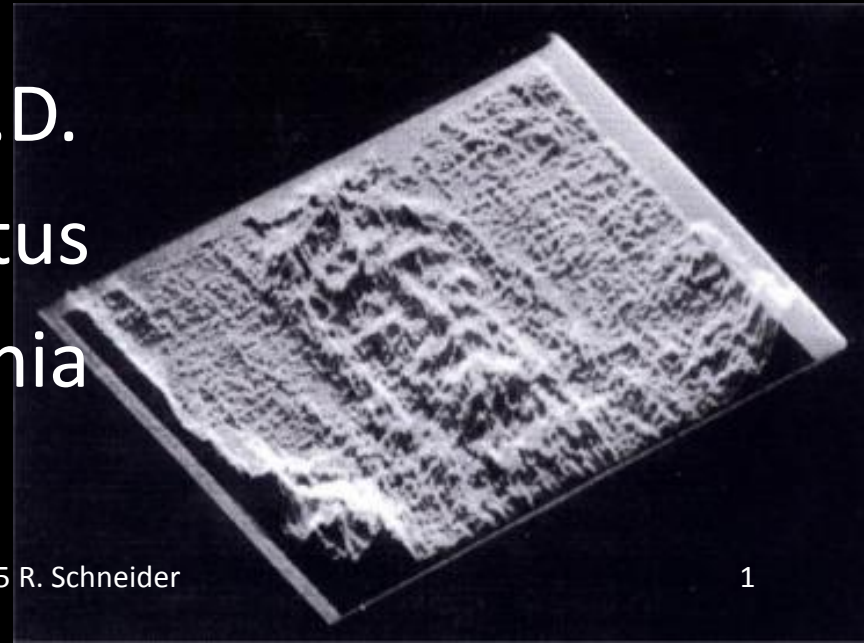




The Shroud of Turin an Enduring Mystery

Part 2: Science Encounters the Shroud

Dr. Ray Schneider, P.E., Ph.D.
Associate Professor Emeritus
Bridgewater College, Virginia

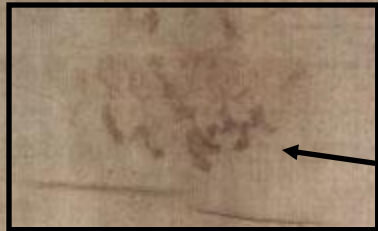




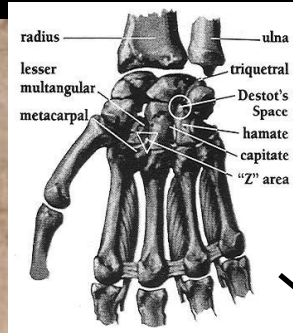
Last Week We Looked At Characteristic Markings

- Except for incidental markings of burns, water stains and other small markings what we saw was:
 - Image of a Crucified Man
 - Blood Stains
 - Flow from the wrists and feet
 - A large wound in the chest
 - Large blood and serum separated flow across back
 - Blood stains from smaller flows about the head
 - Numerous small doublet blood stains on the back, thighs, calves, and buttocks characteristic of a severe scourging

Blood Stains



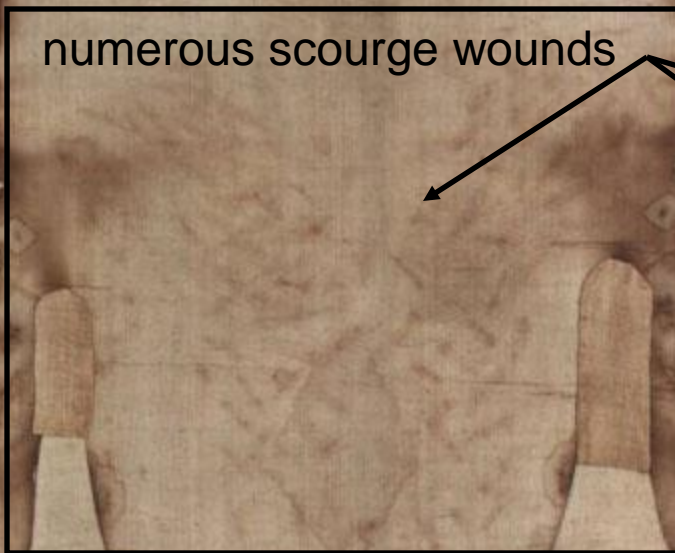
head wounds
Crown or Cap of Thorns



chest wound
consistent with
spear thrust



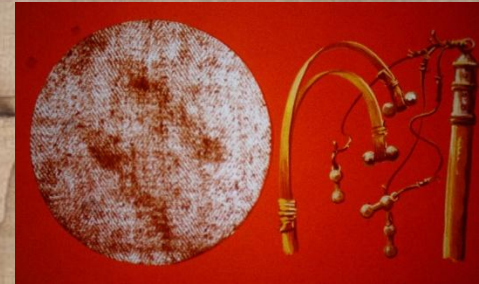
wrist wound
consistent with nails



numerous scourge wounds



foot wounds
consistent with nails



Scourge Wounds
consistent with a
Roman flagrum



blood and serum flow across the back





Today Our Focus Is On SCIENCE

- Science is partly responsible for the increased interest in the shroud, especially photography
- There Are Many Other Perspectives on The Shroud of Turin
 - History
 - Archeology
 - Religion
 - Textile Technology
- **Today Though We'll Look At The Science**

Science Discovers the Shroud



Secundo Pia



- Science paid no attention to the shroud and then ...
- On May 28, 1898 Secundo Pia photographs the Shroud of Turin for the First Time
- and was amazed to see a face emerge from the darkroom developer

Science Discovers the Shroud



Secundo Pia



The Shroud
behaved like a
photographic
negative!



A Sensation!

- Pia's photographs create a sensation!
- A group of scientists at the Sorbonne in Paris become interested
- On the advice of Yves Delage a member of the French Academy of Sciences and a scientist of international reputation,
- Paul Vignon an instructor of Science and associates take up the study of the Shroud



Paul Vignon



- For almost three years Vignon and his associates conducted an intense study of the Shroud
- He concluded:
 - "The impressions on the Holy Shroud are produced by chemical action, largely without absolute contact between the body and the cloth. Of this we have no doubt."

— *The Shroud of Christ by Paul Vignon*

© 1902 pg. 154 English Version



April 21, 1902



- Yves Delage presented their findings to the French Academy of Sciences
 - the Shroud is **not a painting** regardless of historical documents that say it is.
 - **negative image** and fidelity beyond the ability of Renaissance artists
 - **no pigments** present nor signs of artistic preparation
 - conclude **image is an imprint of a human corpse produced by the action of natural forces**
 - presented a physical theory of image formation called the **vaporograph theory**



The First Scientific Image Theory

Vignon's Vaporograph Theory

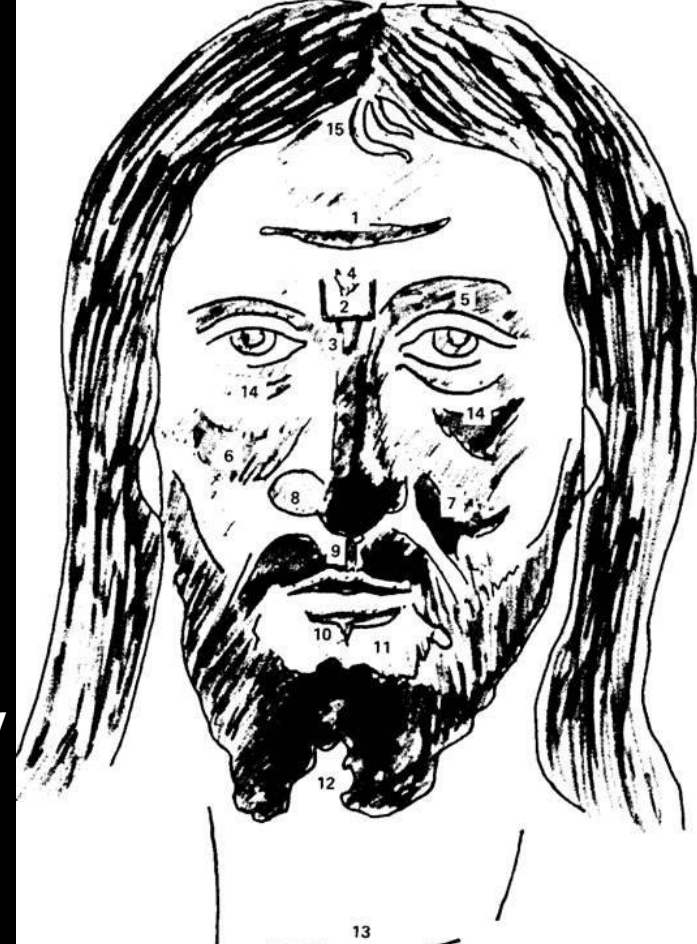
- Febrile sweat covering the unwashed body contains urea which changes to ammonia and releases an ammoniac vapor
- A mixture of spices containing aloes on the body react to produce staining vapors
- The vapors rise vertically in the humid air trapped between the body and the Shroud
- The stain is graduated on the receptive surface according to the contours of the body

— paraphrased from an account of Edward Wuenschel summarizing Vignon's theory

Vignon Markings

15 Characteristic Traits of Shroud in Artistic Depictions of Christ starting about the 6th century.

The Vignon markings - how Byzantine artists created a living likeness from the Shroud image. (1) Transverse streak across forehead, (2) three-sided "square" between brows, (3) V shape at bridge of nose, (4) second V within marking 2, (5) raised right eyebrow, (6) accentuated left cheek, (7) accentuated right cheek, (8) enlarged left nostril, (9) accentuated line between nose and upper lip, (10) heavy line under lower lip, (11) hairless area between lower lip and beard, (12) forked beard, (13) transverse line across throat, (14) heavily accentuated owlsh eyes, (15) two strands of hair



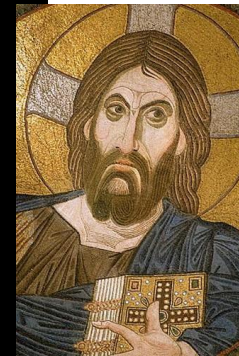
ca. 1148



ca. 1260-1289



ca. 590



ca. 1050-1100



1931 Giuseppe Enrie Photographs

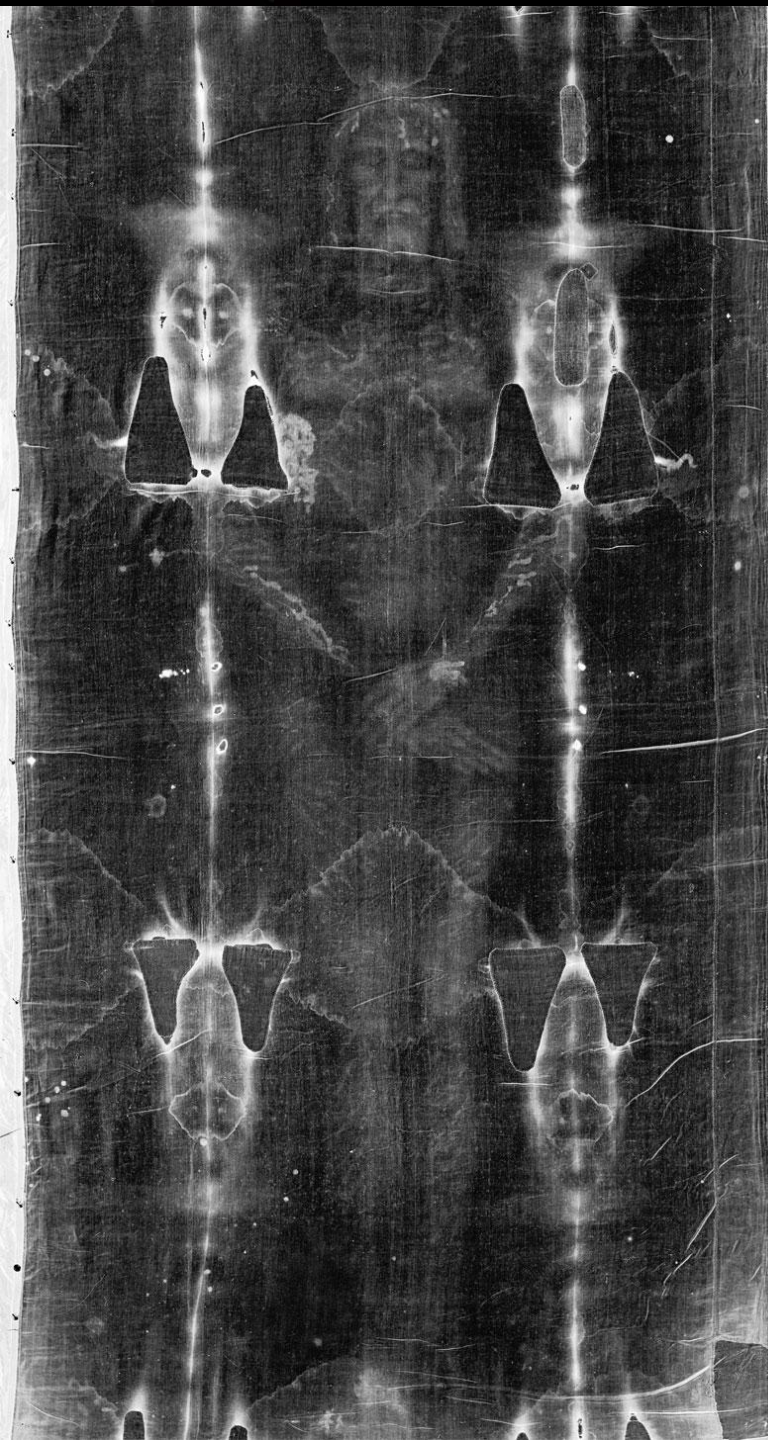


an elderly Secundo Pia attended

- May 4-24, 1931 on the occasion of the marriage of Umberto, Crown Prince of Italy, and Princess Maria Jose of Belgium
- Twelve photographs were taken on large glass plates by professional photographer Giuseppe Enrie
 - 4 of the entire Shroud
 - The entire Shroud in 3 sections on 3 plates
 - Complete dorsal
 - the face
 - the bust
 - the face in 2/3rds of original dimensions
 - the face in original dimensions
 - the wound on the wrist enlarged seven times

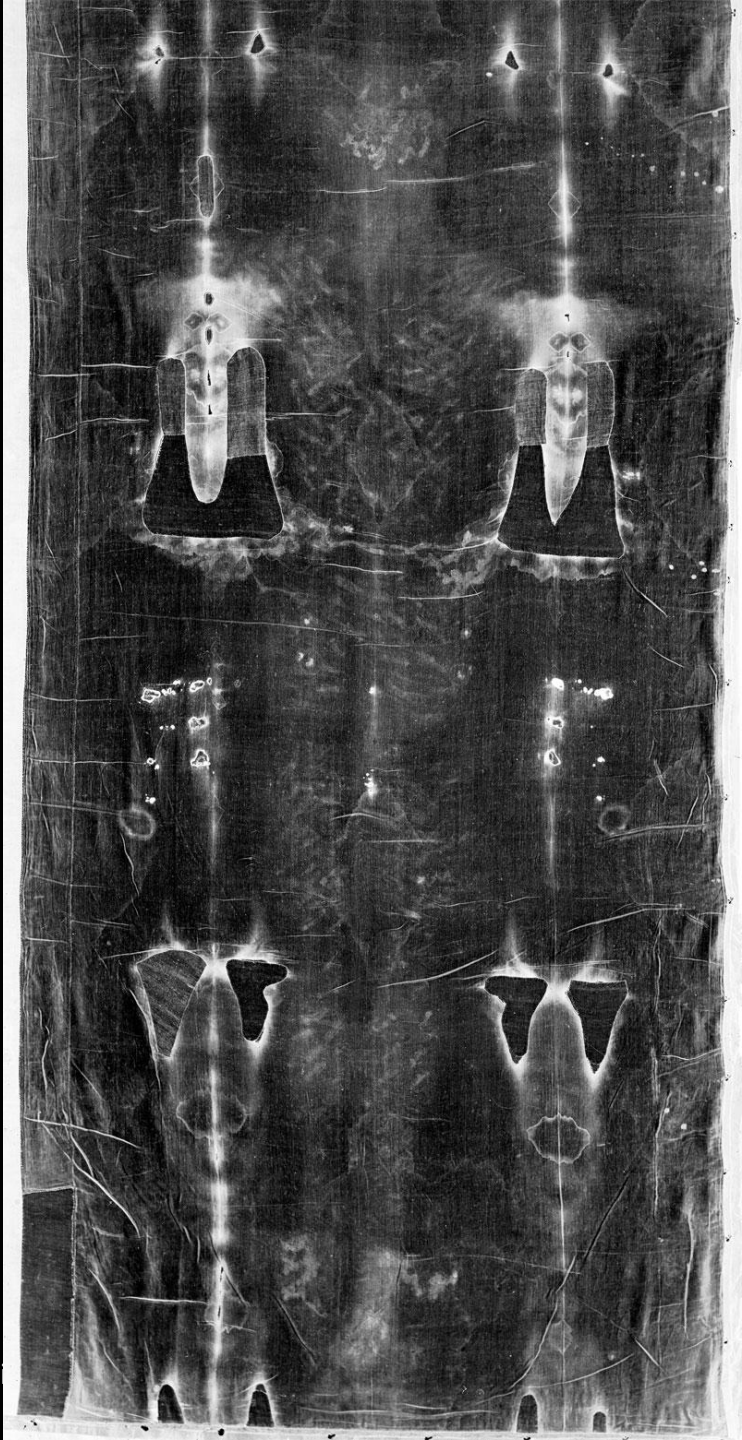


Giuseppe Enrie



**1931
Enrie
Photos
[negative]**

**Much Superior
to Pia's Photos
due to the
More Mature
Technology
in 1931**



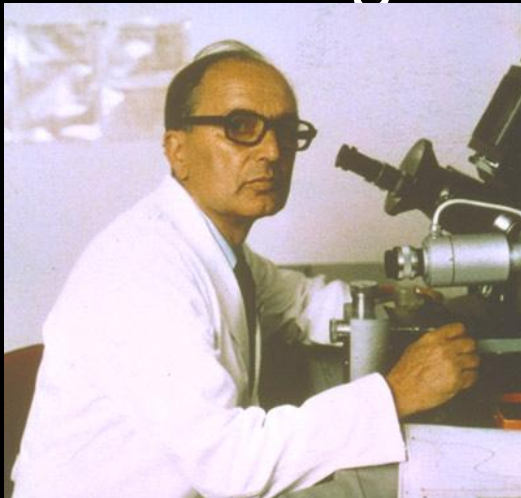


Beyond Visual Examination

- A Commission formed by Cardinal Pellegrino to advise him on scientific investigation of the Shroud met on June 16-17, 1969
- Four years of diplomatic activity and preparation followed until in January 1973 approval to conduct the first scientific studies of the Shroud was received from Count Umberto the exiled king of Italy and owner of the Shroud

November 23, 1973

- Swiss Criminologist Dr. Max Frei takes 12 tape samples of the dusts on the Shroud from non-image areas



Sticky tape on microscope slides taken from Shroud of Turin by Dr. Max Frei (Courtesy of Frau Gertrud Frei-Sulzer)



- He subsequently discovered in the dusts the pollens of species of specifically Palestinian plants
- The adhesive tape technique was subsequently used by Frei again and by STURP in 1978

Pollens



The conclusions of the Swiss botanist are interesting: "The presence on the Shroud of pollen of **29 plants of the Near East**, and especially of 21 plants that grow in the desert or the steppes, directly leads to the hypothesis that the Shroud, now preserved in Turin, in the past was exposed to open air in countries where these plants are part of the normal vegetation. (...) **Three-quarters of the species found on the Shroud grow in Palestine**, of which 13 species are very characteristic or unique of the Negev and the Dead Sea area (halophyte plants). The palynology thus allows us to say that during its history (including manufacturing) the Shroud resided in Palestine. This result does not explain the presence of pollen of steppe plants that are missing in Palestine or are extremely rare there. According to palynology, the Shroud must have been exposed to open air in Turkey because **20 of the found species are abundant in Anatolia (Urfa, etc..)** and **four around Constantinople**, and are completely lacking in the Central and Western Europe."

Quoted by Emanuela Marinelli in

<https://www.shroud.com/pdfs/marinelli2veng.pdf>

1973 Raes Sample



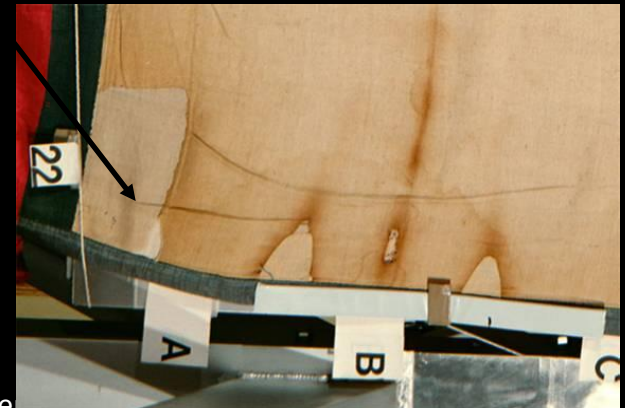
- November 24, 1973 Gilbert Raes was permitted to take small samples of the Shroud:
 - 2 threads 12mm weft and 13 mm warp, and
 - 2 larger samples

- 40 mm x 10 mm from side strip
- 40 mm x 13 mm from corner



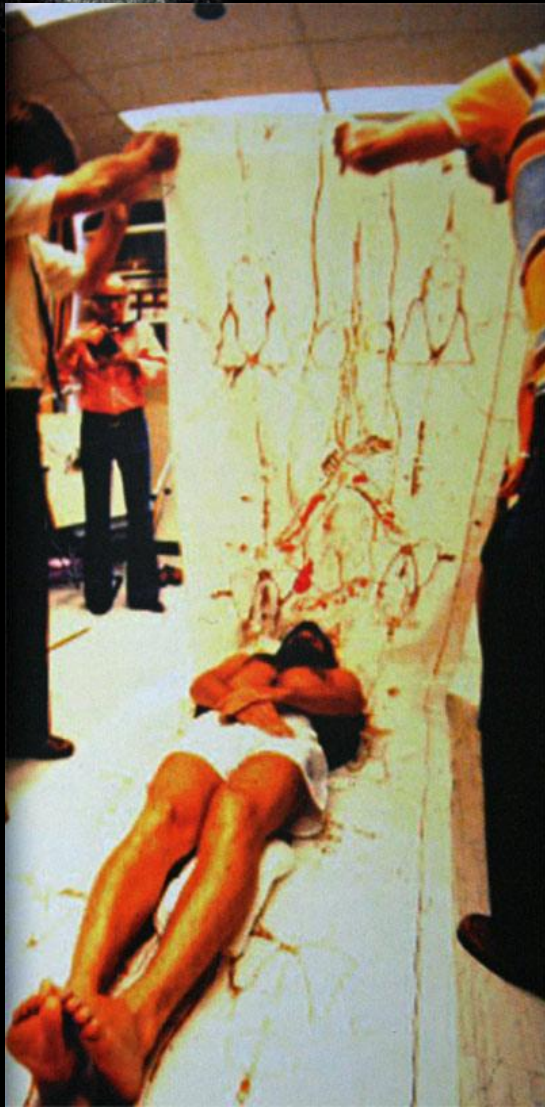
	Warp	Weft
Threads/cm	38.6	25.7
Size of thread	16.3	53.6*
Twist	Z	Z
tex = gm/Km		
cotton intrusions		
<i>gossipium herbaceum</i>		

normal lighting



Topology of the Shroud

work done c. 1974 to 1976



John Jackson and Eric Jumper, two young Air Force Captains investigate the Shroud.

They concluded that the image is consistent with a cloth wrapped body. Jumper says, "***There is only one way to correctly wrap the body.***"

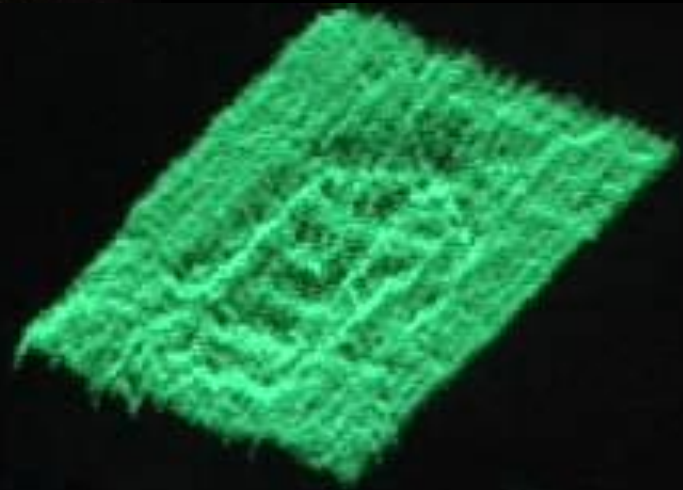


1976 the Discovery Made the News



John Jackson

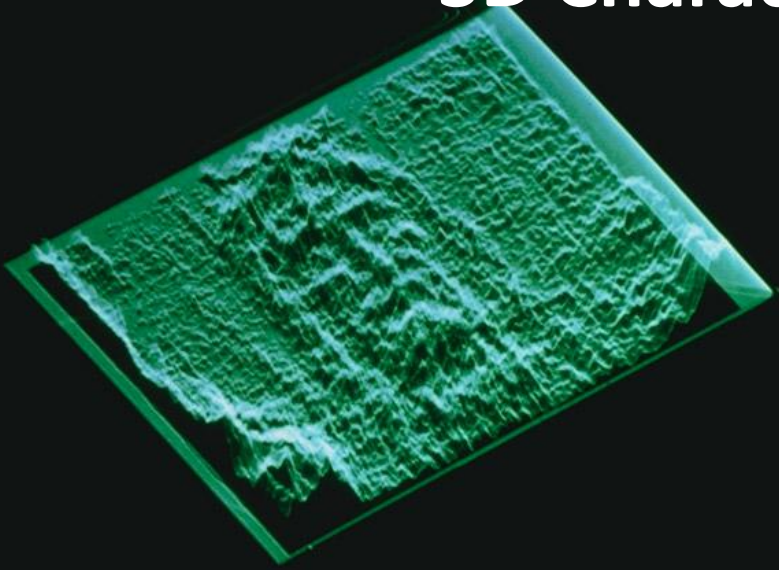
Eric Jumper



February 19, 1976

VP-8 Analyzer Reveals 3D Character of Shroud Image

Light and Dark translate into
vertical relief using the VP-8

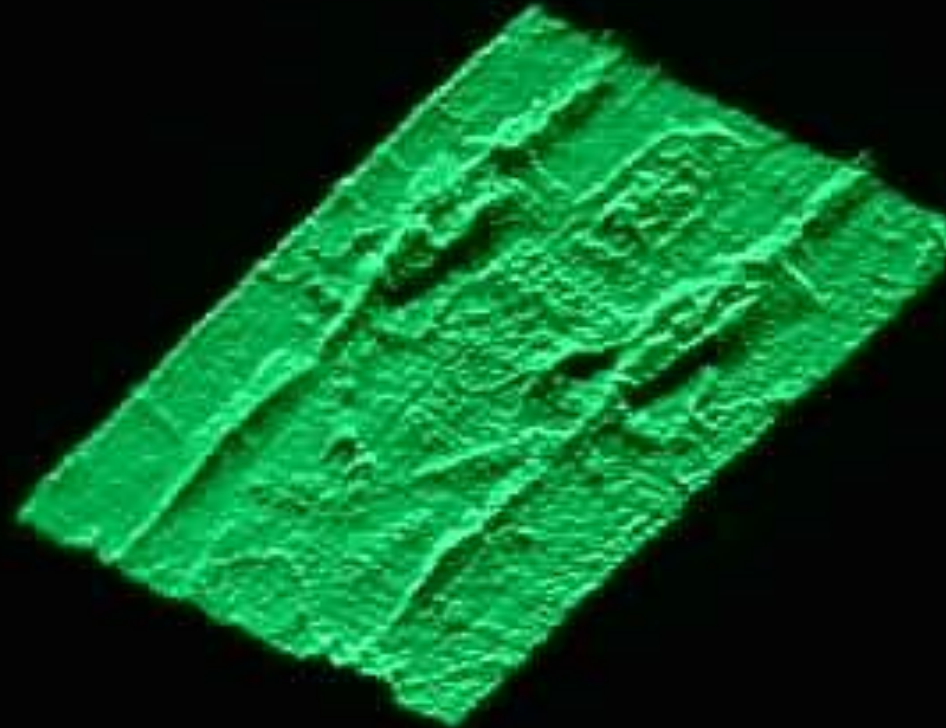


This 3D property of the shroud image further revealed when at John Jackson's prompting, Bob Mottern of Sandia Laboratories put an Enrie photograph in the VP-8 image analyzer on February 19, 1976

More VP-8 Examples

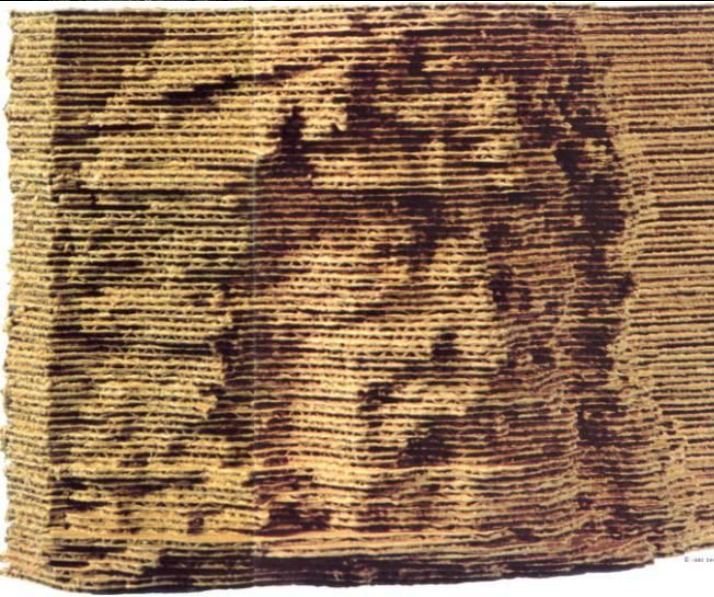


Vertical Relief Gain



Rotation

Microdensitometer Readings Confirmed a Cloth to Body Distance Intensity Relationship



Line Scan Models were methodically cut out of corrugated cardboard by volunteers and a three-dimensional figure emerged from the background noise.

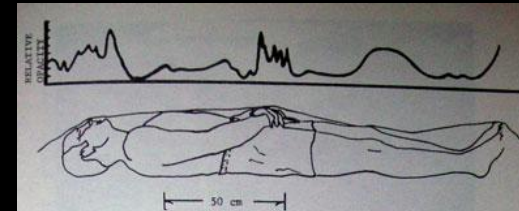
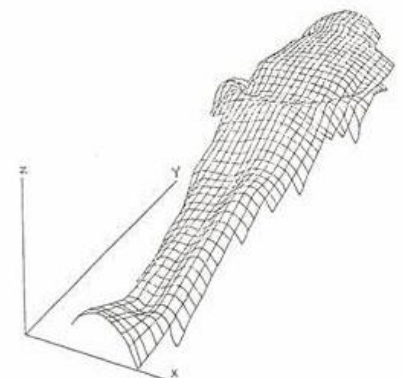
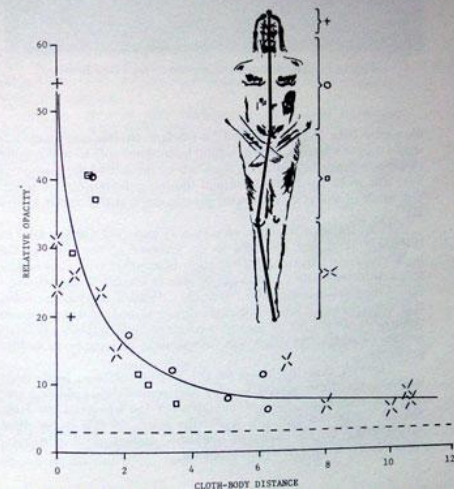


Figure 20. Relative positions of the ridge line of the cloth and the body profile below. Image intensity scan shown above figure.



Three Dimensional Image

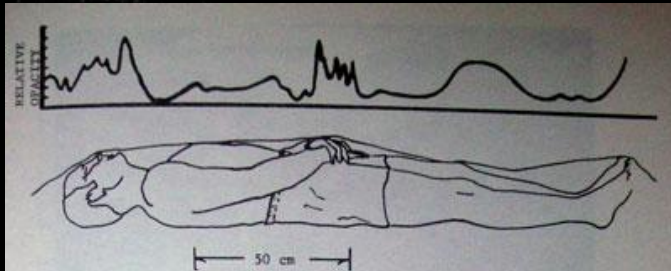
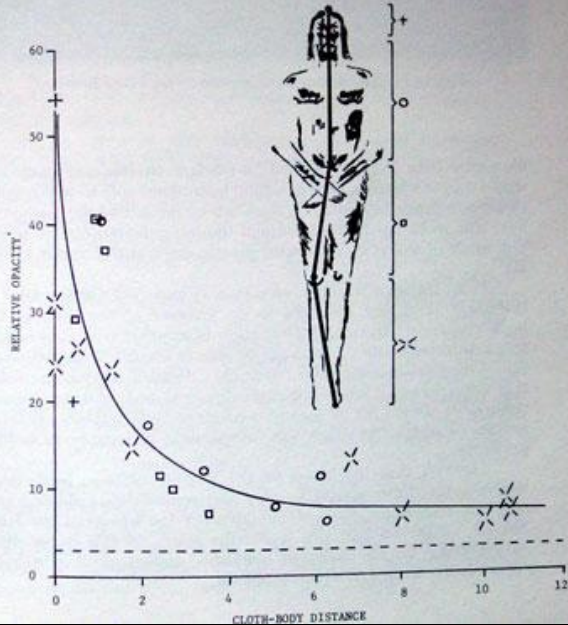
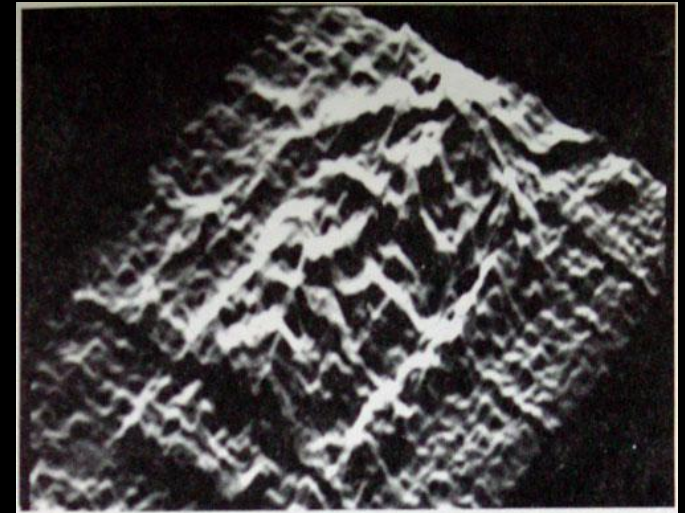


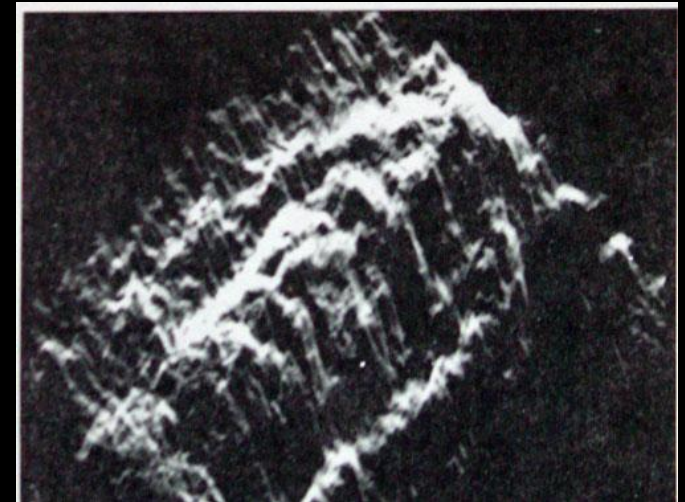
Figure 20. Relative positions of the ridge line of the cloth and the body profile below. Image intensity scan shown above figure.



VP-8 Image



Transfer Function at left applied to Shroud



A Later Result

<http://shroud3d.com/>

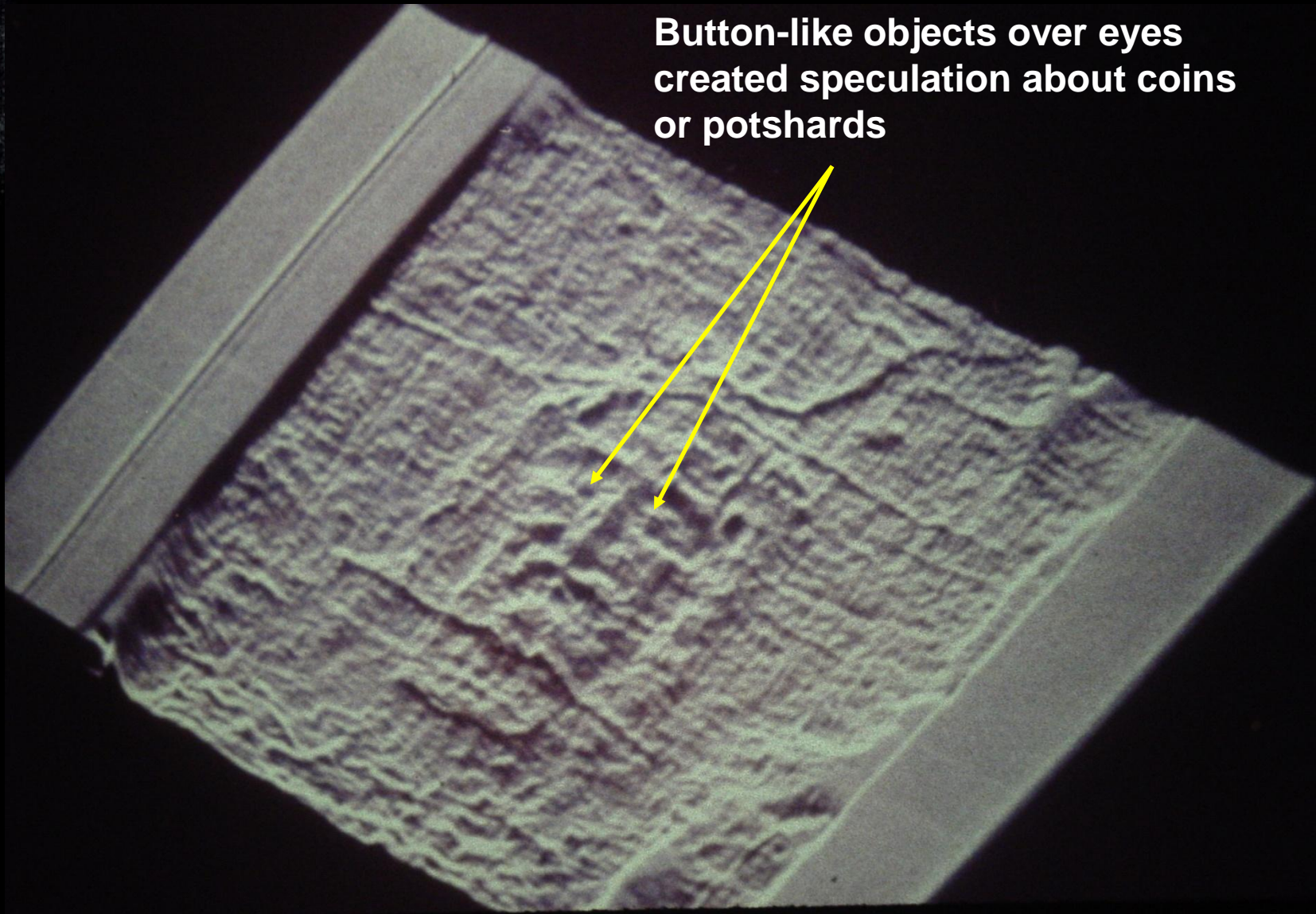
Petrus Soons

Pete Schumacher



VP-8 Image Analyzer

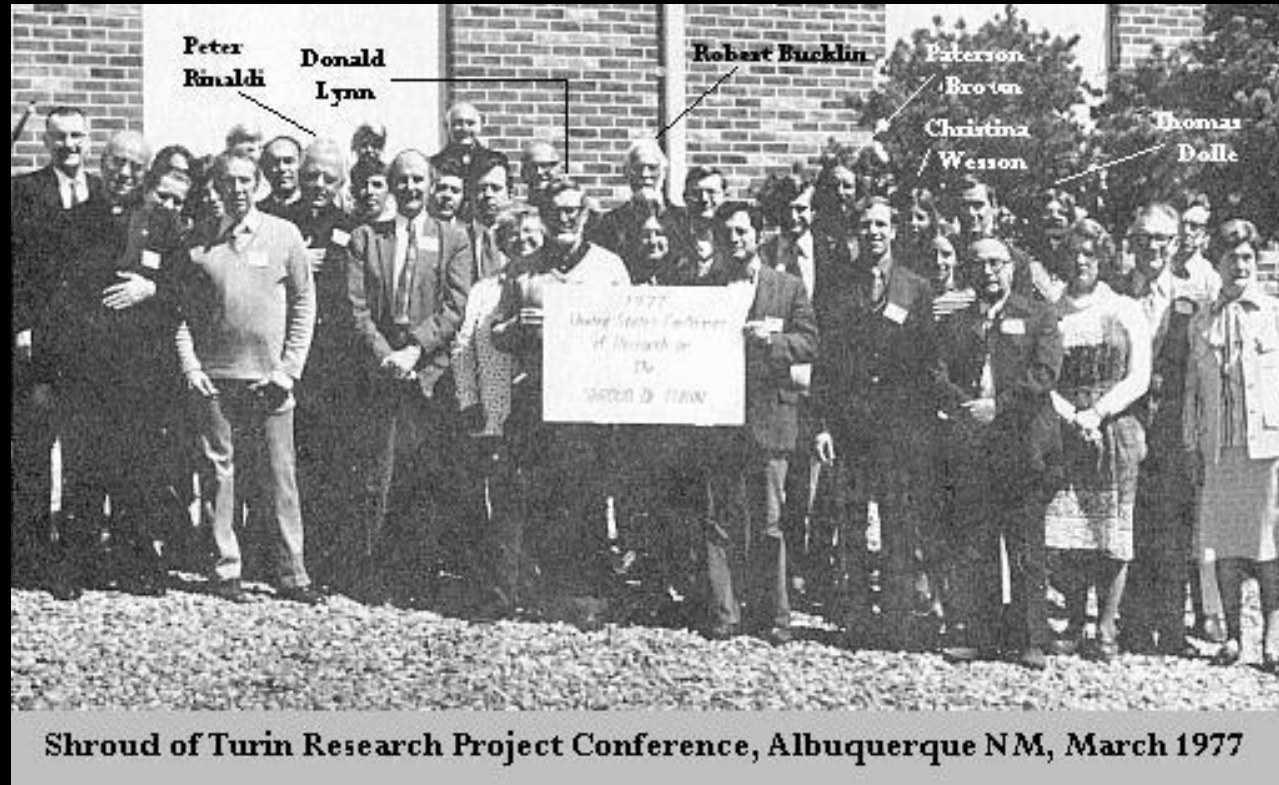
Video taken at 2008
Shroud Conference in
Columbus, Ohio



**Button-like objects over eyes
created speculation about coins
or potshards**

March 23-24, 1977

United States Conference of Research on The Shroud of Turin, Albuquerque, New Mexico



- Jumper and Jackson Put U.S. Science on the Shroud Map
- Encouraged the prospect of a serious scientific study of the Shroud
- In September 8 STURP members go to Turin and distribute copies of the proceedings of the March 1977 meeting. The authorities are impressed.



May 1978 Planning Conference Colorado Springs

- **No Money, No Organization, No Plan, No Equipment** and No Firm Commitment from Turin to even have access to the Shroud
- Eric Jumper suggested planning in fixed time 12 hour blocks: 12, 24, 36, 48, 96 hours
- Tom D'Muhala of Nuclear Technology Corp. stepped up to the plate to help with organization and funding
 - Organized STURP as tax exempt corporation
 - Designed a complex table to support the Shroud during tests
 - Solicited equipment donations from manufacturers
 - Organized a Dry Run on Labor Day Weekend 1978 to rehearse the scientific tests to be performed
 - Arranged for a mock-Shroud to be created to help with the tests
- **And it happened in less than five months**

STURP 1978

REPORT ON THE SHROUD of TURIN



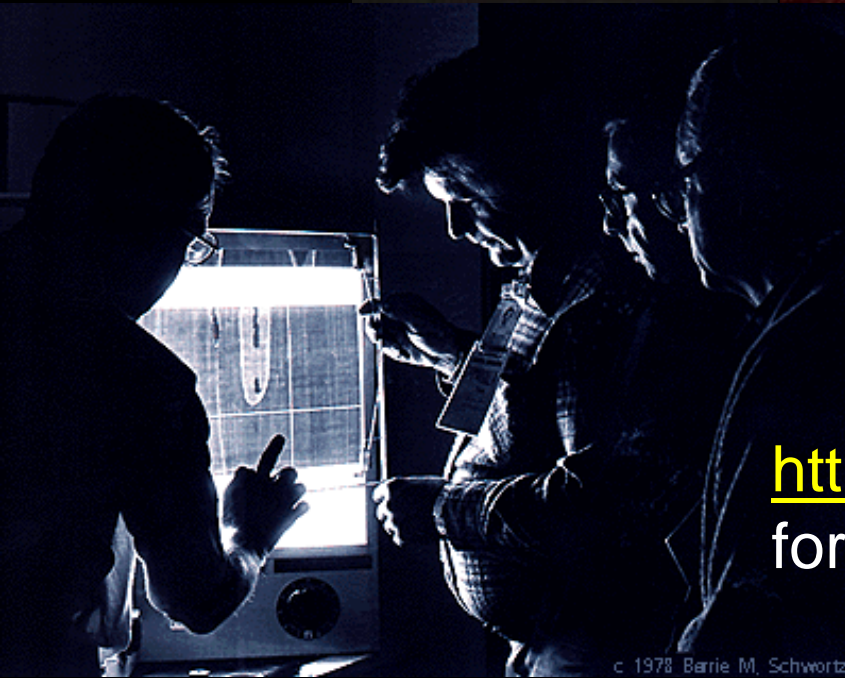
The story of 40 American scientists who, using modern instrumentation, tackled the problem of how the image was formed—and the remarkable conclusions to which they came.

DR. JOHN H. HELLER

MEMBER OF THE SHROUD RESEARCH TEAM



c 1978 Barrie M. Schwartz



c 1978 Barrie M. Schwartz

<http://www.shroud.com/history.htm>
for more on the history of the Shroud



Intermission

Let's take 10 minutes to stretch



Before We Go On

- Did anyone find some interesting things since last time they'd like to share with the group?
- Do you have any questions that you'd like to see addressed in this session or future sessions?
- How do you think the course is going so far?

1978 STURP

The Shroud of Turin Research Project

\$2.5 M of donated scientific equipment arrives in Turin only to be held up by customs at the last minute it is released and the most intense scientific investigation of the Shroud ever performed begins.



Planning session, Shroud of Turin Research Project, Turin, Italy, Oct. 1978



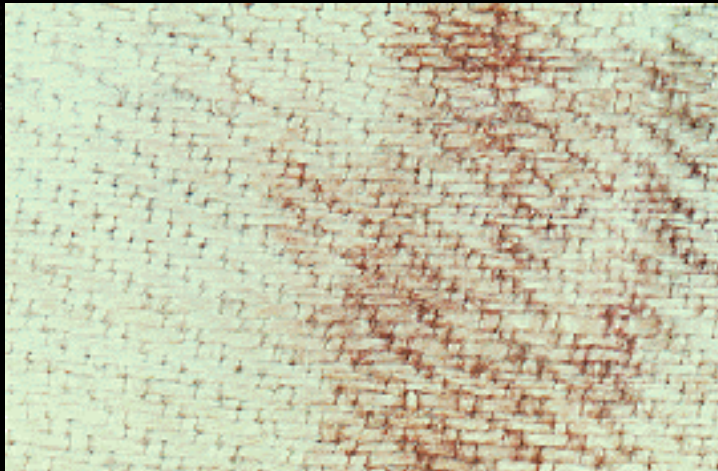
Extraordinary Battery of Tests

- High Resolution Visible Light Photography
- Photo Microscopy
- X-Ray Radiography
- Infrared Reflectance Spectroscopy
- Ultraviolet Reflectance, Fluorescence Photography
- Visible Narrowband and Wideband Photography
- Adhesive Tape Sampling
- Optical Transmission Photography

STURP carefully blocked out tests ...

Hour	Test Group	# Personnel Required	Time Allocated [hours]	Remarks
1			4 1/2 hours	
2			photomosaic	
3	Photography	8	6	
4	(block 1)		1 1/2 hours	
5			spectral	
6	coverage			
7	X-Ray Radiography	7	2	Preliminary
8				test exposures
9				
10	X-Ray Fluorescence	6	4	Foot blood
11	(block 1)			
12				
13	Infrared (block 1)	6	1	I/R photo test exp.
14	Spectroscopy (block 1)	...		

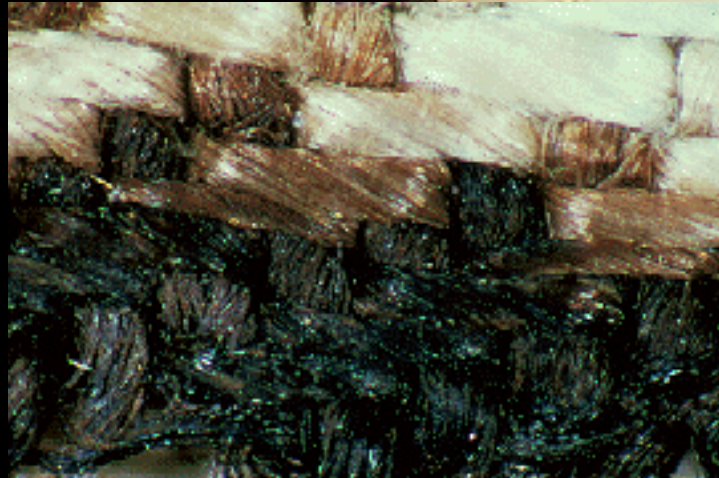
Photomicroscopy



blood stains dorsal image



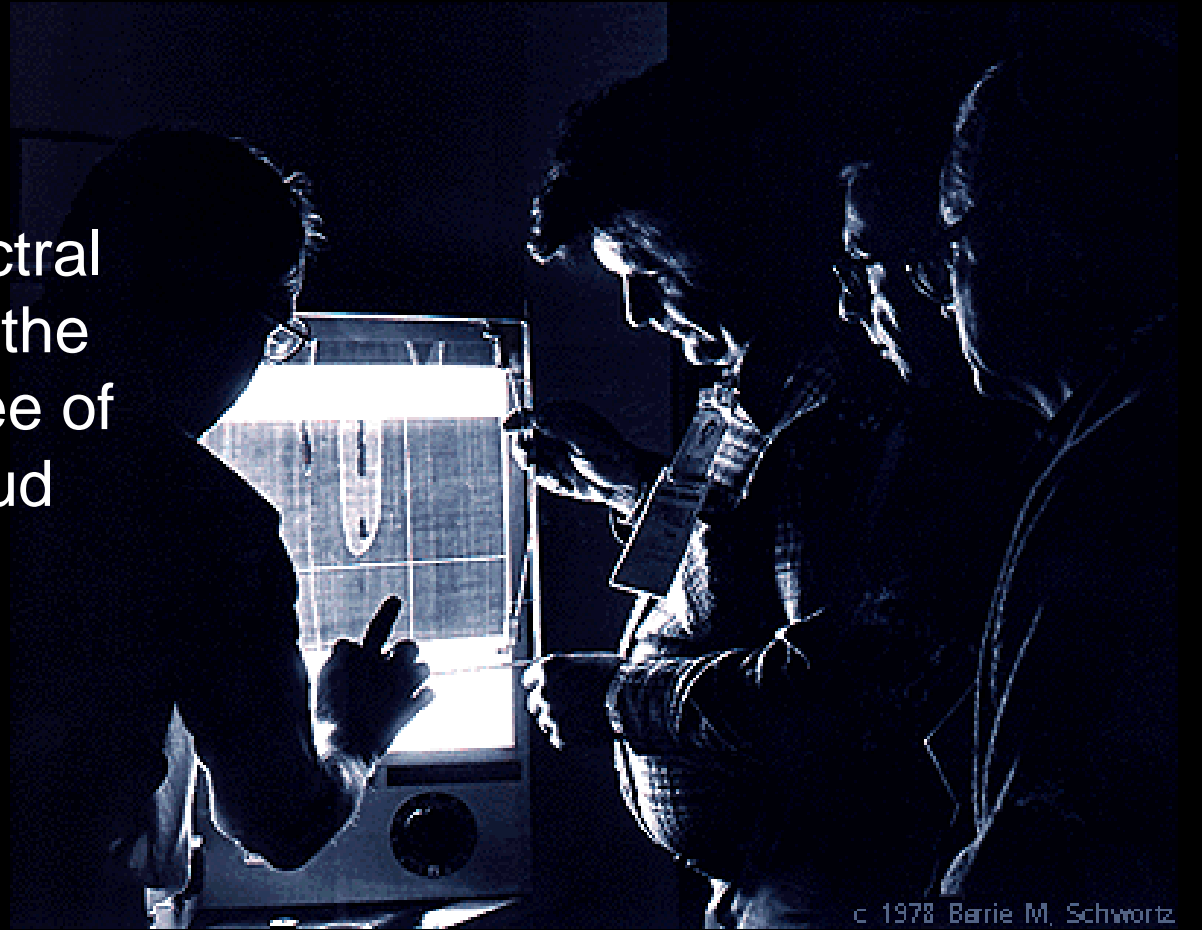
microscopic view of an image fiber



burn detail

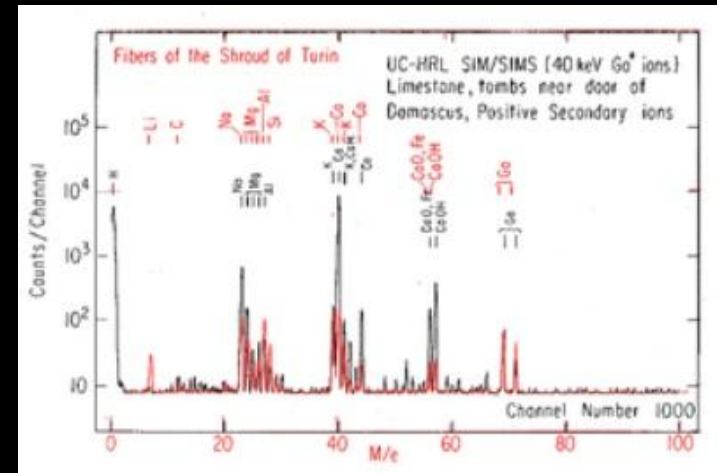
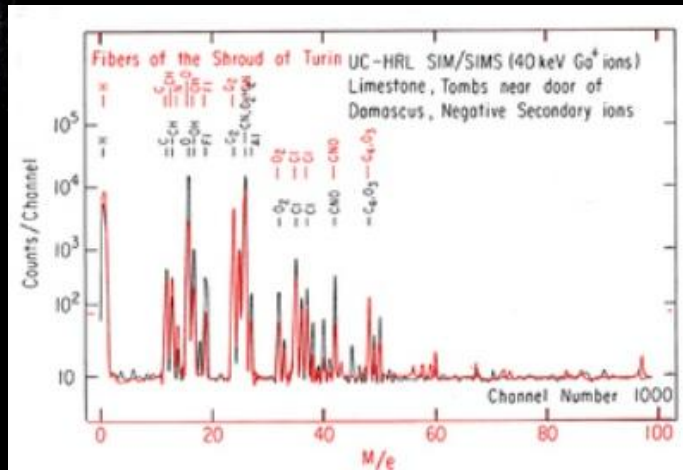
STURP Team Examines X-Ray Radiography

STURP detects spectral responses of dirt on the Feet, Nose, and Knee of the man of the Shroud



c. 1978 Barrie M. Schwartz

Rare Travertine Aragonite



- Dirt Found on Nose, Left Knee, and Heel. Rare Calcium Carbonate Form Found On Heel Matches Samples from Jerusalem
- Dr Ricardo Levi-Setti (University of Chicago) compared shroud sample with samples collected in Jerusalem using high resolution scanning ion microprobe observing an excellent match

Frei and Rogers take Tape Samples of Shroud

- Frei: 25 samples in non-image areas
- STURP: 37 samples
 - 19 dorsal, 17 ventral, 1 of Holland cloth



An Enduring Mystery ©2015 R. Schneider

c 1978 Barrie M. Schwartz

(c)1978 Barrie M. Schwartz

**Back of the Shroud
Seen for 1st time
in 400 years**



(c) 1978 Barrie M. Schwartz

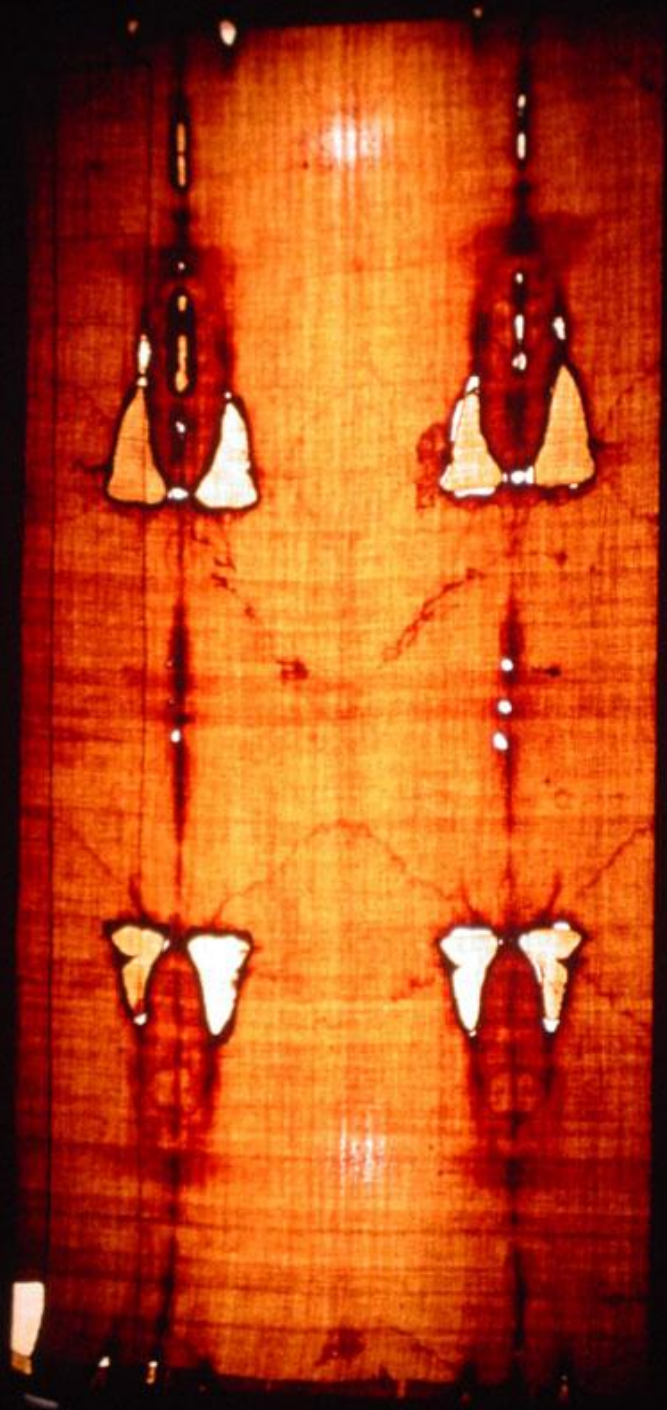


The Shroud in Transmitted Light

- The blood stains are dense and the image markings are ephemeral (note horz. bands)



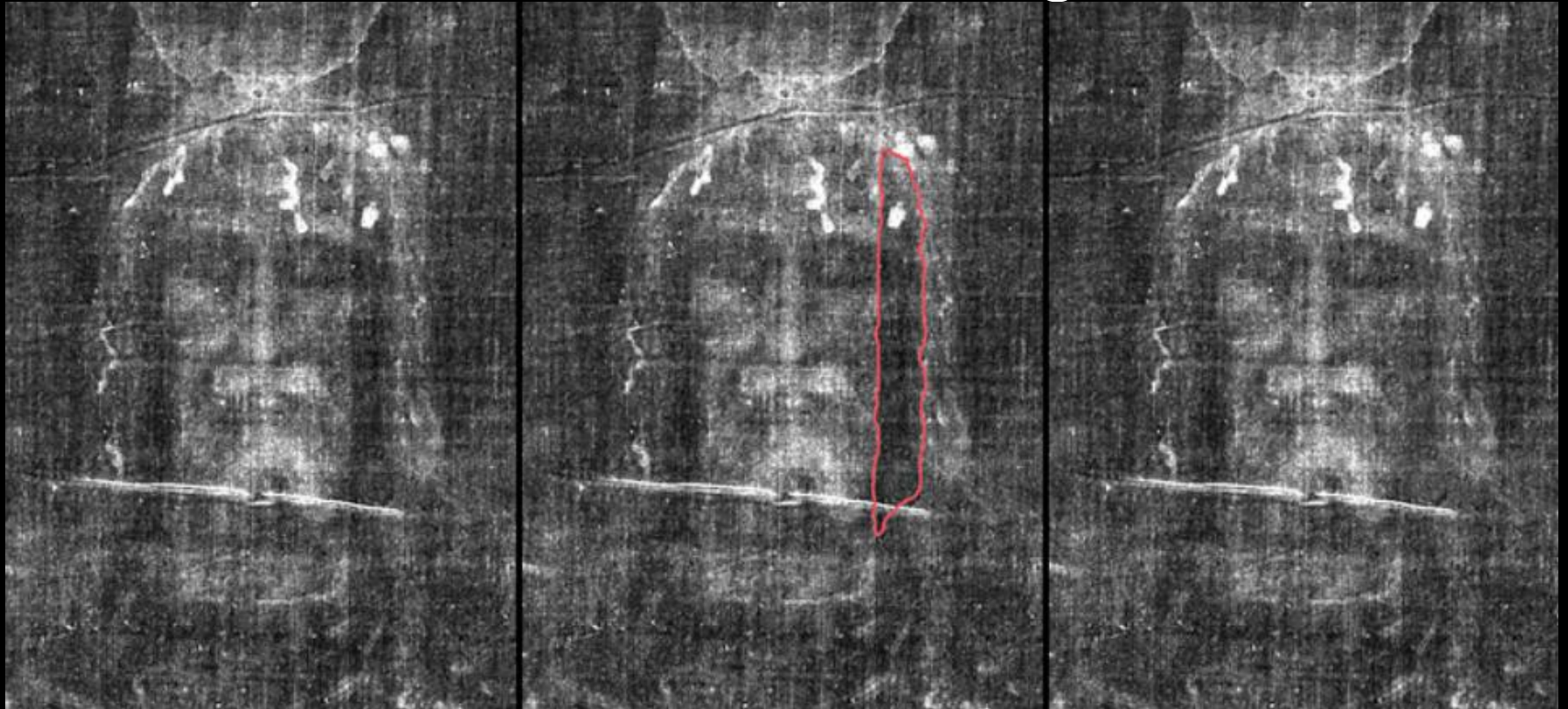
An Enduring Mystery ©2015 R. Schneider



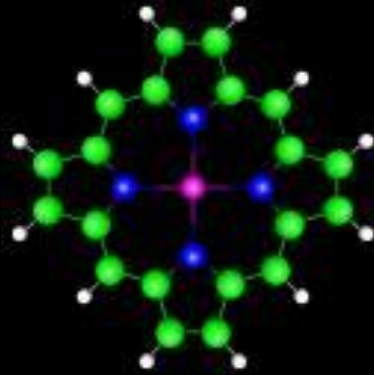
A Banding Example

<http://shroud3d.com/making-of-the-holograms/making-holo-expertise-barrie-schwartz>

- In the apparently blank "band" by the left side of the face there is attenuated image information

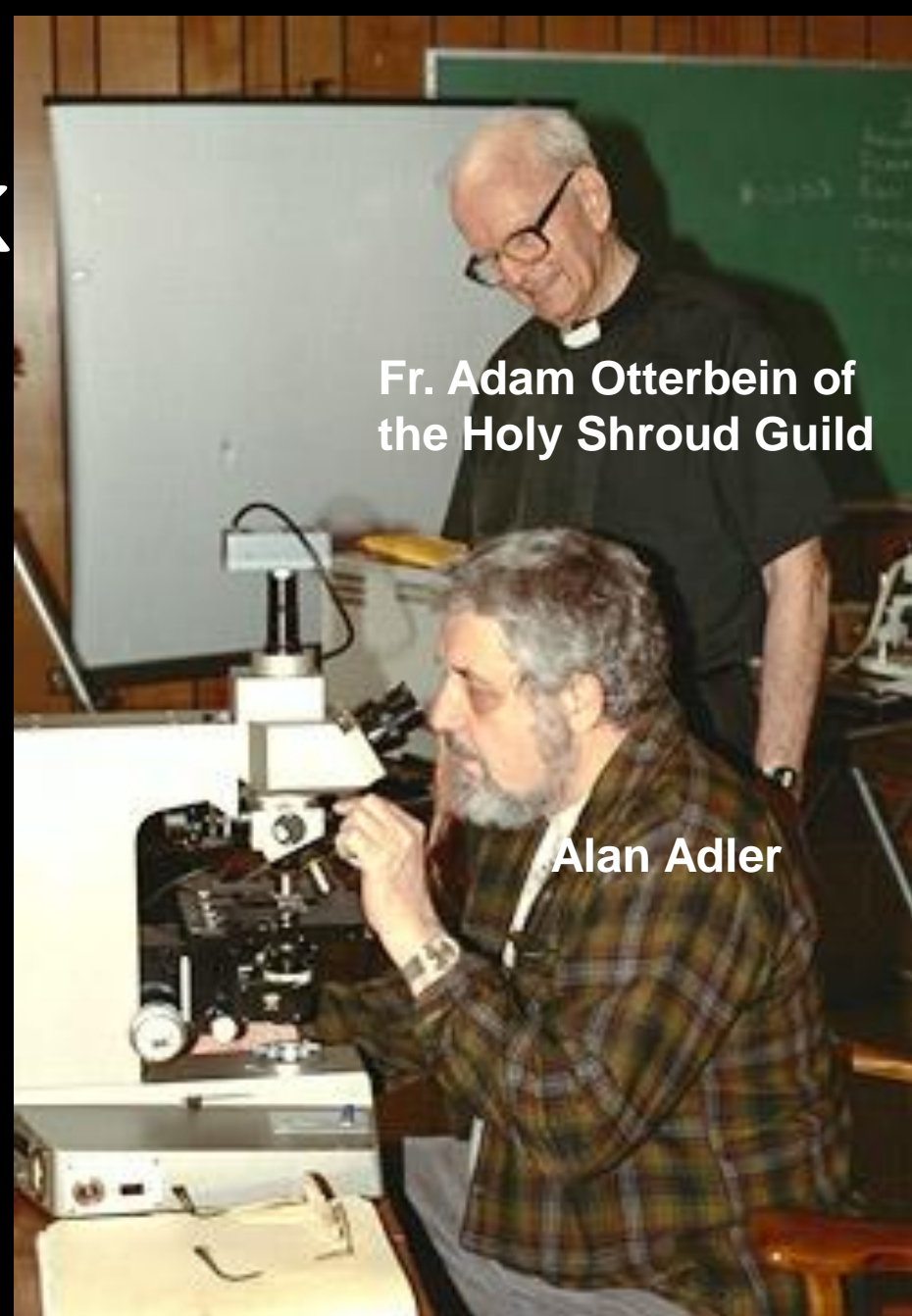


Blood Work



porphyrin ring

- Alan Adler, an expert porphyrin chemist, and his associate John Heller confirmed through a range of chemical testing that the blood markings on the Shroud were human blood.
 - florescence of the porphyrin ring



Fr. Adam Otterbein of the Holy Shroud Guild

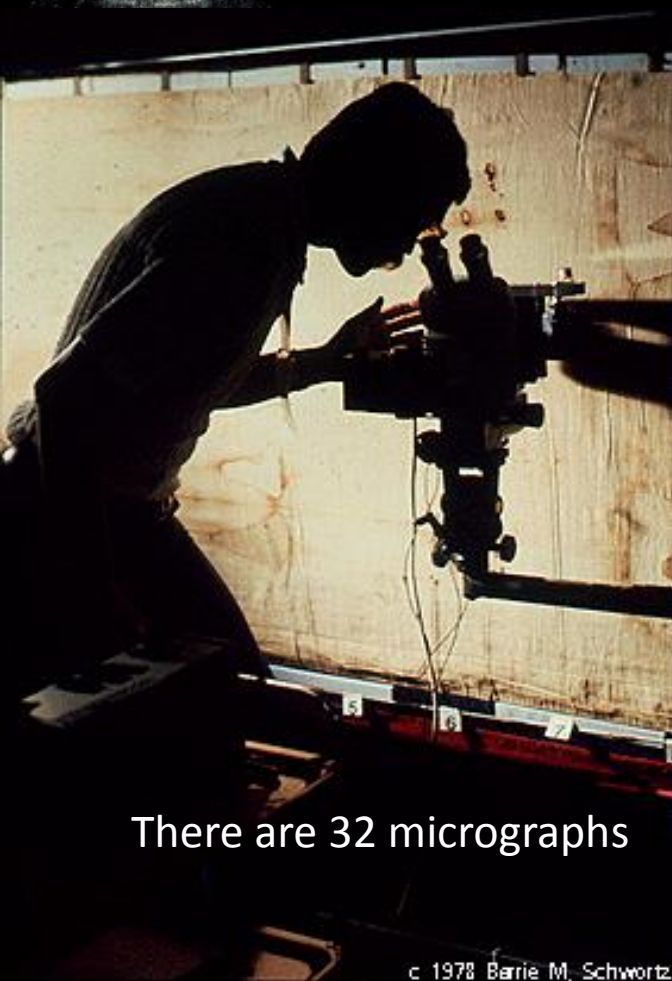
Alan Adler



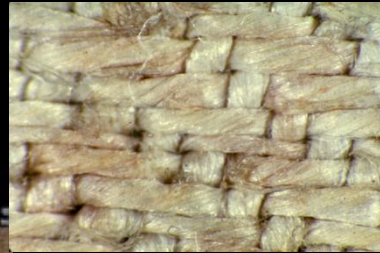
Confirmation of Whole Blood

1. High Fe in Blood Areas by X-ray fluorescence
2. Indicative reflection spectra
3. Indicative microspectrophotometric transmission spectra
4. Chemical generation of characteristic porphyrin fluorescence
5. Positive hemochromagen tests
6. Positive cyanmethemoglobin tests
7. Positive detection of bile pigments
8. Positive demonstration of protein
9. Positive indication of albumin specifically
10. Protease tests, leaving no residues
11. Microscopic appearance as compared with appropriate controls
12. Forensic judgment of the appearance of the various wound and blood marks

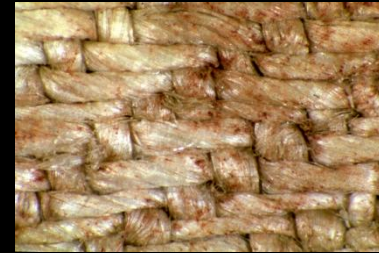
Some Mark Evans Micrographs



There are 32 micrographs



ME-5 small of back blood x32



ME-6 Dense blood small of back x32



ME-29 nose image location D13 x64



ME-15 clear cloth location C13 x32



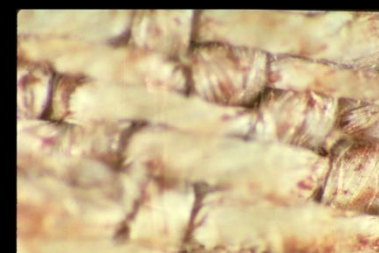
ME-17 dorsal foot blood x6.3



ME-20 image eye loc D13 x32



ME-19 blood and image foot x32



ME-24 blood small of back C8 x54



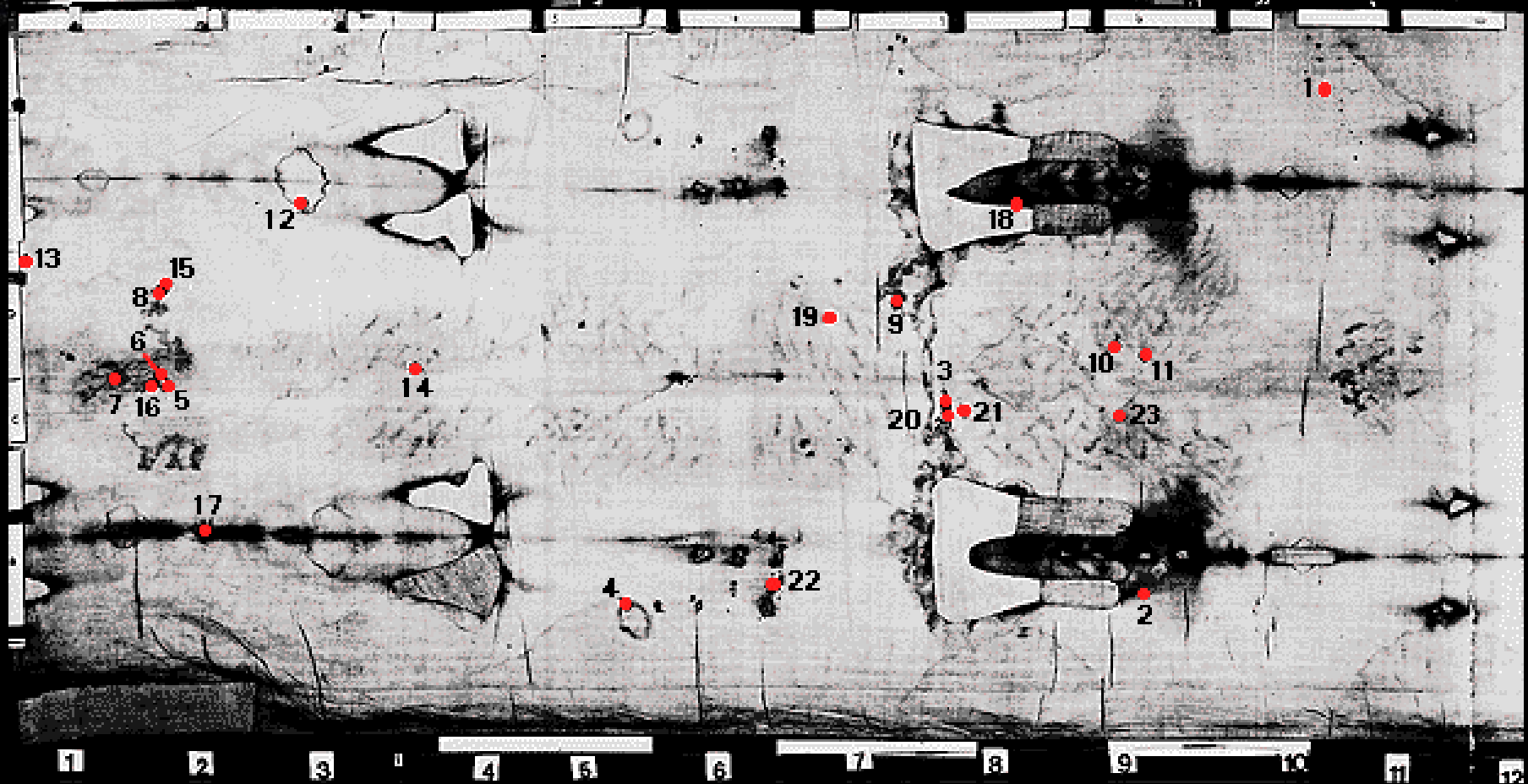
ME-12 wax loc F11 x6.3

c 1978 Barrie M. Schwartz

<https://shroudofturin.files.wordpress.com/2013/11/mark-evans.pdf>

Dorsal Microphotography Map

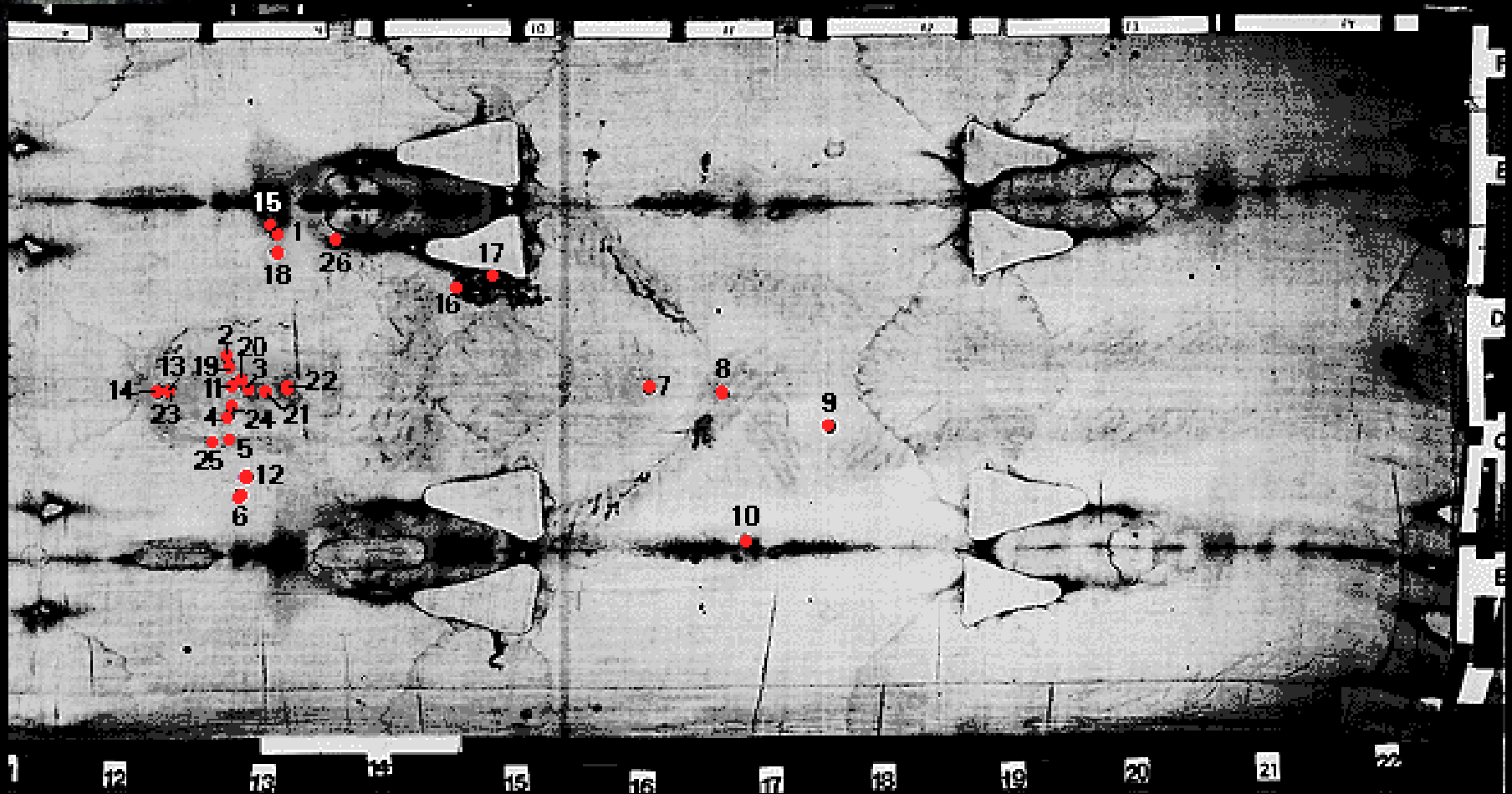
<http://www.sindonology.org/photomicrographs.shtml#locations>



<https://www.shroud.com/mapping.htm>

Ventral Microphotography Map

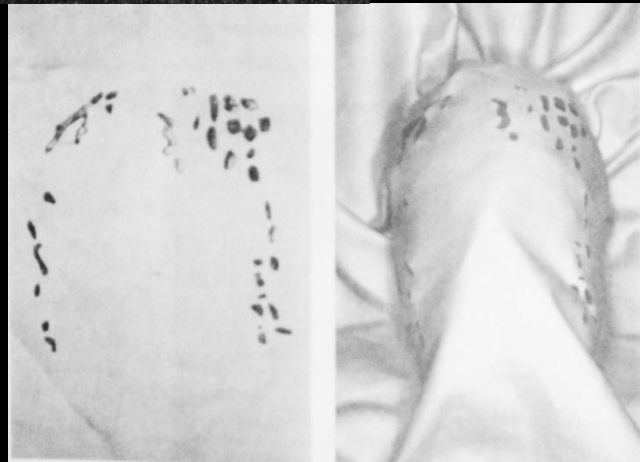
<http://www.sindonology.org/photomicrographs.shtml#locations>



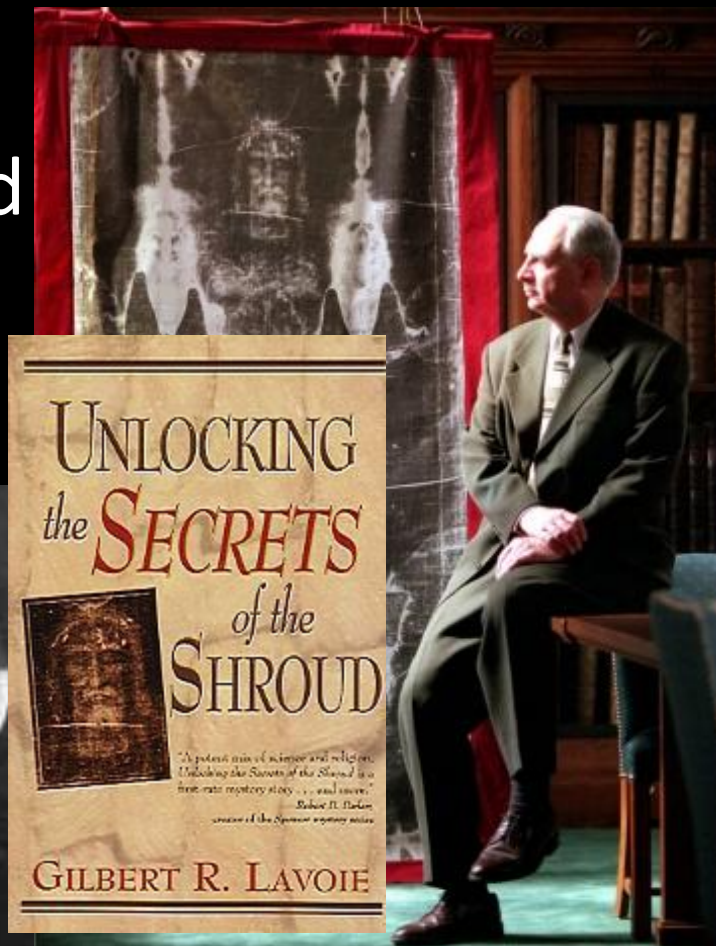
<https://www.shroud.com/mapping.htm>

A Blood Mystery

- Why does blood that should be on the face appear to be in the hair?

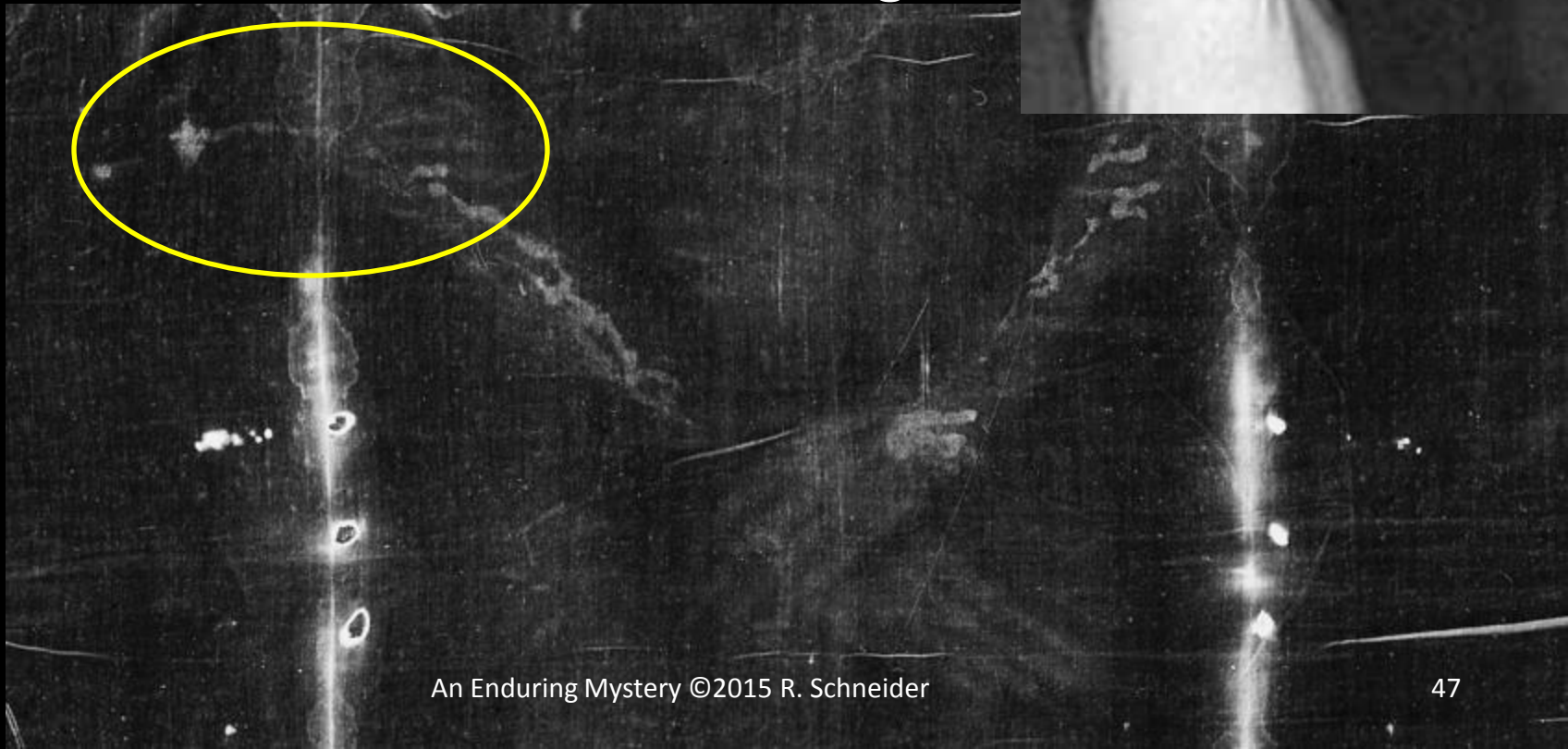


Cloth shift
between blood
and image
transfer



Blood Transport

- A Cloth-Wrapped Body
 - Blood runs down the arm and drips off the elbow onto the enfolding cloth





STURP Findings

- the shroud is not a painting, no pigment, no directionality, not an albedo image
- the image encodes cloth to body distance
- the image is ephemeral no more than 15 to 30 microns thick (one or two fibrils)
- the chromophore is straw-yellow, oxidized linen
- fluorescent halos surround blood
- blood went on before image (no image beneath blood)
- the blood is human blood, work by others has shown it is type AB and male (DNA testing)
- calcium and strontium and iron are uniformly present on the shroud in small quantities consistent with ancient manufacture of linen



Further Findings

- the image is medically accurate
- venous and arterial blood flows are accurate
- distortions are consistent with a cloth wrapped body
- forensic medical examiners have no problem interpreting the image
- wounds are entirely consistent with 1st century practices
- faint and incomplete images of flowers and coins and others (*speculative*)



1978 STURP Conclusions

“The Shroud image is that of a real human form of a scourged, crucified man. It is not the product of an artist.”

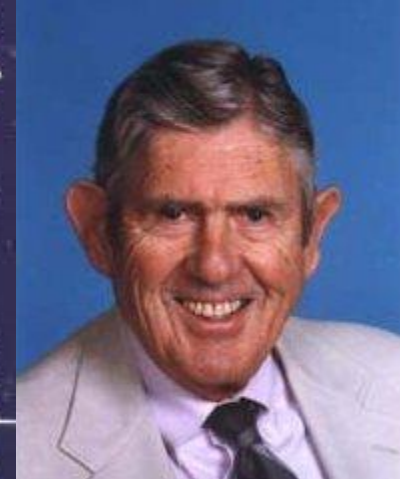
“The bloodstains are composed of hemoglobin and also give a positive test for serum albumin.”

“The image is an ongoing mystery and until further chemical studies are made . . . the problem remains unsolved.”



May 1977

The Carbon Dating Chase Begins



Dr. Harry Gove

- Harry Gove, Ted Litherland, and Kenneth Purser develop Accelerator Mass Spectrometry (AMS) — 100 to 1000 times more sensitive than previous Libby counter Carbon-14 dating method.
- David Sox, an English cleric sends Gove a letter in June saying that at last this makes Carbon Dating of the Shroud feasible.
- In 1978 Gove visited Turin to explore the possibility of Carbon Dating the Shroud



Planning a Test

- Competition Developed to Control the Carbon Dating of the Shroud
 - March 1979 Gove attends a STURP meeting
 - Initially Brookhaven and Rochester proposed making measurements with STURP involvement
 - The issue becomes a tug of war among factions. Gove does not want STURP involved.



1982 A Bootleg Carbon Date

- Alan Adler and John Heller get a thread from the Raes sample informally C14 tested
- the Thread is divided in two
- One ends tests 200 a.d. while the other end tests 1000-1200 A.D.



1983

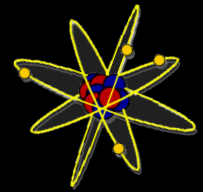
- Six Carbon Dating Labs receive test samples #1 Ancient Egyptian Linen and #2 a more recent cotton from Peru
- Labs are Arizona, Bern/Switzerland, Brookhaven, Harwell, Oxford, and Rochester
- The Shroud is given to the Vatican by the House of Savoy
- In 1984 STURP gives Turin a plan to test the Shroud. 26 tests. #6 Carbon Dating



1986

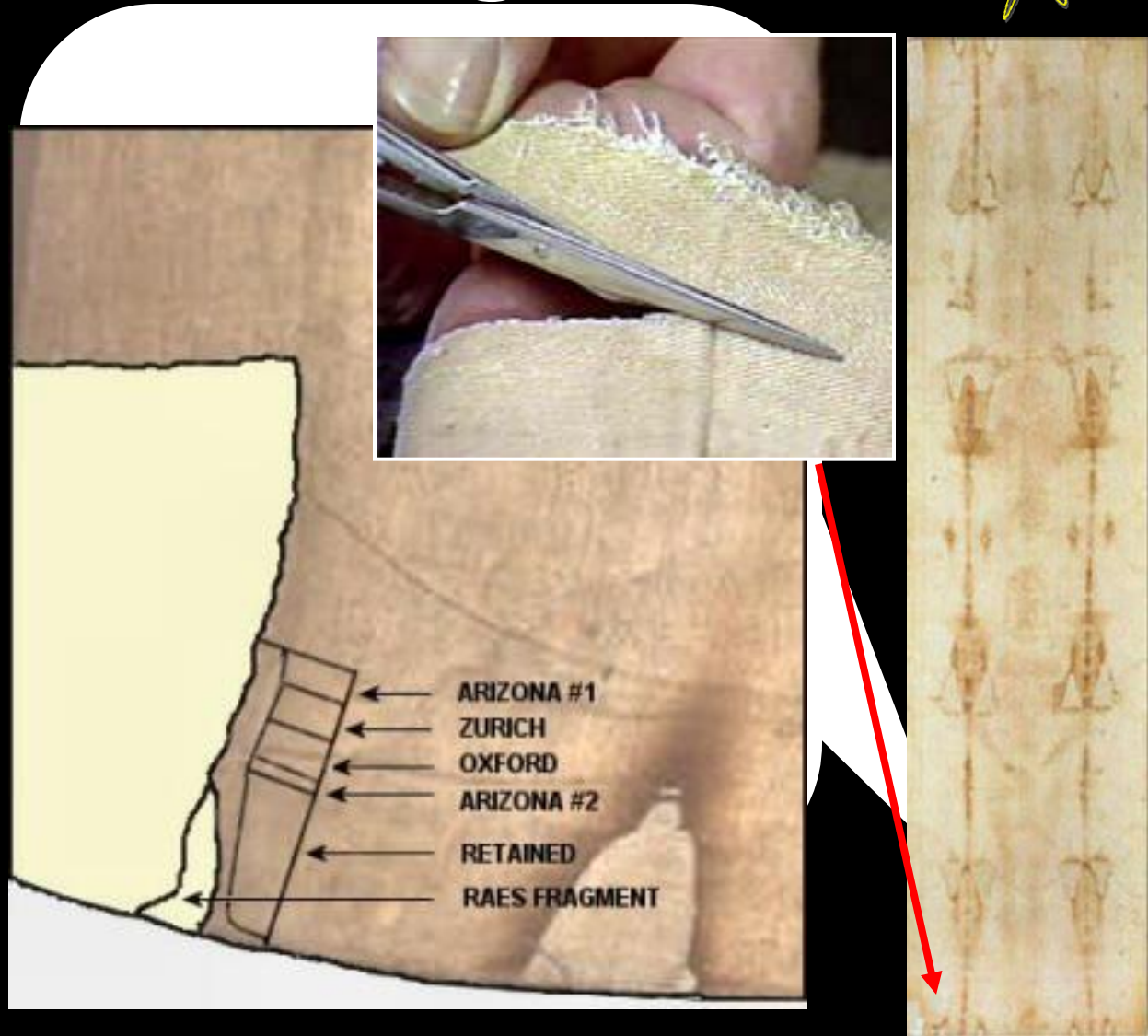
- After nothing short of Byzantine complications a meeting is held to plan the Carbon 14 testing
- A protocol was developed for seven labs and multiple sample sites, at least three and preferably five or more

Carbon Dating 1988



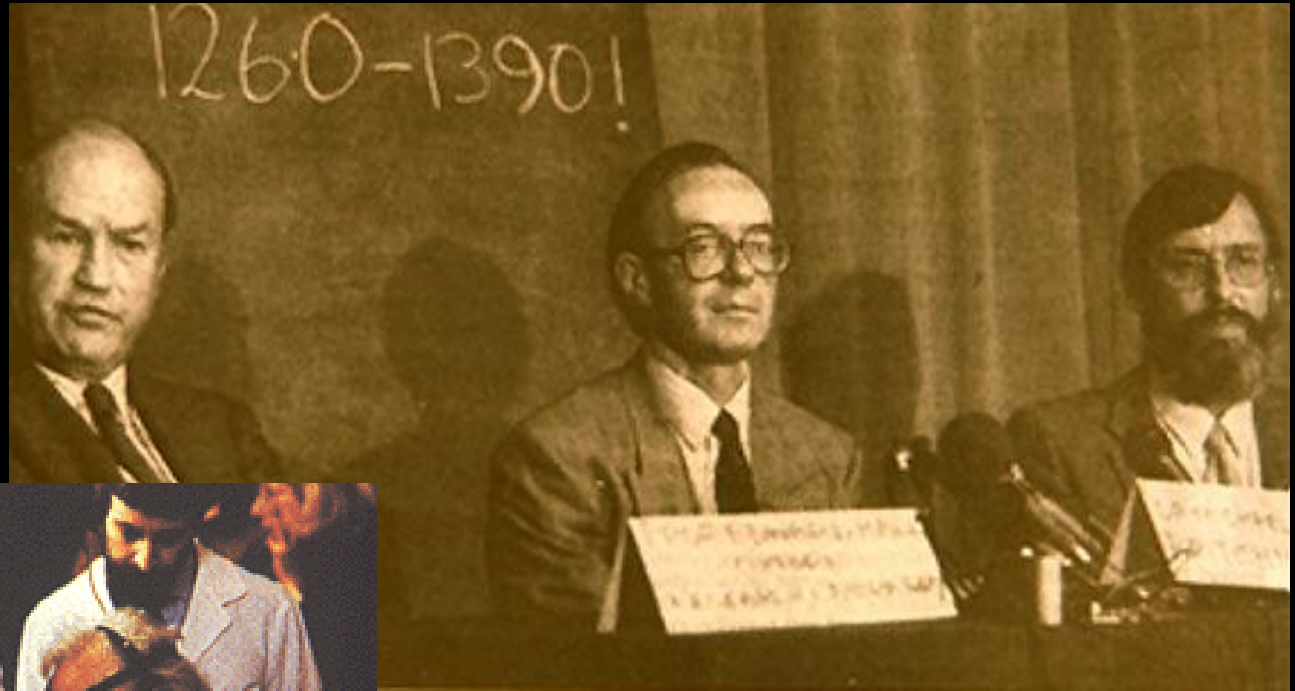
Three labs supervised by the British Museum

- Arizona
- Zurich
- Oxford



The Dating of the Shroud

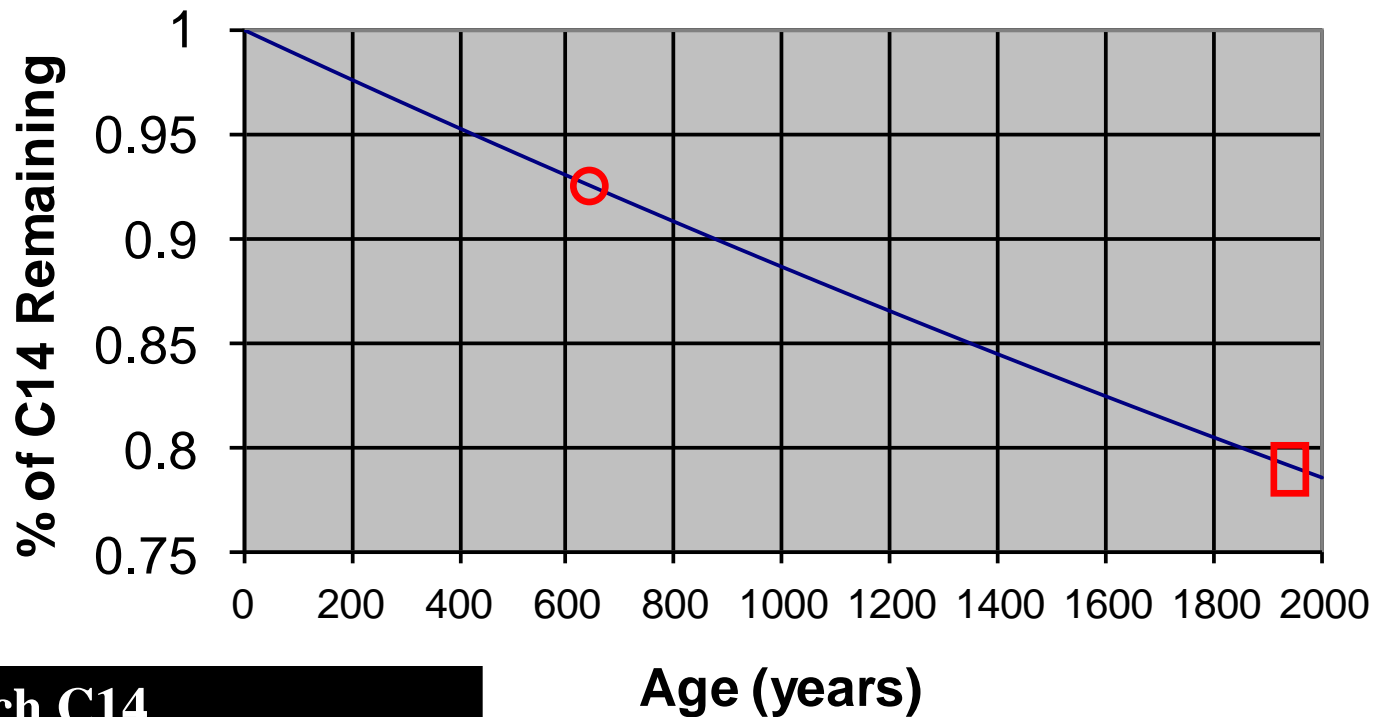
Round 1



**British scientists Professor Edward Hall, Dr. Michael Tite, and Dr. Robert Hedges announcing the results of the carbon-dating at a press conference held at the British Museum
13 October 1988**

1260 to 1390!

Carbon Dating From 1988 To 2000 Yrs In The Past



**Too Much C14
Nominally 92% versus 79%
i.e. 13% too much**

Predictable Results

The publicity and controversy surrounding the 1988 Carbon 14 date brought shroud research to a standstill.

But one bad result in the midst of universal good results calls for an explanation not dismissal.



Edward Hall (left), Michael Tite (centre) and Robert Hedges at the British Museum after revealing their findings on the shroud.

Turin Shroud shown to be a fake

By Michael Sheridan in Rome and Phil Reeves in London

CARDINAL Anastasio Ballestrero of Turin yesterday confirmed what newspaper readers around the world have known for weeks: that tests on the Turin Shroud have shown it to be of medieval origin.

The shroud, believed by many to carry the imprint of Christ's face and body when laid in the tomb, has attracted devout pilgrims to Turin for centuries. Leaks of the results of modern carbon-dating tests had infuriated the archdiocese of Turin and the shroud's Italian custodians who spoke darkly of foreign plots against Italy, anti-Catholic prejudice and the like.

Yesterday it was at last official: the tests had established a 95 per cent likelihood that the 14-foot linen was made between 1269 and 1399 AD. There is no chance that it dates back to the time of Christ.

Cardinal Ballestrero pointed out that the church had never claimed that the shroud represented Jesus but had honoured a tradition of piety rooted in centuries past.

"Considering the results of the scientific tests, the church reiterates her respect and her veneration for the shroud," he said.

The tests were carried out in laboratories at Oxford University and in Arona and Zurich. They were based on counting the number of radioactive carbon 14 atoms in a fragment of the shroud about the size of a postage stamp.

However, they did not resolve the icon's ori-



The Shroud of Turin: exposed as a fake.

gin, or the mystery which surrounds the blood-stained image on the shroud, resembling a photographic negative, of an apparently crucified man.

Professor Edward Hall, the director of the Oxford research laboratory involved, gave his theory: "There was a multi-million pound business in making forgeries during the four-

teenth century. Someone just got a bit of linen, faked it up, and flogged it."

Professor Hall, 64, who said he had a file full of mostly "cranky" letters from believers in the shroud's authenticity, added that some people would probably continue to regard it as genuine, "just as there is a Flat Earth Society". But he was utterly convinced his findings were right.

Modern Catholic teaching holds that relics are an aid to devotion. They divide into three classes: a first-class relic is either an instrument of the Passion, such as the Turin Shroud, or bones of the saints.

A second-class relic is an object which has touched one of these, and a third-class relic is an object which has touched a second-class relic.

The disappointment to believers in the shroud is unlikely to deter enthusiasts for the tens of thousands of relics, many of them the products of medieval tricksters, which repose in gilded cases and cushioned jewel-boxes in churches throughout Italy.

In Rome, one may view a feather from the Archangel Gabriel at the church of Santa Croce in Gerusalemme.

Other examples include vials containing the last breath of Saint Joseph, several heads of Saint John the Baptist, innumerable splinters from the True Cross, and two thorns from the crown.

In Naples, a vial containing the blood of Saint Januarius miraculously liquefies each year. In 1980, when it failed to do so, the city was struck by an earthquake.

The Carbon-14 Data

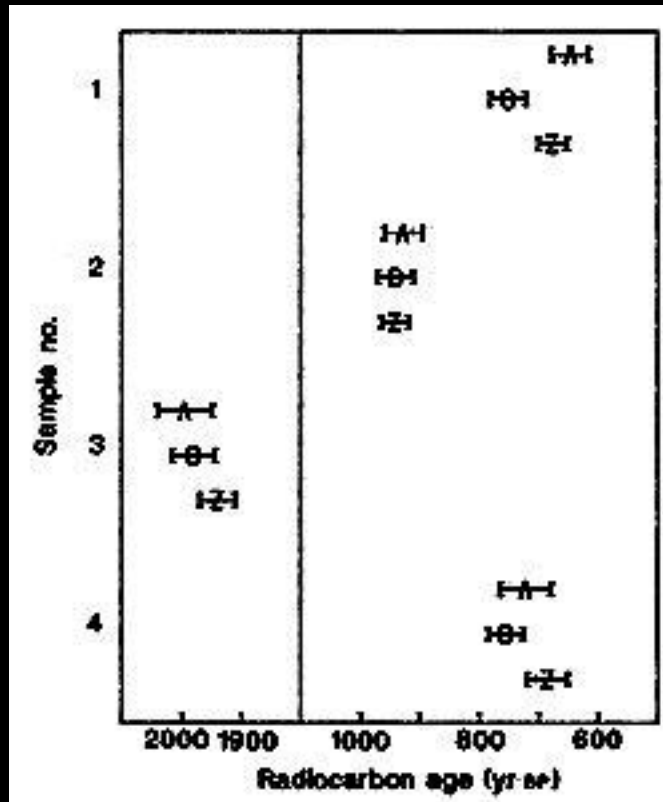
$\chi^2=6.4$ for Shroud, anomalously high

$\chi^2 >$
6.4 5

0.1 90

1.3 50

2.4 30



Shroud of Turin

Linen from tomb in Nubia
11th to 12th century A.D.

Egyptian Mummy carbon
dated earlier to 2010 \pm 80
-110 B.C. to 75 A.D.

Cope of St. Louis d'Anjou
dated 1290-1310 A.D.

IS IT REALLY A VALID TEST?



The Aftermath

- Speculation ensued on why the Shroud could be so convincing in other respects and yet date Medieval?
- Many Unsatisfactory Accounts were advanced:
 - the 1532 fire contaminated it
 - biological contamination (bioplastic coatings)
 - biofractionalization
 - isotope enrichment
 - radiation induced enhancement due to "the physics of the Resurrection"
- Many Just Accepted the Date
- Support and Interest in Shroud research declined

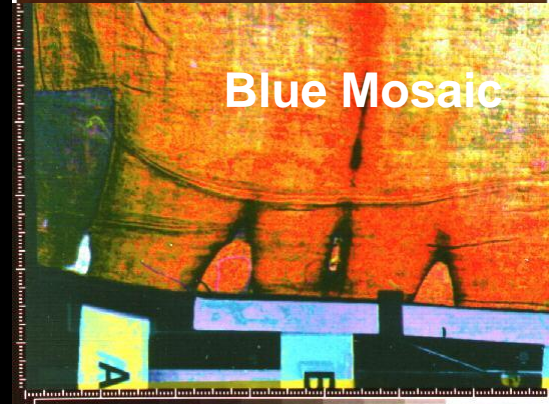
Problems with the C14 Test

- Only a Single Sample Site
- High Probability of Contamination at Selected Site — **contamination found (ex. cotton and dyes) in the sample area**
- History of Shroud Makes It a Difficult Subject
 - Fire of 1532 Subjected It to Extreme Opportunities for Contamination
 - Textiles Often Date Unreliably
 - biofractionalization, ion-exchange, and build up of contamination (ex. "bioplastic") are examples of possible skewing mechanisms
 - possible site of repair and reweaving and evidence from UV and Blue Mosaic show that the region is anomalous.

UV Florescence



Blue Mosaic



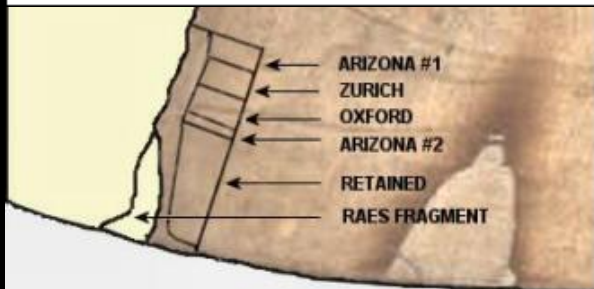
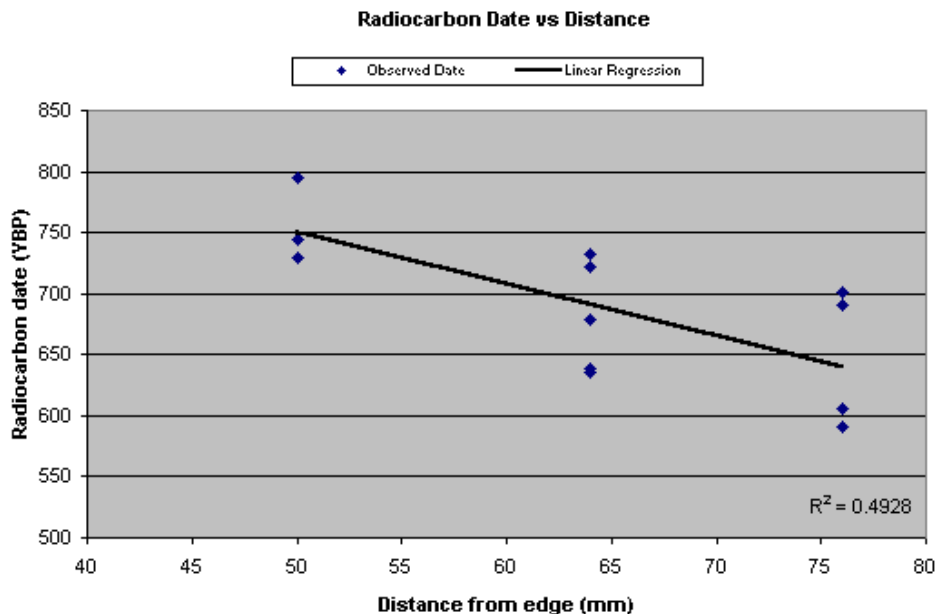
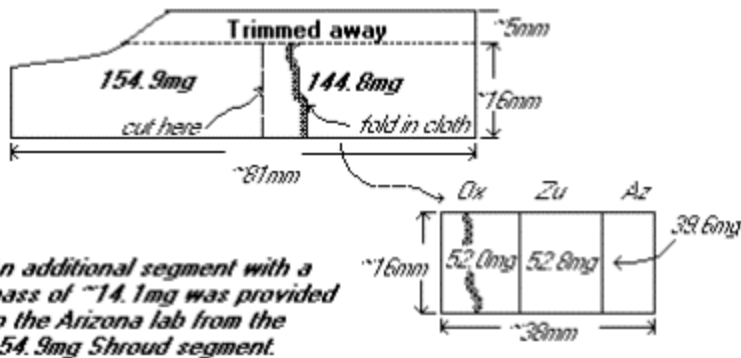
Sample Site



1999 A Clue

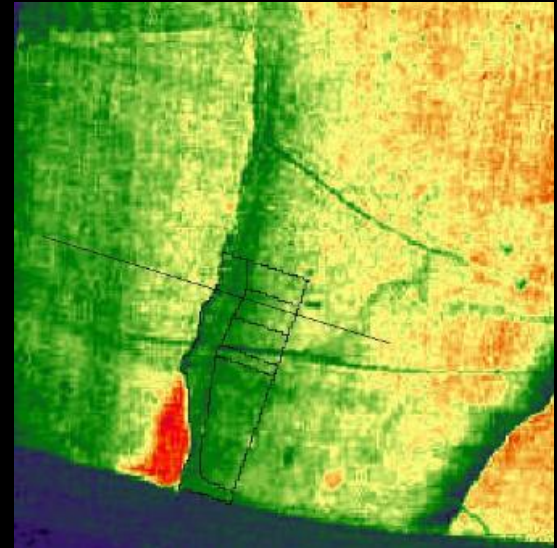
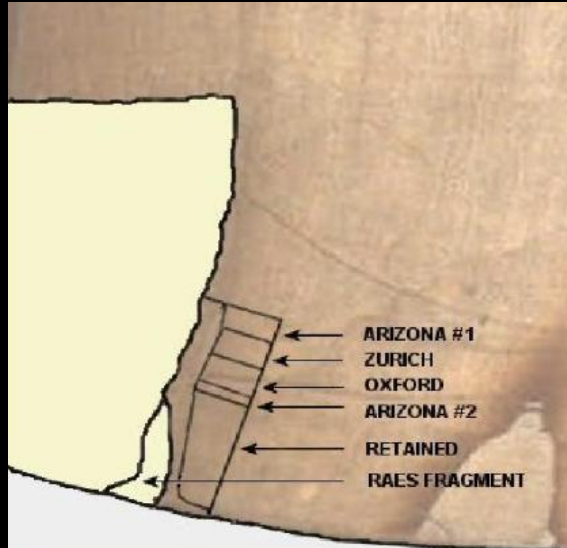
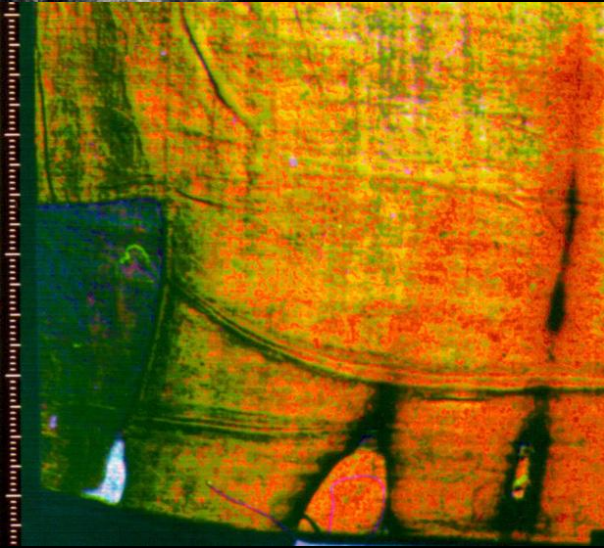
- Brian Walsh points out an interesting fact
- The Carbon Dates exhibit a systematic shift with distance from cloth edge
- Chance or Evidence of a Problem

Schematic of Shroud sample extraction



What's Wrong With Carbon Dating?

To Be Valid The Samples Must Be Uncontaminated and Representative of the Whole

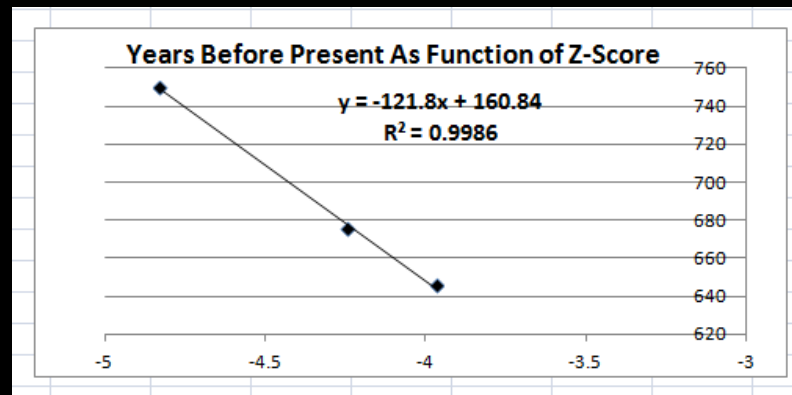
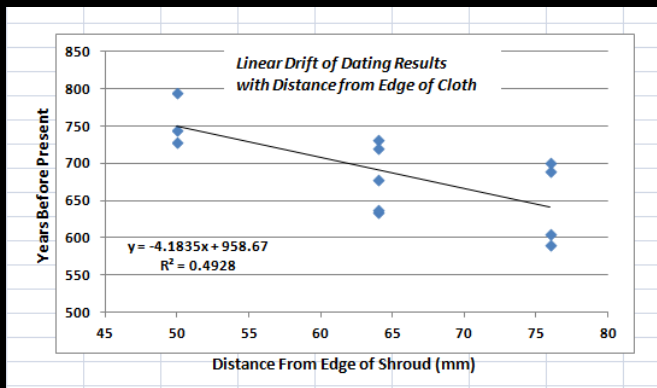


Blue Quad Mosaic

UV-Fluorescence

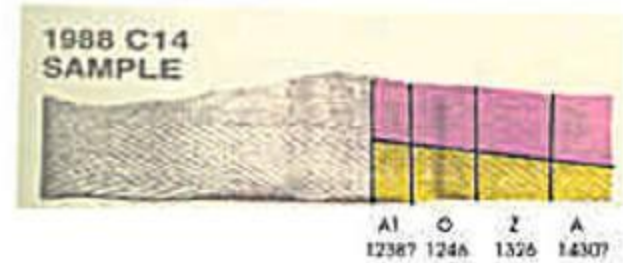
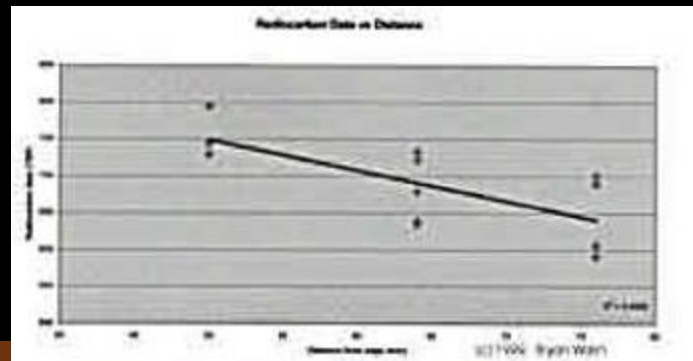
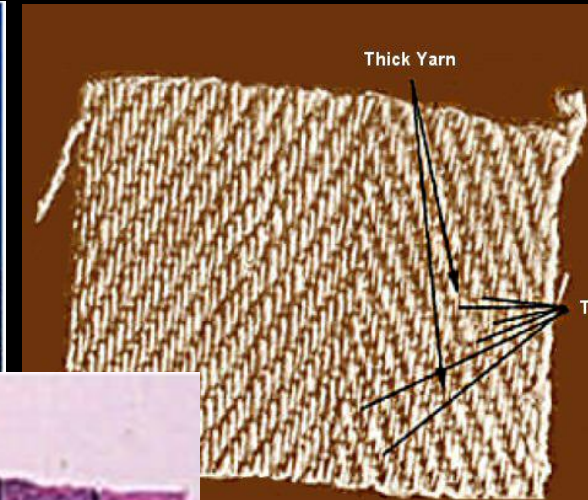
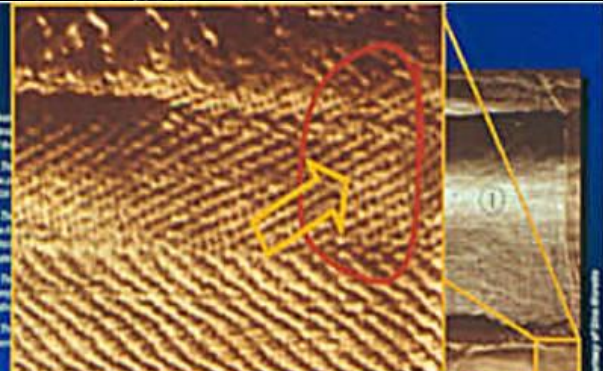
False Color Depiction of 1st Component of PCA

$$\chi^2 = 6.4$$



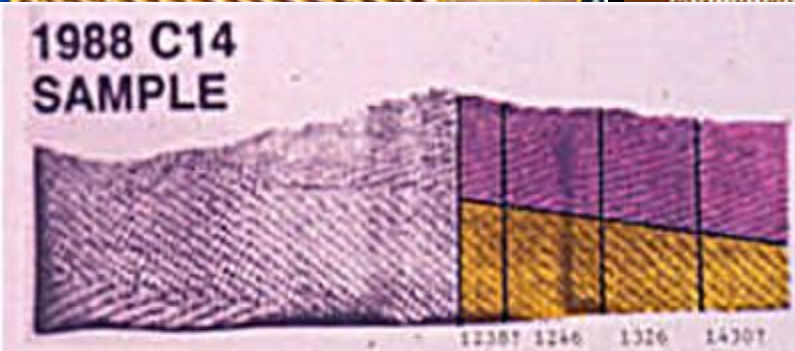
Samples were contaminated and dating correlated strongly with the contamination

Benford and Marino Propose the Mediaeval Patch Theory



Illustrations showing the precise statistically-determined angular skewing of the dates corresponding with the individual laboratories with reference to the location of the samples received.

© Copyright 2000, Marino and Benford [C-14 sample photo courtesy Ian Wilson]



PROPOSED CARBON DATING SEQUENCE FROM ACTUAL RESULTS

PINK - 16TH CENTURY PATCH

YELLOW - ORIGINAL 1ST CENTURY MATERIAL

A1 - ARIZONA	12387
O - OXFORD	1246
Z - ZURICH	1326
A - ARIZONA	14307



Introducing Raymond Rogers

- UCLA / Los Alamos Science Fellow
- Member of the 1978 STURP team
- Cofounder of the Coalition for Excellence in Science Education.
- Member of the Department of the Air Force Scientific Advisory Board
- Published over 50 peer-reviewed papers in scientific journals.



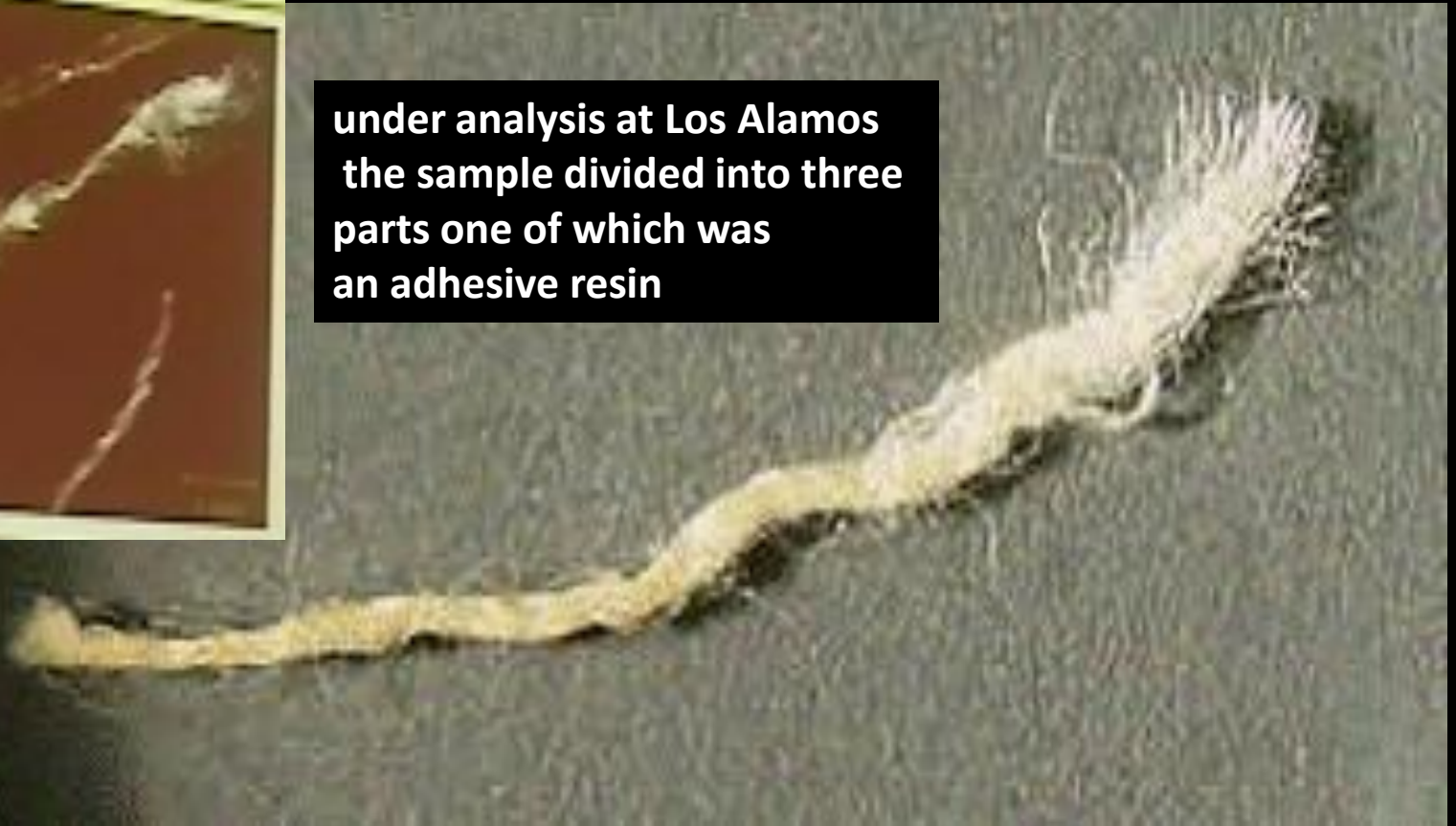
(c)1978 Barrie M. Schwartz

SURPRISINGLY

He found splices dyed at one end



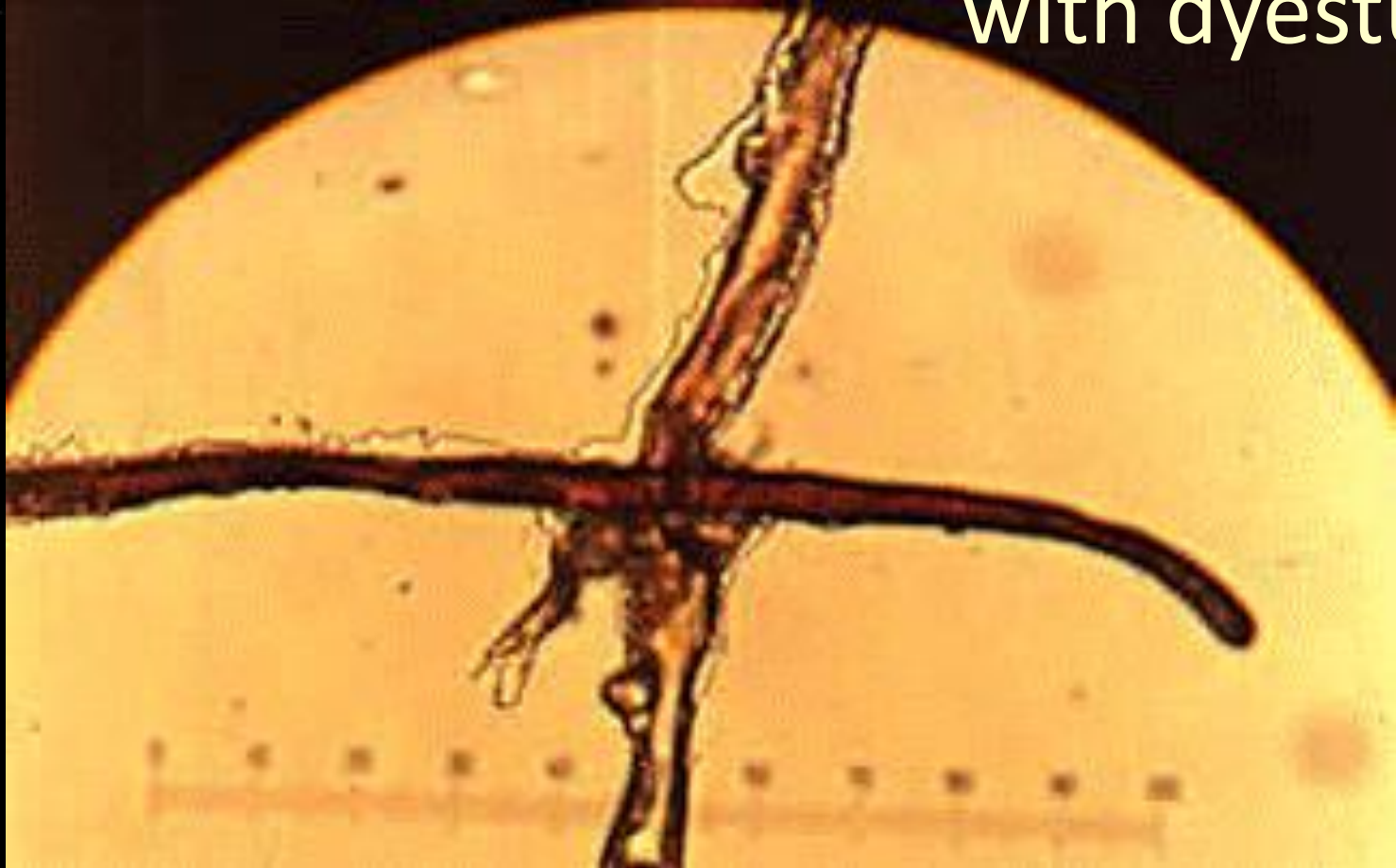
**under analysis at Los Alamos
the sample divided into three
parts one of which was
an adhesive resin**



AND

the fibers were encrusted

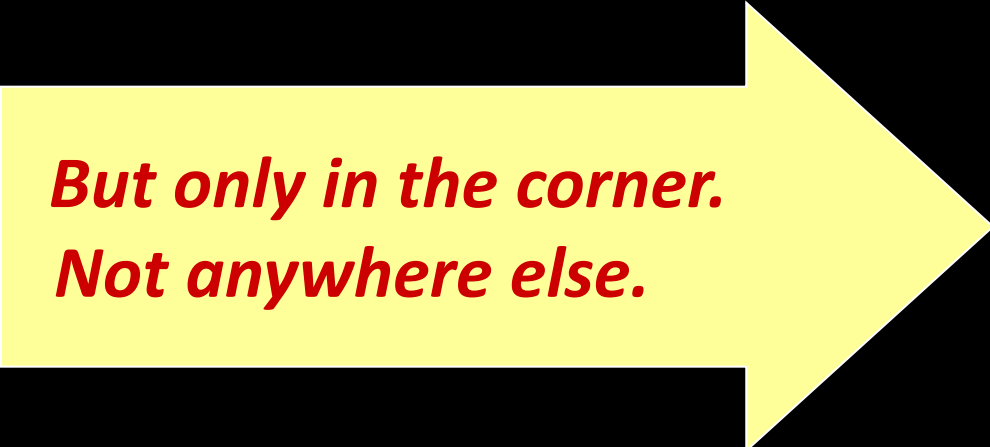
with dyestuff



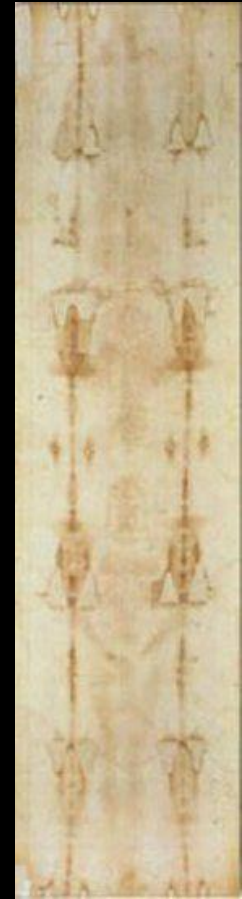



AND

- Madder root dye (Alizarin)
- Alum
- Gum Arabic
- Vanillin



***But only in the corner.
Not anywhere else.***





In 2002, Rogers and Anna Arnoldi of the University of Milan published preliminary findings suggesting mending.

Important Point: What was dated was chemically unlike the rest of the cloth.

- ✓ Lloyd Curry in U.S. Government's *Journal of Research of the National Institute of Standards and Technology* credited Rogers with significant findings.



In January 2005, Rogers' findings were published in *Thermochimica Acta*

- ✓ BBC: “Shroud Older Than Thought”
- ✓ Philip Ball, writing in *Nature Online*, found the vanillin discovery particularly significant.





VANILLIN

Average Conditions

Years to Fully Decompose

Very warm

≈ 1300

Normal

≈ 2000

Cold

≈ 3000

A medieval cloth would have retained about 38% of its vanillin. The shroud is not medieval.

Three New Dating Methods



COURTESY:
Padua University

- Three Mechanical Tests
Developed by Italian Researcher Giulio Fanti
 - nine ancient fabrics used in compiling the calibration curves: 3000 B.C. to 1000 A.D.
 - 5 from Egypt, 3 from Israel, 1 from Peru
 - plus two modern fabrics of recent manufacture
 - Results: 300 BC \pm 400; 200 BC \pm 500; and 400 AD \pm 400
 - Jointly: Averaged 33 BC \pm 250



Dating Status

- Five independent dating methods now
 - C14
 - Vanillin
 - Fourier transform infrared spectroscopy
 - Raman spectroscopy
 - mechanical parameters of fibers under tension and breaking
- Four agree only C14 is the outlier
- Fanti's methods require further confirmation



Next Time

- So if we can't rule out authenticity then where exactly did the Shroud of Turin come from?
- How can the burial cloth of Jesus Christ have been hidden in history only to turn up in the hands of a Christian knight around 1353?
- Next time we'll look at that question

The History of the Shroud