Mandylion?

29. A What folding patterns can be seen on the Shroud?

30. A Is the hypothesis that the image is that of Jesus consistent with what is observed on the Shroud?

31. A In what climate was the flax for the Shroud grown (i.e. Europe or Middle East)?

32. A What is the structure of the seam joining the alleged "side- strip" to the Shroud?

33. A Does the side-strip represent a separate piece of material sewn onto the Shroud or a continuation of the Shroud with a seam being an added artifact?

34. A What is the three-dimensional structure of various foldmarks found on the Shroud?

35. AI Has the body image always been visible or did it develop with time against a more slowly developing cloth background discoloration?

36. AI In what temporal order did the blood and body images physically appear on the Shroud?

37. AI Are there materials present on the Shroud that can further confirm the forensic hypothesis that the cloth covered a wounded human body?

38. AI Are there artist's materials present on the Shroud and can they be accounted for?

39. AI Can novel materials be discovered that in themselves suggest new ideas concerning the nature of the Turin Shroud?

40. Al From a forensic point of view, what is the probable sequence of events which led to the image structures (i.e. body and blood) on the Shroud?

41. AI Can the weave structure be eliminated from the eye region in such a way as to not disturb the image (possibly that of a coin) in that area?

42. AI Can the inorganic pigment hypotheses (e.g. Fe_2O_3) be quantitatively tested by x-radiography, which can be performed more sensitively today than in 1978?

43. AI What does the "serum"/blood interface look like?

44. Al Can greater detail in the body-only image be observed?

45. Al Can blood density variation, serum, and waterfront zones (from 1532 fire) be documented?

46. AI What do body, scorch, cloth, blood, waterstain fibrils look like at high magnifications?

47. AI How do the spectra of bloodstains compare with those of various pigments that have been suggested (Fe_2O_3, HgS, etc.)?

48. AI Are there pigments in the blood regions?

49. AI Is there a correlation between image shading and iron (or other inorganic) concentration in the body image?

50. AI Is there mercuric sulfide in the bloodstain regions?

51. AI What is the elemental composition of the scourge-mark areas compared with blood, halo, body-image, and background areas?

52. AI Do the areas of the shoulder and calves (leg) contain deposits of dirt or dust similar to the heel area?

53. Al Can more detail in the skin wounds, eyes, etc. be observed?

54. I Can any of the various proposed image hypothesis mechanisms (e.g. scorch, ionization, photolytic, chemical, etc.) be tested?

55. I Can previous image analysis studies pertaining to image resolution, enhancement, and three-dimensional interpretation be improved?

56. I What is the relative reflectance of the dorsal body image to the frontal (at presumed contact points)?

57. I Does the shading structure of the dorsal body image permit a three-dimensional interpretation as does the frontal image?

58. I What are the spatial limits of the detectable body image?

59. I What is the thermal diffusivity of the Shroud both longitudinally and transversely?

60. I Can spectral data in the infrared be obtained which provides chemical information concerning the image?

61. I What does the entire Shroud look like in the infrared while being illuminated with visible light?

62. I Can particulate material be seen in the waterfront zones?

63. I What are the visible fluorescent characteristics of various areas on the Shroud (e.g. body, blood, waterstain, cloth, scorch, etc.)?

64. I How does the "serum"/blood transition zone fluoresce visibly?

65. I Can differences between scorch and body image be recorded for later quantification and comparison with photoelectric spectrometry?

66. I Do waterfront zones show different fluorescence?

67. I What is the fluorescent pattern of the cloth weave?

68. I Is the Shroud body image the result of a thermal scorch?

69. I Why are there color differences among and within bloodstain regions?

70. I What is the spectrum of the skin wound stains? Is it like blood?

71. I Based on different blood spectra; can age, chemistry, microbiology, exposure, etc., account for the spectral features?

72. I Are there detectable differences in spectral absorption (or reflectivity) of widely separated or specific body image areas?

73. I Quantitatively, can subtle differences between scorch and body image be defined?

74. I Are there differences in the degree of cellulose crystallinity on either side of the "chinband" image discontinuity that might correlate with the discontinuous shading in this region?

75. I Are there variations in elemental concentrations in the "chinband" area which might correlate with the discontinuous image shading in this region?

76. I What is the elemental composition of the body image areas compared with background areas?

77. I What is the elemental composition of the finger areas compared with that of body-image and background areas?

78. I What is the variation, if any, of the elemental composition of the background?

79. IC What is the penetration depth of the body image into the cloth?

80. ICA What is the discoloration (degradation) rate of the Shroud cellulose as a function of temperature, oxygen availability, and UV radiation flux?

81. ICA Does the body image contain any dried pigmentation which might produce a detectable irregularity in the random crease and wrinkle structure of the Shroud?

82. ICA Can microbiological activity explain the presence of iron oxide on the Shroud and/or the coloring of the bloodstains?

83. ICA Where are particles (dust) found and can these be used to locate the Shroud in specific geographical locations?

84. ICA What is the elemental composition of the area between the dorsal hips compared with blood, halo, and body image areas? Is there feces contamination there?

85. ICA Are blood images human blood?

Collaboration

In the STURP proposal, we indicate an interest in collaboration with other well-qualified Shroud groups and/or individuals. In this, our goal is not simply to seek collaboration for collaboration's sake, but rather to use collaboration as a tool to effectively investigate the scientific complexities of the Shroud (and thereby optimize scientific knowledge concerning it). Accordingly, we are not suggesting unrestrained collaborative investigations of the Shroud, but rather responsible collaboration which provides the best conditions and potential for illuminating critical scientific issues. Those who might be

interested in collaboration with STURP are asked to submit a letter to:

Shroud of Turin Research Project, Inc.
P.O. Box 7
Amston, CT 06231

This letter should describe the studies contemplated as well as provide documentation concerning the nature and technical qualifications of the group or individual (as the case may be). After evaluating the correspondence, STURP will respond to those with whom collaboration seems appropriate.

The above address can also be used for correspondence of a public relations/information nature as well as to subscribe to the STURP external Newsletter for a tax-free contribution of $25 or more (to support STURP research activities).

Concluding Remarks

The program we propose covers many areas of current scientific interest. We believe these studies have the potential for providing definitive answers to questions which would otherwise lie unanswered.

In this paper, we have attempted to announce the scientific studies which STURP is asking the church authorities for permission to conduct. We applaud responsible scientific studies which may be proposed by other investigators and we invite responsible collaboration with the work we have proposed.

We would like to encourage support for this proposal; for through encouragement, such studies and their responsible incorporation into the scientific literature of mankind are likely to someday succeed.

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Before 1978 Examination

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   d. DEVAN, D.: "Photography of the Turin Shroud for Use in Image Analysis Experiments."
   e. GERMAN, D.: "An Electronic Technique for Constructing an Accurate Three-Dimensional Shroud Image."
   f. JACKSON, J.: "Color Analysis of the Turin Shroud: A Preliminary Study."
   g. JACKSON, J.: "A Problem of Resolution Posed by the Existence of a Three-Dimensional Image on the Shroud."
   h. JACKSON, J.; JUMPER, E.; MOTTERN, W.; STEVENSON, K.: "The Three-Dimensional Image on Jesus' Burial Cloth."
   i. JANNEY, D.: "Computer-Aided Image Enhancement and Analysis."
   j. JUMPER, E.: "Considerations of Molecular Diffusion and Radiation as an Image Formation Process on the Shroud."
   k. LARUE, R.: "Tonal Distortions in Shroud Image Photographs."

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