

The Shroud of Turin RESEARCH PROJECT, INC.

P.O. Box 7, Amston, CT 06231

3 October 1988

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Dear Luigi,

The enclosed new draft protocol has been prepared at Tom's request to serve as a basis for your forthcoming visit to the U.S. It has been sent in parallel to Tom, but because of the short time available for its preparation, it has not at this point received the approval of the STURP Board.

This protocol should be viewed as a modification of the 30 June 1987 protocol, and thus has as its basis the original 1983 STURP testing proposal. The changes derive from the recent radiocarbon age results that have been reported informally in the press and by word-of-mouth. Other updates have been included as a result of our continued refinement of the ideas in the original proposal and by changes in our scientific understanding and improved measurement capabilities.

Specifically, this protocol covers what, in the 30 June 1987 plan, was called Phases B, C, E, G, and H. Omitted at this time, for reasons explained in the protocol, are Phases D and E.

If your meeting with STURP is still scheduled for the weekend of 22 October, it is unlikely that I will be able to join you. Nevertheless, I hope that the meeting will result in a decision to continue scientific testing of the Shroud.

Sincerely,



S. J. Lukasik

cc: Tom D'Muhala

DRAFT PROTOCOL
FOR FUTURE EXAMINATIONS
OF THE SHROUD OF TURIN

S. J. Lukasik
Coordinator for Data Acquisition
3 October 1988

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INTRODUCTION

The Shroud of Turin has been hypothesized to be, and believed by many to be, the burial cloth of Jesus Christ. In a previous draft test protocol [Ref. 1] the position was taken that the weight of evidence available at that time favored the view that the Shroud is an artifact of a real crucifixion. On the basis of the time period in which crucifixion was practiced and noting the specific details of that crucifixion was revealed by medical evidence, a first century origin and an identification of the Shroud with Jesus Christ was felt to be plausible. It was further argued that the Shroud should be conserved with a degree of concern appropriate to its potential significance. In particular, it was recommended that no destructive tests be undertaken and that physical baselines be established against which degradation of the Shroud could be assessed, understood, and controlled. Two passages from Ref. 1 summarize the position taken:

"... it is better to assume that the Shroud is unique and authentic and to preserve it until proven otherwise, than to put it at risk only to find that the Shroud in fact deserved more care than was provided it."

"...one should give the Shroud the "benefit of the doubt" for the present, at least until its preservation is assured."

Consequently, tests related to the "authenticity" of the Shroud were given a low priority and the destruction of 50 mg of Shroud for radio-carbon dating was not recommended, despite its inclusion in the original STURP proposal [Ref. 2], because they were not required for the conservation of the Shroud. The issue of the accuracy of carbon dating was mentioned [Ref. 3], based not on the precision of the technique, but rather on the diverse conditions to which the Shroud

had been exposed and the unknown nature of potential contamination of the Shroud.

In the event the recommendations of Ref. 2 were overwhelmed by the need to satisfy man's curiosity about the authenticity of the Shroud. In April 1988, about 10 cm² (or approximately 200 mg) of Shroud material was removed for radiocarbon dating from a single location near that of the 1973 Raes sample. This significantly exceeded the 50 mg specified in the Turin Protocol [Ref. 4] although it is understood that 3 cm² has been retained by Prof. Gonella, and additional unconsumed material may still be in the hands of the three laboratories that performed the dating measurements. While no scientific details of those measurements are available at this time, the following unofficial information has been provided to the author:

1. Each laboratory was able to subdivide the approximately 2 cm² made available to each of them so that about 10 independent dating measurements were made (this was also contrary to the sample size requirements stated at the 1986 Turin Protocol meeting).
2. The tests were not done blind, as specified by the Turin Protocol. The Shroud samples were identifiable from the weave and the dates of first and fourteenth century control samples were provided to the dating laboratories. No unofficial information is available on the age measured for control samples, nor is it even known if they were dated.
3. The first dates apparently were "unreasonable" and the sample decontamination process was modified by the first laboratory and passed on to the other two laboratories. Again no details are available.
4. The dates range from 1220 to 1410. From the precision of the data (absent any statistical information beyond the range), the three laboratories appear to have confirmed each other's measurements and a 14th century origin for the cloth is indicated.

In view of the apparent success of the Shroud dating and the 14th century result, the popular identification of the Shroud of Turin with Jesus Christ would no longer appear tenable. The question facing STURP (and others) then, is "What, if anything, is next?"

PERSPECTIVES FOR POSSIBLE FUTURE TESTING

A fundamental premise of science is that experiments either address a testable hypothesis or they explore some domain where at least intuitively one thinks there may be information of potential significance to be gained. Multiple independent hypotheses can be formulated so that experimental programs need not be completely consistent, only consistent with one or more hypotheses. In this section seven different perspectives on possible future testing of the Shroud are presented, any one or more of which could provide a framework for such work. It is to be emphasized that they are presented as possible frameworks only. Recommended directions are presented in the next section.

1. Conservation

The Shroud is an object of traditional veneration and at least symbolic significance. It is (at least) 600 yr old. It thus merits conservation at least comparable to other museum objects of artistic, technical, or historic significance. Within the context of the Shroud conservation should address:

- (a) the cloth itself - for this one needs to know the chemical nature of the fibers, their current surface conditions, some idea of its past exposure and treatment, and the nature and causes of changes currently underway.
- (b) the image on the cloth - the issue here is to understand the chemical nature of the fibril discoloration and to stabilize

the image in order to maintain the contrast between image and cloth background.

- (c) other materials present - these include a wide variety covering biological materials relatable to the alleged crucifixion (blood, serum, epithelial cells, etc.); material related to the history of the Shroud (pollen, dirt, etc.); and material that could result in degradation of the cloth or the image on it (bacteria, mold, biological debris, wax, scorch, etc.).

2. Accuracy of the radiocarbon age

A number of comments have been made and questions about the conduct of the radiocarbon dating have been raised earlier. None of them provides reason to reject the 14th century age although they are troubling. There are additional concerns, however:

- (a) the dating samples were taken from a single location, thus raising issues of systematic error if that location is atypical for reason of contamination or past history. In particular, the location near that of the Raes sample is suspicious in the light of peculiarities of that sample noted by others, e.g. the "wrong" twist to some Raes sample threads.
- (b) apparently no overall survey of the cloth was undertaken or documented to justify the sampling location. Thus questions of waterstains, edge handling, possible 14th century reweaving, and the like remain unanswered.
- (c) all three dating laboratories utilized the newer, and hence less well-established, accelerator technique. Considering that 2 cm^2 is adequate for a counter measurement, if samples that large were taken scientific prudence would perhaps have warranted the use of different measurement techniques.

3. Inconsistency of the Evidence

The Shroud has been studied by a large number of people and by a variety of techniques and disciplines since the 1898 Pia photographs. The conclusions reached from almost a hundred years of scientific and historical studies regarding the nature and authenticity of the Shroud have been inconsistent.

Clearly the most negative evidence is the radiocarbon date of 14th century. But the historical evidence has been equally negative. No reliable evidence of the existence of a Shroud prior to about 1350 has been found despite the fascinating speculation of Wilson [Ref. 5] and the leads it offers. The historian's view is that an object is as old as objective evidence of its design, materials, and fabrication technology.

Various types of evidence, positive and negative, are suggestive of an earlier than 14th century date and/or that the Shroud is a record of a real crucifixion. This includes the analyses of art historians; the physical studies of the three-dimensional nature of the image; the chemical studies of the blood on the Shroud; other 1978 STURP studies; and the lack of credibility that 14th century technology could have provided an adequate basis to fabricate what we see in the Shroud.

The most positive evidence that the Shroud is an artifact of a real crucifixion and even that of Jesus Christ is provided by the forensic pathologists. The medical knowledge of blood and blood flow and the response of the body to scourging and crucifixion all suggest that the Shroud is a unique and authentic record of a Christian era execution.

What is most unsatisfying about this array of evidence is its inconsistency. No obvious fault can be found with the evidence at either extreme and the weight of suggestive evidence is substantial. Thus the Shroud poses a scientific puzzle.

4. Fabrication technology in the 14th century

A great deal of argument and speculation has been undertaken to understand how the image on the Shroud was created. Consistency of viewpoint requires that the technology be available at the time of the hypothesized creation or fabrication. There are at least four fabrication technology issues posed by the Shroud:

- (a) the image is the result of a surface discoloration of fibrils. There is no evidence of pigments or vehicle external to and, particularly, in between the fibrils.
- (b) the image density is proportional to the number of discolored fibrils per unit area. This idea is quite understandable to modern technologists who are familiar with photography and the printing of screened images. But these are sophisticated concepts not known in the 14th century.
- (c) The image is a negative, not a positive. Again the positive/negative nature in images is a modern concept, although it is similar to the positives and negatives employed in the casting of solid objects and to rubbings of low relief images.
- (d) the perspective of the image is peculiarly distorted but it is understandable in terms of a $1/\text{distance}$ encoding.

Thus, if the image is a 14th century artifact, it tells us many new things about the state of technology at the time, and will be of interest to students of the history of technology.

5. Historical Puzzle

Whatever the circumstances of the 14th century origin of the Shroud, they are bound to be interesting and possibly enlightening. Who is responsible for the fabrication of the Shroud? Was the person(s) of

historical interest? Why was the Shroud fabricated? Was it originally intended to be simply a representation of the burial of Christ or was it fabricated with intent to deceive? Was it intended for exhibition for fee? Or for sale to a gullible wealthy family? Who was the unknown artist who "painted" or "copied" the Shroud?

Everyone relishes a mystery and the origin of a 14th century Shroud is no exception.

6. The Shroud as a Fraud

While the original intent of the person or persons who fabricated a copy of the burial cloth of Christ need not have been to deceive, clearly the Shroud has acquired a reputation as the "real thing." Does one now consign the Shroud to the dustbin of history, unworthy of further scholarly interest? No, inquiring minds study everything, even frauds. Certainly of the many frauds perpetrated in the history of man, the fabrication of a phony burial cloth of Christ and its continued acceptance for six hundred years ranks as one of the greater and more interesting ones.

7. Curiosity

The Shroud is a very unusual object, the like of which we have never seen before. We study its many facets because it is so unusual, because we may learn something from it. We study it because we are curious and because it is there.

FURTHER TESTING: WHY AND WHAT?

The central decision to be made by STURP is whether to continue testing and, if so, to decide on the objective of future tests. The basis of this protocol is the view that testing should continue despite the

results of the radiocarbon dating that point to a 14th century origin. The reasons for this position are (in no implied order of weight):

1. As an object of traditional veneration the conservation of the Shroud requires understanding of the nature of the image and the mechanism of its formation.
2. The Shroud is a most unusual object. The mechanism of formation of the image remains a puzzle. Previous tests do not support the obvious expectation that it is a painting, nor are the characteristics of the image consistent with other mechanisms that have been suggested.
3. The negative nature, the image density representation, and the depth information in the image seem to be inconsistent with presumed 14th century fabrication technology.
4. The forensic analysis implies more understanding of crucifixion and human pathology than is reasonable in view of our understanding of 14th century science.
5. The accuracy of the radiocarbon age is not beyond question.
6. Questions of why the Shroud was fabricated can be aided by understanding more about how it was fabricated.

For these reasons, therefore, it is proposed that testing of the Shroud continue.

Granted further testing, what then are the objectives? It is proposed that they are, in order or priority:

1. To understand the chemical nature of the image so that we can learn more about:
 - (a) how to preserve the image
 - (b) how the image was formed, in the light of 14th

century technology

(c) why the Shroud was fabricated, and by whom.

2. To understand more about the current physical condition of the Shroud in terms of biological and physical materials embedded in the cloth for reasons of:
 - (a) conservation
 - (b) circumstances of origin
3. To collect information that could establish whether the origin and formation of the image on the Shroud is related to an actual crucifixion.
4. To validate, in the light of questions about the radiocarbon dating methodology and possibly discordant physical and forensic evidence, the 14th century origin of the Shroud.

TEST PLAN FOR PRELIMINARY STUDIES

How then, in the light of these issues, should we proceed? Clearly there is a substantial amount of controversy over the Shroud at this point. Traditional expectations have been contradicted by the radiocarbon age; substantial scientific questions remain; the puzzle of who, why, and how are unanswered; the public wants to know more. What is proposed is a two part process.

First, an immediate brief approximately 24 hr. examination should be undertaken to secure samples for off-line scientific study and to undertake preliminary studies in preparation for a follow-on series of tests.

Then, guided by the results of this short sampling examination, the first of a continuing series of periodic examinations of the Shroud be undertaken to assess its physical condition, deterioration,

effectiveness of conservation measures, and such other studies as may be suggested by the scientific community and approved by the Custodian of the Shroud.

Since the last two examinations of the Shroud have been brief and discreet, viz. the private examination by Pope John Paul in 1981 and the radiocarbon dating sampling in 1988, it is proposed that the sampling proposed here be undertaken:

- (a) without prior public announcement
- (b) within a 24-36 hr period
- (c) by a group of about six investigators
- (d) immediately after the celebration of Christmas and New Year in the Turin Cathedral

Specifically what is proposed is:

1. The removal of 1 cm long threads from:
 - (a) three different image regions
 - (b) three different non-image regions
 - (c) three different water stain regions
 - (d) three different blood regions
 - (e) three different backing cloth regions
 - (f) two different serum regions

These thread samples will be examined non-destructively by UV-visible spectroscopy, fourier transform IR spectroscopy, scanning electron microscope, low temperature electron spin resonance, microscopy, x-ray fluorescence, spectrofluorimetry, and photoacoustics. They will be maintained by STURP and made available to non-STURP researchers. The reason for removing multiple samples of each type is to minimize the problem of sampling from a unique location and being misled by idiosyncratic results.

It is expected that these studies will yield information on the physical and chemical state of the Shroud and image. By making

samples available to researchers in their home laboratories, risk to the Shroud is minimized, field costs will be minimized, and the collection of the maximum amount of information will be possible under the controlled conditions and extended time periods thereby made possible. All materials will be collected by scissor or razor and tweezers and will be stored in labeled polyethylene vials. The samples will be weighed and characterized and the removal sites documented.

2. The removal of about 50 mg of blood. The samples will consist of small amounts from numerous separate areas, typically less than 1 mg each. They will be taken by tweezers from the back surface of the Shroud in areas of blood flow from the wrists, foot, head, back, and lance wound. The removal of blood from the back of the cloth through the weave has been tested and is known to be feasible.

The samples will be examined destructively by chemical, spectroscopic, immunochemical, and spectrofluorimetric tests. The immunochemical investigations will include histocompatibility antigen tests to identify the blood as human. Samples from the back buttock blood flow will be tested for the presence of human lung proteins to confirm the crucifixion pathology hypothesis and to rule out the notion that normal blood has been used as a "paint."

3. Removal of any adventitious materials encountered will be undertaken in order to support these scientific objectives and also to elucidate some of the historical problems. The extent of this sampling will be limited by the time available and by the limited opportunity that will be afforded in this preliminary series of studies for the complete and thorough baseline documentation of the cloth. Testing of such samples will be non-destructive to the maximum extent possible and the samples will be made available to non-STURP researchers for further non-destructive tests.

4. Because the April 1988 radiocarbon dating samples were taken from only a single location and only the accelerator technique was employed, it is proposed that the accuracy of the date be checked by:

- (a) submitting the 3 cm² sample that it is understood Prof. Gonella has retained to a counter laboratory for dating.
- (b) removal of an additional 3 cm² sample from a different location for dating by the same counter laboratory. It is proposed that this be taken either from the opposite side and edge where the Raes sample and the April 88 sample was taken (at location 1 between D and E in the attached figure) or at location 9F on the edge (the opposite side from the side seam.)
- (c) a control sample consisting of 3 cm² of backing cloth, also to be radiocarbon dated by the same counter laboratory.
- (d) 3 cm² of the Raes for radiocarbon dating by the same laboratory if that sample can be made available by its current custodians.

5. In preparation for the follow-on tests described in the next section, undertake such work as will aid in the planning and execution of those tests. This will include:

- (a) measurement of the time required to remove and replace the stitches securing the Shroud to the backing cloth.
- (b) trying several location marking options to see which are most satisfactory in terms of time required per marker, minimum (adequate) visibility, lack of impact on the physical condition of the Shroud, etc.
- (c) photographing the foldmarks with grazing illumination to document the current state of the Shroud.
- (d) undertaking an overall examination of the Shroud to document gross signs of deterioration and to plan future sampling and

other possible test strategies.

6. All of the above samples (thread, blood, adventitious materials, and dating samples) will be documented by photographic and video techniques in order to record the site of the sampling and to be able to cross-reference the results back to the physical object. Photographic spectra will also be obtained for the samples removed under 1,2,3, and 4 using a range of filters in the UV to IR region of the spectrum. Complete written records of the sampling and testing will also be maintained.

Comparing this work plan with that in the previous protocol [Ref. 1], one sees that what has been included consists in large measure of what was previously called Phases B,C,E,G, and H. Referring back to the original STURP proposal [Ref. 6], this includes all or part of the following work packages:

30 June 1987 protocol	1983 STURP proposal work packages
Phase B	9
C	7
E	2,3,4,5,10,16,17, 24,25,26
G	6

The omission of Phases D and F at this time means that only 6 of the original work pages, viz. 8,11,13,19,21, and 23 in the 30 June 1987 protocol are not covered.

The time proposed here is less than what was required for the comparable phases in the 1987 protocol because the amount of microscopic and macroscopic sampling has been reduced.

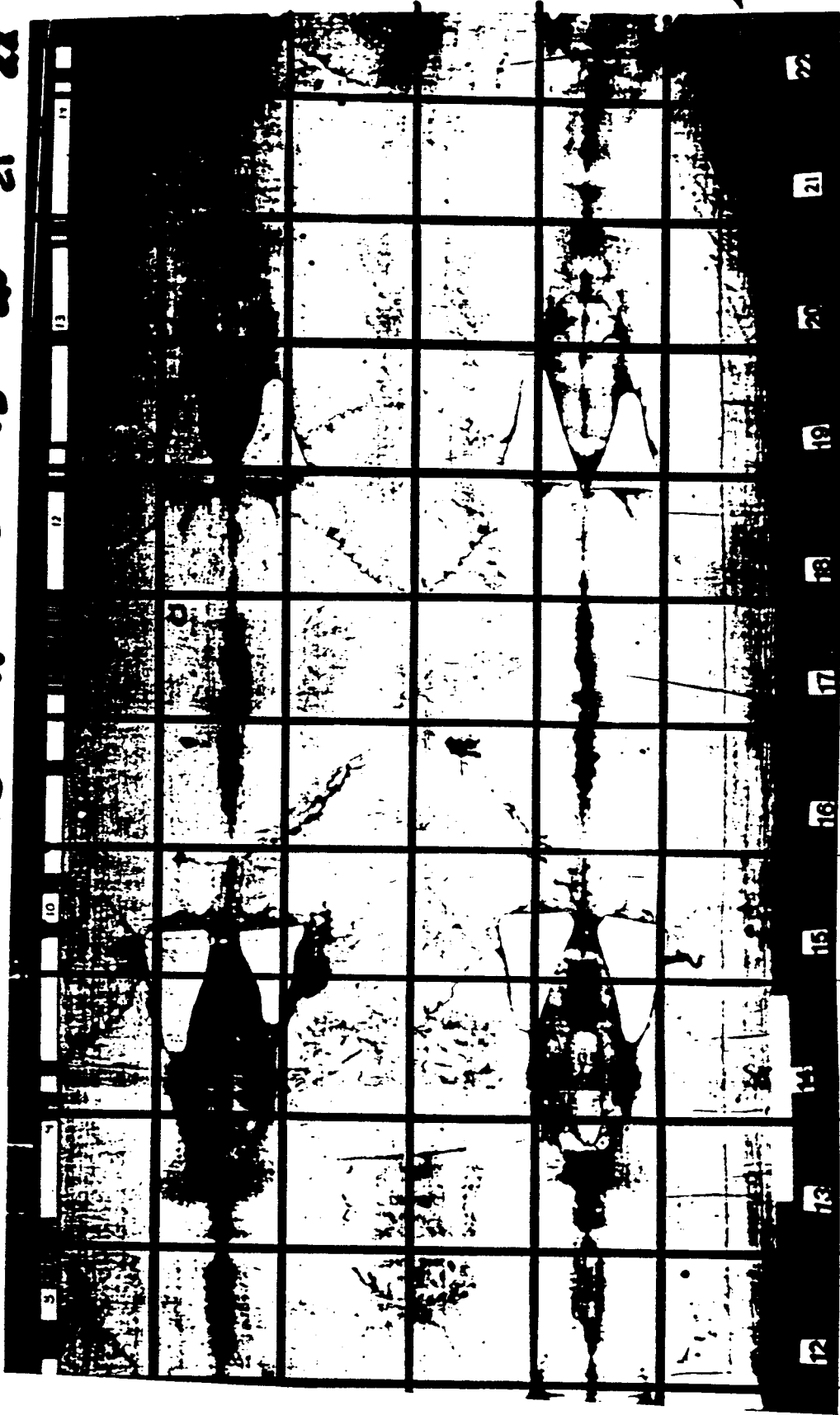
1 2 3 4 5 6 7 8 9 10 11 12



Edges unsexed in 1978 by G. RIEGGI
and re-sewed provisionally

10-1

12 13 14 15 16 17 18 19 20 21 22



'RAES' Sample 1973

REQUIRED RESOURCES

For the sampling work proposed here, only the most minimal resources will be required because the bulk of the work will be done on the samples in the researcher's home laboratories. All that will be needed will be a simple clean polished metal horizontal table. The STURP table described in the earlier proposal will not be needed. Equipment needs will be minimal: sampling instruments and photographic, spectral, and video documentation equipment. Project personnel will also be minimal:

- 2 samplers
- 1 photographic documentor
- 1 video documentor
- 1 written documentor
- 1 conservator

One can expect that ecclesiastical control will be provided by Prof. Luigi Gonella and such other participants as he will designate.

The cost of the work proposed here will be trivial since there should be minimal need to purchase equipment and consumables. At worst the air fare, lodging, and meals for three days can be assumed by the individuals involved as part of their continued support of their scientific curiosity. Alternatively, all or part of the roughly \$12-15K required could be solicited from past supporters of Shroud research. Thus large amounts of STURP administrative and overhead costs can be avoided. It is assumed, though, that all participants will execute the STURP membership agreement prior to the testing.

SUBSEQUENT TESTS

Omitted from this protocol is the low and high resolution imaging and spectroscopic scans (phases D and F in Ref. 1). These were intended to serve five purposes:

1. To provide wide area information of surface condition to assess conservation requirements and to plan conservation procedures.
2. To provide a baseline to assess deterioration of the Shroud and thus to be able to measure the efficacy of conservation measures to be adopted.
3. To map the presence of and characterize the type of adventitious materials in order to understand the degree to which such materials pose a threat to the Shroud.
4. To provide convenient video images for future researchers and test planners, much as conventional photography has opened up the Shroud for analysis.
5. To provide detailed spectroscopic information for all or large areas of the Shroud to address the questions of uniqueness that inevitably arise when detailed studies of specific areas are undertaken.

These objectives remain valid and STURP recommends that they be undertaken. There are several reasons why it is believed that they need not be undertaken as part of the first series of tests proposed here. First, they are expensive in terms of the design and procurement of scanning and recording equipment; number of people needed; and time required to acquire funds for the necessary equipment and for the support of an expedition to Turin. Second, the priority of such work has changed in the light of the radiocarbon age results. And third, in view of the synoptic nature of Shroud conservation measures and

subsequent monitoring of progress, one can expect that a larger role in such work will inevitably be assumed by local authorities and less by STURP volunteers.

Commitment to periodic examinations of the Shroud as part of a long-term program of conservation would be an effective way of prosecuting a research program. Experiments to be undertaken could be proposed as part of a continuous process. The best could be selected for execution on the basis of their relevance to conservation and image formation. Risks to the Shroud could be assessed and modification of a proposal could be made as required. A rejected proposal could be resubmitted for a subsequent test period. Shroud studies could be opened up to a wider set of potential researchers. And scientists could plan more rationally than is possible now when the approval of each test period is the subject of an intense and uncertain political process.

Such periodic testing could be at whatever pace would seem appropriate to terms of the results being collected. One might guess that 3-5 yr intervals would be appropriate. This is not unlike the process in many other fields of science where access is limited by natural processes or the need to fund and organize major programs. Space programs and geophysical studies are cases in point.

REFERENCES

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