

## I. CARBON DATING THE SHROUD

### A. CARBON DATING THE CLOTH:

#### 1. Evaluating Plans for Carbon Dating the Cloth:

The single most important question concerning authenticating the Shroud is that of its date. ASSIST understands that STURP has proposed six laboratories to date the cloth of the Shroud. Indeed, a paper read on Monday, June 24, 1985 by a member of a coordinating team headed by Dr. Michael Tite of the British Museum shows that, while there are some questions about certain aspects of this study, in general it demonstrates that carbon dating can be done on ancient cloth with a precision to about plus or minus one hundred years of the actual date on a cloth variously estimated to be between 600 and 2000 years old.

ASSIST believes this test to be extremely important. We are not proposing a separate, competitive, plan to carbon date the cloth of the Shroud. To enable us to approach the carbon dating effort as objectively as possible we have established a three member scientific advisory panel on carbon dating. The members of this advisory group are as follows:

Lloyd A. Currie, Ph.D., Dept. of Analytical Chemistry, The National Bureau of Standards, Washington, D.C. Dr. Currie is an internationally recognized specialist in the occurrence of errors in carbon dating.

D. Erle Nelson, Ph.D. Department of Archaeology, Simon Fraser University, Burnaby, British Columbia, Canada. Dr. Nelson is a specialist in the use of accelerator mass spectrometry (AMS).

Edward V. Sayre, Ph.D. The Smithsonian Institution, Washington, D.C. Dr. Sayre is a specialist in the use of the small proportional counter.

ASSIST has two major concerns regarding the carbon dating of the Shroud:



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a. The first concern has to do with the nature of applying carbon dating to the Shroud and the later interpretation of the data. ASSIST wishes to sponsor an international conference on carbon dating the Shroud and to bear the cost of this conference. ASSIST makes the following recommendations regarding the nature of such a conference:

1/. We believe this conference should be a closed-door conference of all participants plus the scientific representative or representatives of His Eminence Cardinal Archbishop Ballestrero and of the Holy Father.

2/. We further believe this conference should take place before any carbon dating begins and before any samples have been taken.

Such a conference would enable participants to discuss possible errors in sampling methods and to establish certain standards of sample taking. It would enable participants to discuss the different possible sampling sites on the Shroud and the merits and dangers in selecting certain types of sites for such samples. It would also allow for a discussion of statistically valid sampling techniques and such discussion would enable participants to develop plans for surmounting problems faced by taking samples from specific sites. There should also be discussion of the numerous methods available for sample preservation and decide upon which method is to be employed for the samples taken from the Shroud. (See further below in section 3. on preservation of samples). Such a conference should also explore various methods of record keeping and establish a standard for this. (See further below in section 4. on a recommendation by ASSIST in this area).

The above three scientists have agreed to be participants in any conference held to discuss the various facets of planning for carbon dating the Shroud.

b. A second area of concern is the careful and objective control of samples taken from the Shroud to



be carbon dated. ASSIST urges that at least two members of the above mentioned precision advisory team be permitted to observe and assist in the taking of and/or packaging of samples from the Shroud and that those persons be scientists not directly involved in the actual carbon dating of samples removed from the Shroud. In this way these members would be able to offer immediate advice to help prevent the kind of contamination which might otherwise occur during such sampling. We therefore request permission for Dr. Lloyd A. Currie and Dr. Edward V. Sayre to participate in this capacity.

## 2. A Recommendation for Blind Carbon Dating:

To maintain a rigorously objective carbon test of the Shroud we urge that all such samples be tested blind. There are several steps which can be taken to ensure that the test be truly blind and provide controls on the carbon dating equipment, and provide a sound data base upon which later to interpret the results.

a. Since the D'Arcis Memorandum states that the Shroud was painted by an artist in about 1356 we would logically expect that the simplest means for an artist to obtain cloth for his project would have been fabric available on the market in France at the time he made his plans. To obtain controls of cloth relatively close in time to 1356 we urge that samples of thread be teased from the patches applied by the Poor Clare Nuns in 1534. If enough can be spared from these patches then we urge that both small proportional counters as well as the accelerators be provided samples from the patches for testing. Samples might also be removed from the Holland cloth to provide enough materials for both the small proportional counters and the accelerators involved.

b. Since many authorities expect a date in the first century AD we urge that linen samples of ancient cloth (controls) be provided to all laboratories involved for testing. ASSIST has been investigating sources of ancient linen and we believe we can supply such controls.

In this manner each laboratory would be dating a sample from the Shroud itself, a sample from one of the patches,



and a sample from an ancient linen, the latter two being controls. We recommend that these samples be specially packaged in the manner to be discussed in section 3.

c. We urge that a specialist in working with linen be selected to tease out the samples using micromanipulative techniques. ASSIST has selected textile chemist Dr. Kathryn A. Jakes, Associate Director of the Center for Archaeological Sciences, the University of Georgia, Athen, Georgia to represent its interests in the removal of textile samples from the Shroud for research. Pending permission from Authorities and agreement by all parties concerned, she would be willing to apply her expertise to the removal of the samples for carbon dating. If it is decided that several samples should be removed at once to save time, ASSIST would be happy to offer the services of textile chemist Dr. Jeanette M. Cardamone of the Dept. of Textile and Clothing, Ohio State University, Columbus, Ohio, to aid Dr. Jakes in this effort.

d. We urge that no carbon dating plans be made which exclude the use of the small proportional counter in dating samples from the Shroud. This is extremely important because many carbon dating scientists feel that since the accelerator is the youngest member of carbon dating technology, the use of the small proportional counter, which is the direct descendant of the classical Libby method of carbon dating, is absolutely necessary to verify and/or reinforce the results obtained by the accelerator.

#### C. A Recommendation for Sample Preservation:

We have recommended above that a blind study be done using various control samples from the patches and ancient linen. ASSIST also strongly recommends that every effort be made to guarantee the quality of the samples once these have been removed from the various sites on the Shroud and patches selected. Also, every measure should be taken to prevent tampering with the samples, which, we urge, be taken in the presence of multiple knowledgeable witnesses both Church Officials and radiocarbon chemists. One measure which can be taken to preserve this quality and make tampering difficult would be to immediately, on-site, place the samples in sealed ampules. These ampules would then be packaged and special labels affixed for hand



carrying to the various locations for processing.

ASSIST recommends the following specific plan:

a. National Scientific Co., Quakertown, Pennsylvania, has agreed to prepare specially constructed ampules for use in preserving such samples. Each ampule would be made of pure quartz (which has a melting temperature of 1100 degrees C). In this way the samples would not be exposed to soda line glass which might contain contaminants. Each ampule would initially be three inches long. National Scientific Co. would prepare constrictions one inch from the top opening of the ampule for ease of sealing once the sample has been placed in the vial. All ampules would be identical.

b. We strongly recommend that the normal atmosphere in the ampules be replaced with an inert gas. Therefore, Gas Technics Co, a subsidiary of Linde International, has agreed to supply a specially made argon gas (99.9995+ pure) to replace the air in the ampule before sealing and to provide a chemical engineer to supervise the entry of argon into those ampules. Since argon is 38% heavier than air the atmosphere in the ampules will be replaced as the argon settles to the bottom.

c. A specially trained person would seal the ampules using a small portable torch with oxygen/propane gas. The special constrictions in the quartz ampules will enable such sealing to take place on-site and the sealing of the ampules one inch from the top will prevent contamination from entering which might otherwise be in the sealing gas.

#### 4. A Recommendation for Record keeping:

In order to ensure that the blind study be truly a blind study we urge that no labels be used which can be easily memorized. This recommendation would specifically exclude labels composed of letters and numbers.

Instead, we recommend that bar code labels be used which can only be decoded with the use of a bar code reader. Each sample would receive a specially coded bar code tag immediately upon being sealed. The ampule, with its bar code tag, would be placed inside a polyethylene bag and a second bar code tag would be



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affixed to the bag. When the samples arrive at their various designated laboratories for processing, the labs would be free to affix their own labels for their own records. However, the bar code tags would remain attached to each ampule for future decoding and matching to the original records.

Using a bar code reader would enable an operator to immediately access all the original records which had been entered on-site into a small personal computer. Available in these records would be the details of each site selected including codes to video coordinates, the nature of the sample removed, the personnel involved in the removal, problems encountered during such removal, unique characteristics of each site and sample taken, date and time of day during which removal occurred, and recorded observations and recommendations of the specialists (textile, radiocarbon, and sindonological) involved in the sample removal.

Any bar code reader could be used to decode the bar code so long as it is capable of reading UPC code. However, use of such a bar code reader would not access the identity of the original sample without the use of the original diskette on which this identity is stored. Two backup diskettes would be made of the original diskette preserving the details. All diskettes would be stored in separate fire proof, non-magnetic vaults and kept in hold until the data from all the carbon tests were available.

In this way all the laboratories could proceed, on their own schedules, to prepare and test the samples, keeping their own records. But the diskettes containing the identity of the samples would not be released until all the test data are in. This is important since the results can be available relatively quickly from accelerator mass spectrometry whereas the counting time for samples dated in the small proportional counter is at least 3 months.

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## B. CARBON DATING THE IMAGE

### 1. The Carbon Dating of Small Amounts of Proteins.



For a number of years it has been known that a carbon date for the cloth would not provide a date for the image. Dr. Walter C. McCrone is already on record as saying that there was nothing preventing an artist from having obtained an old piece of cloth for his project ("Microscopical Study of the Turin 'Shroud' III". THE MICROSCOPE, Vol. 29, (1981), p. 36f.). And although it is logical to assume that a date for the cloth will provide important information on the matter, Mr. William Meacham, secretary for the Hong Kong Archaeological Society, agrees with the view that a carbon date for the cloth would not date the image ("The Authentication of the Turin Shroud:...", CURRENT ANTHROPOLOGY, Vol. 24, no. 3, (June 1983), p. 289b).

Archaeologists like to talk in terms of two kinds of dates. The terminus a quo, or beginning date, provides us with a bench mark to indicate a time before which something could not have happened. The terminus ad quem, or ending date, tells us when something was completed. In the case of a carbon date for the cloth we would only have access to a terminus a quo. ASSIST has, for the past two years, been interested in the developing technology surrounding the carbon dating of animal proteins, amino acids, and blood. Most observers agree that the blood areas on the Shroud are intimately connected with the image.

What is not agreed among scientists is the identification of those red colored areas which are alleged to be blood. Dr. Walter C. McCrone believes that these areas consist of iron oxide in a tempera base with a later superficial admixture of vermillion. However, STURP scientists have concluded that the red material is a blood exudate high in bilirubin (See Eric J. Jumper, et al, "A Comprehensive Examination of the Various Stains and Images on the Shroud of Turin." in ARCHAEOLOGICAL CHEMISTRY III, J. B. Lambert (ed.), Advances in Chemistry Series, no. 205, American Chemical Society, 1984, p. 459).

One of the most significant amino acids for our purposes is hydroxyproline. Hydroxyproline occurs only in animal gelatin (tempera) or collagen from which gelatin is obtained. Dr. McCrone is convinced that if an artist painted the Shroud, he did not use a milk or egg based protein binder. Tests with sodium azide could not demonstrate the presence of sulfur which would have been the case with the latter two binders. On the other hand, McCrone's tests with Amido Black have indicated to him that there is the presence of an animal gelatin (which would contain hydroxyproline) in the blood area and possibly also in the image



area. If this should ultimately prove to be the case it could be carbon dated. (For identification proposals see section II).

Dr. Richard C. Gillespie, of the Oxford accelerator facility, and his colleagues, have studied this matter carefully. They have successfully been able to date tiny amounts of hydroxyproline at Oxford. (See R. Gillespie, et al, "Radiocarbon Dating of Bone by Accelerator Mass Spectrometry", JOURNAL OF ARCHAEOLOGICAL SCIENCE, (1984) Vol. 11, pp. 165-170, esp. p. 168f.)

On the other hand, if STURP's analyses are correct, and the red material is blood this also can be dated using a very small sample. In 1985 Dr. D. Erle Nelson and his colleagues at the accelerator facility at Simon Fraser University, Burnaby, British Columbia, Canada, using ancient blood materials prepared by Thomas H. Loy, were able to date such materials successfully in two separate tests--one sample was 3 mg of blood carbon and the other 50 micrograms of blood carbon. The latter was done on a sample known to be about 2000 years old. (See D.E. Nelson, T.H.Loy, J.S. Vogel, and J.R. Southon, "Radiocarbon Dating Blood Residues on Prehistoric Stone Tools" forthcoming in RADIOCARBON, Summer, 1986)

The first step in dating the red colored material on the Shroud is to determine exactly what the material is. In section II ASSIST will propose two separate precision teams to work on this problem. But once the identification is made we can state that the technology is now in place to carbon date the blood areas and provide us with a terminus ad quem for the Shroud.

Establishing a terminus ad quem is crucial to settling a date for the Shroud. If an artist painted the Shroud in the 14th century then a carbon date could show that the artist selected an ancient cloth on which to paint his image. On the other hand, if carbon dates for both the cloth and the blood are consistently in favor of the first century, within the current precision parameters for C14 technology, then it can safely be argued that these carbon dates support a case for the authenticity of the Shroud.

For the above reasons ASSIST urges that samples be taken from the blood areas of the Shroud to enable 5 accelerator laboratories to run carbon tests on the red materials to establish the terminus ad quem we seek. ASSIST therefore requests permission for Thomas H. Loy to remove blood area



samples to identify and carbon date this material on the Shroud. We request permission to submit these samples to the four accelerator laboratories selected by STURP plus ASSIST's selected laboratory, the facility at Simon Fraser University, Burnaby, British Columbia, Canada, under the direction of Dr. D. Erle Nelson.

## 2. Sampling to Carbon Date the Blood areas

### a. Areas to be sampled:

Dr. Lloyd A. Currie has suggested that five of the main blood areas from the Shroud be selected for carbon dating by five different laboratories. Each laboratory would receive blood materials from one area. The following areas are suggested:

- 1/. The wound in the side.
- 2/. The right foot wound.
- 3/. The wrist wound.
- 4/. The blood stain near the frontal ankle.
- 5/. The blood flows on the head.

We request that as far as is possible, such samples be removed from the backside of the Shroud. This would be relatively easy from the area of the frontal ankle wound and the dorsal right foot area since the ends of the Shroud could be unstitched at those points. In fact, if it is found to be impossible to gain access to the other above mentioned areas, we think sufficient samples could be removed from the foot area wounds to do all the carbon dating tests on the blood. However, we believe a better representation may be gained if the above five areas can be sampled.

### b. Size of sample:

As a rule of thumb, if a 50 microgram sample of blood carbon is to be carbon dated, this sample must be doubled to arrive at the sample size before it has been carbonized. This is the purified sample. And if a 100 microgram sample of purified blood material is desired, this size is doubled to arrive at the sample which is



removed from whatever is to be tested. However, Loy has pointed out that in his experience, when carbon dating microscopic samples, it does not take much contamination to "swamp the system". Therefore, the larger the sampling, the better are the chances that the carbon date derived will be accurate. We are urging here that as large a sample as possible be permitted to be removed from the Shroud.

Our recommendation is that the blood carbon sample to be dated be no smaller than one half milligram. This means that a 2 milligram weight sample should be removed from the sampling area, placed in ampules, and sealed for the time when the carbon test will be conducted. The samples removed for carbon dating are exclusive of any sampling which would be needed to determine the identification of the material in the blood areas.

NOTE: Dr. Currie has suggested that a precision pre-weighted scale be used to facilitate the accurate weighing of samples.

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#### C. Can the Pre-1532 Fire Evidence be Carbon Dated?

STURP examined the peculiar burn areas which occur on the Shroud in four places--burns which we know from Durer's rendition must date before 1516. In their report, Drs. Ray Rogers and L. Schwalbe noted that the material looked like "pitch". ("Physics and Chemistry of the Shroud of Turin", ANALYTICA CHIMICA ACTA, vol. 135, no. 1, (Feb. 1, 1982), pp. 3-49. See esp. n. 7, p. 47). There was no chemical analysis of this material, hence, we cannot say precisely what it is.

If the "pitch" is of very ancient origin, then of course all the carbon 14 will have vanished. However, it is known that in the ancient and medieval periods vegetable and animal fats were often boiled and distilled to create a flammable liquid. If analysis could identify the materials in these burns it is quite possible that they could be carbon dated.

ASSIST therefore requests permission for enough of the burn material to be removed by our archaeobiochemist, Thomas H. Loy, assisted by our asphalt chemist, Dr. Felix C. Gzemski, for a



complete analysis to be done to identify the materials in the burns. Arco Chemicals, a division of Atlantic Richfield Co., has agreed to make their facilities available for this analysis.

We suggest that a total of 25 milligrams, taken in total from all four of the burn areas, would be sufficient for the analysis and the carbon dating. If the material can be carbon dated and that date pre-dates 1357 by a significant factor, this alone would provide Shroud historians with important information about the history of the Shroud.