

The background of the slide is a high-contrast, black and white image of the Shroud of Turin. It shows the front and back impressions of a face, with the left side being a negative (lighter) and the right side being a positive (darker). The image is heavily textured with vertical and horizontal lines, possibly representing the fabric's weave or scanning artifacts.

The Shroud of Turin

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Shroud of Turin documentary: Fabric of Time

- <http://www.youtube.com/watch?v=oJB24suDEC8>
- Offers an introduction to the Shroud of Turin controversy

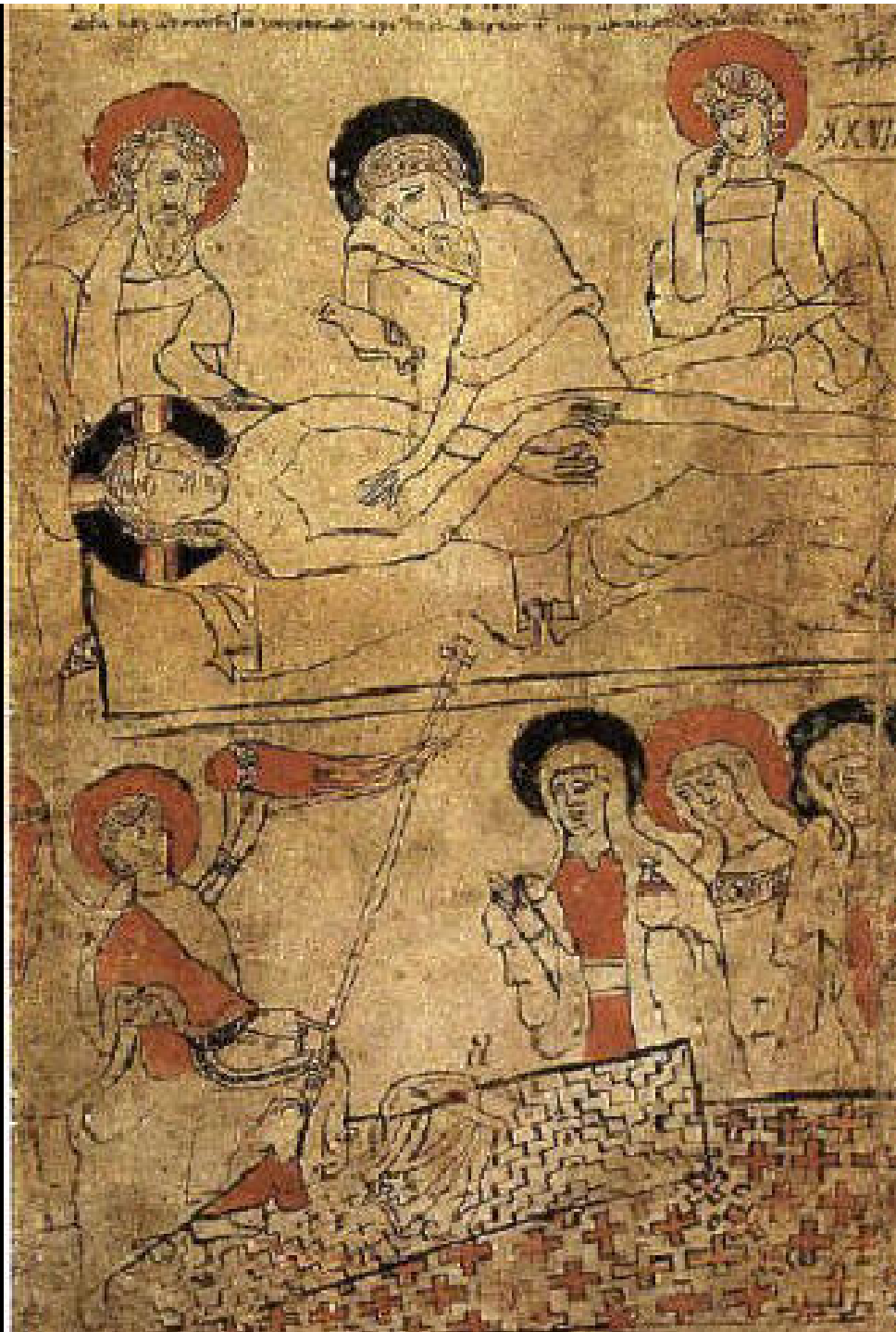
Early History of the Shroud

- The Shroud's exact early history is debatable and uncertain
- 944 A.D. -- the Cloth of Edessa was forcibly transferred from Edessa to Constantinople
- Described as a full image with bloodstains from what appeared to be a person's abdominal wound
- Stolen from Constantinople in 1204 by French knights during the Crusades

Is the Cloth of Edessa the Shroud of Turin?

- Cloth and Shroud had the same folding lines and directions, as supported by a 10th century painting of the Shroud and examination by physicists in 1978
- 1192 Hungarian Pray Manuscript codex shows illustration of Jesus being placed on burial cloths -- placement of body supports marks shown on Shroud/Cloth

1192: Hungarian Pray Manuscript



1356: Geoffrey de Charny

- French knight Geoffrey de Charny displayed a burial shroud in Lirey, France that he claimed belonged to Christ
- de Charny was a descendant of a prominent knight of the Fourth Crusade, the exact time during which the Cloth of Edessa was stolen from Constantinople
- We now know de Charny's piece as the Shroud of Turin

The House of Savoy

- Shroud was given in 1453 to Duke Louis Savoy of the House of Savoy in France, where it remained for four centuries
- A special chapel was built for the Shroud; however, a fire broke out in 1532 and damaged the cloth -- this may have an effect on modern samplings and chemical tests
- Scorch lines, heat, water, and reweaving



Modern History of the Shroud

- 1578: The Shroud was moved to Turin, Italy so that a monk would not have to make the trip to see it in France
- It has remained in Turin except for removal for safekeeping during World War II
- 1986: Shroud bequeathed to the Holy See -- Pope John Paul II and his successors
- Stored in the Cathedral of St. John the Baptist in Turin, Italy
- Has significant religious and cultural importance

Cathedral of St. John the Baptist Turin, Italy



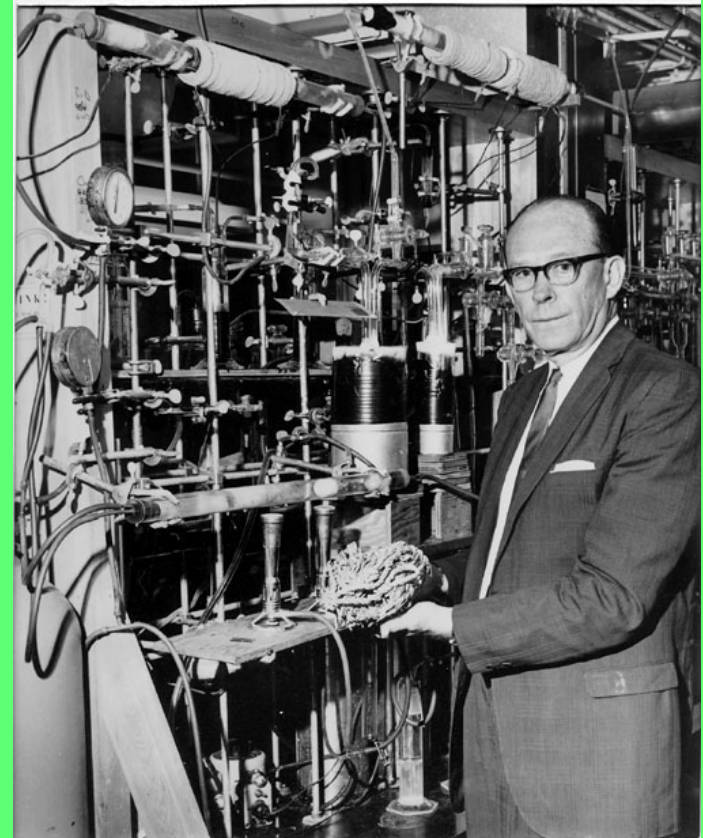
Carbon-14 Dating



Description of the method used
to date the Shroud of Turin

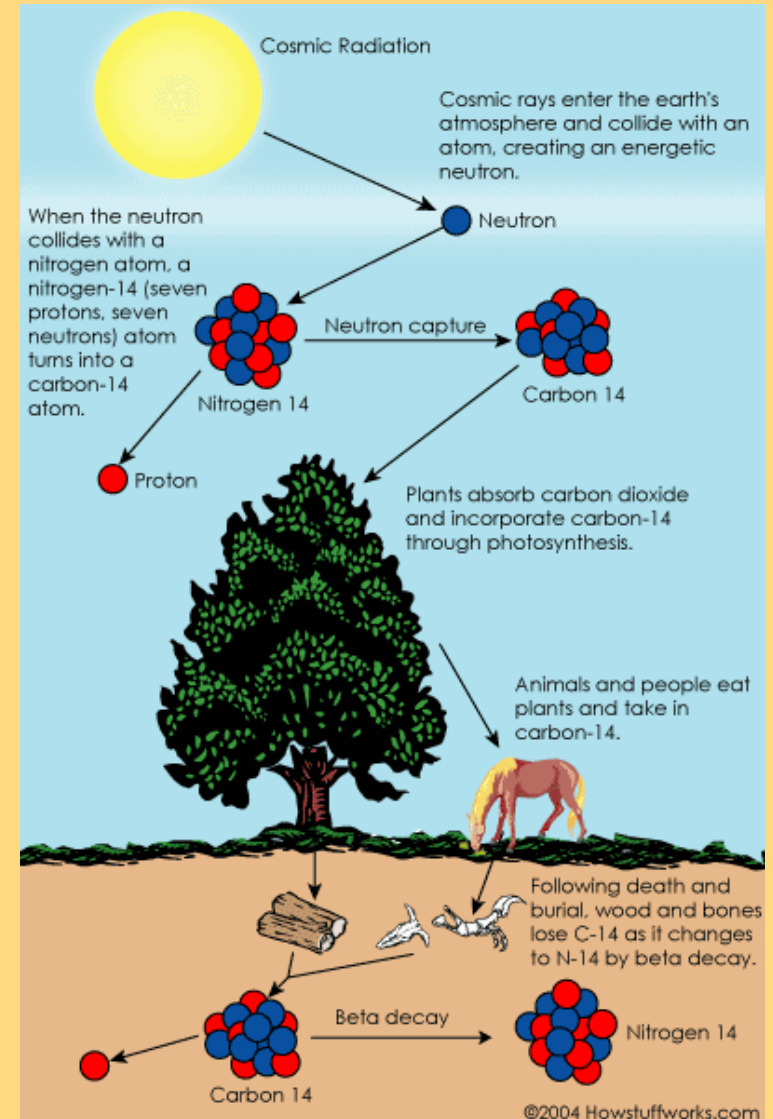
Invention of C14 Dating

- Invented by Willard Libby in 1940s
- Carbon dating involves measuring the ratio of radioactive carbon-14 to stable carbon isotopes in organic material.



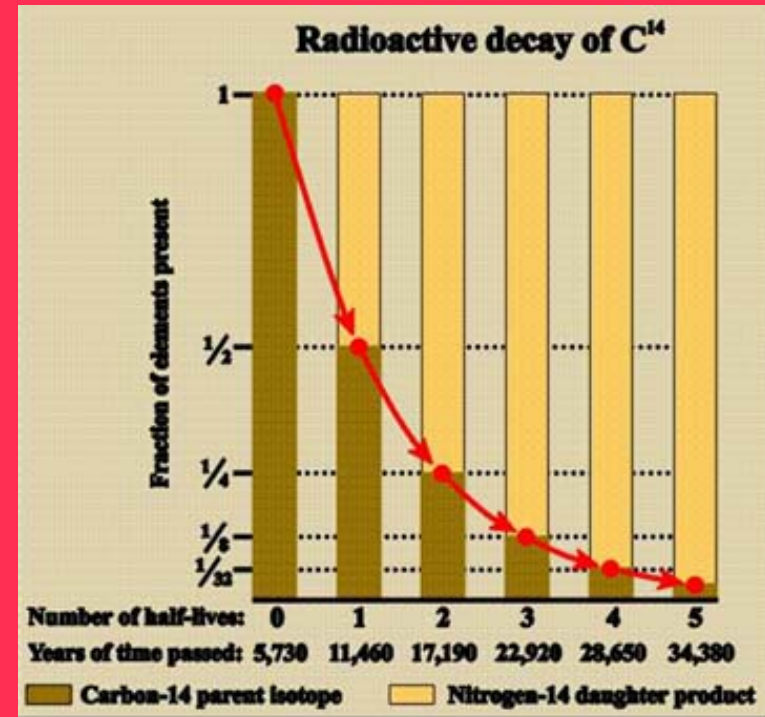
How C14 Dating Works

- Plants and animals, which utilize carbon in biological food chains, take up C14 during their lifetimes.
- The numbers of C14 atoms and non-radioactive carbon atoms stays approximately the same over time.
- As soon as a plant or animal dies, there is only decay.



The “Libby Half Life”

- Libby found that after 5568 years, half the C14 in the original sample will have decayed.
- The half-life is the name given to this value, which Libby measured at 5568 ± 30 years.



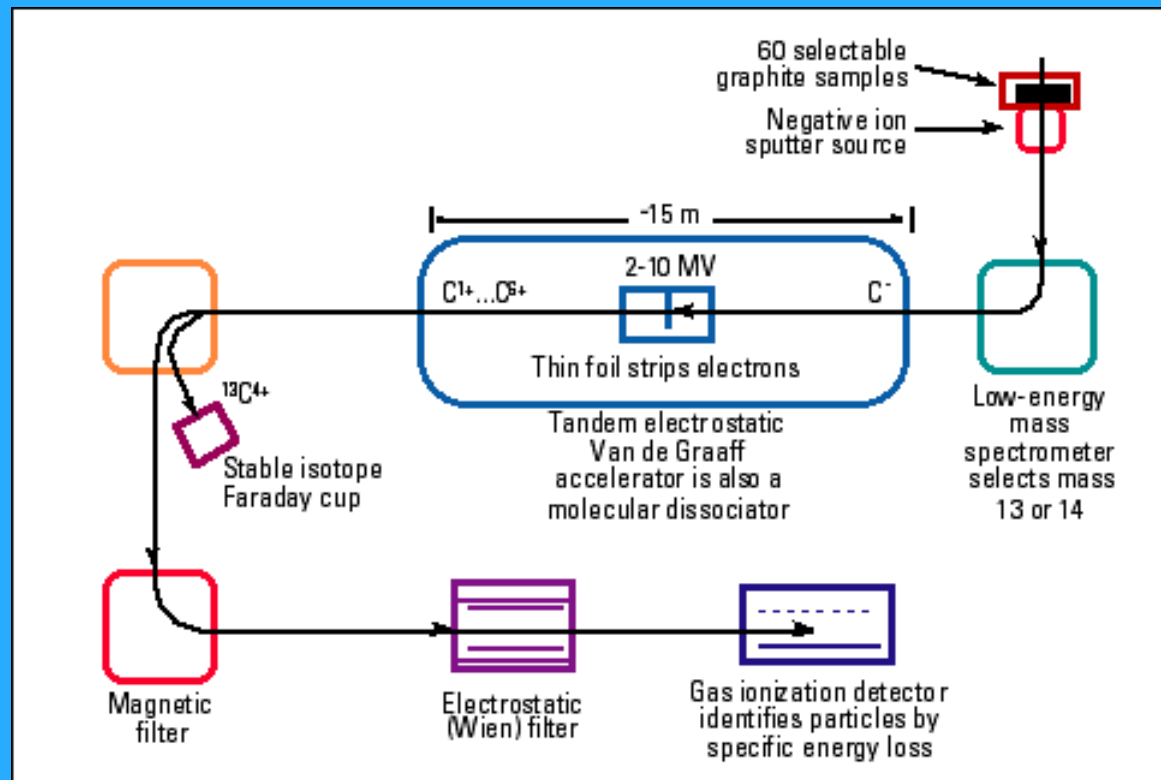
Dating Technology

- The method of C14 counting used by Libby and his co-workers involved measuring radioactivity using modified Geiger counters.
- The next development in counting technology was Gas Proportional counters.
- In the early 1950s, the first attempts were made to detect C14 by the Liquid Scintillation (LS) counting method.

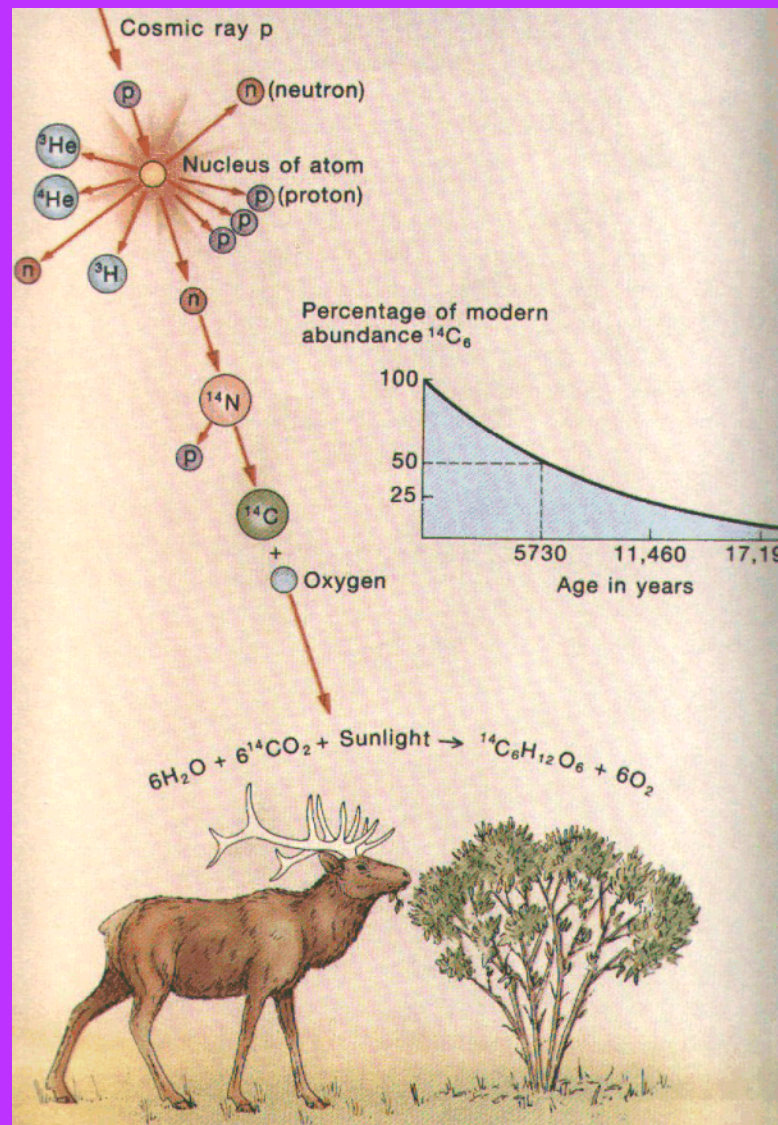


AMS Technology

- The operation of an AMS system to measure natural C14 concentrations involves four basic steps.
- First, the production of ions from a sample in an ion source, next, acceleration of ionized particles, then, the separation of the C14 from other isotopes and molecules, and lastly, counting of individual C14 ions.

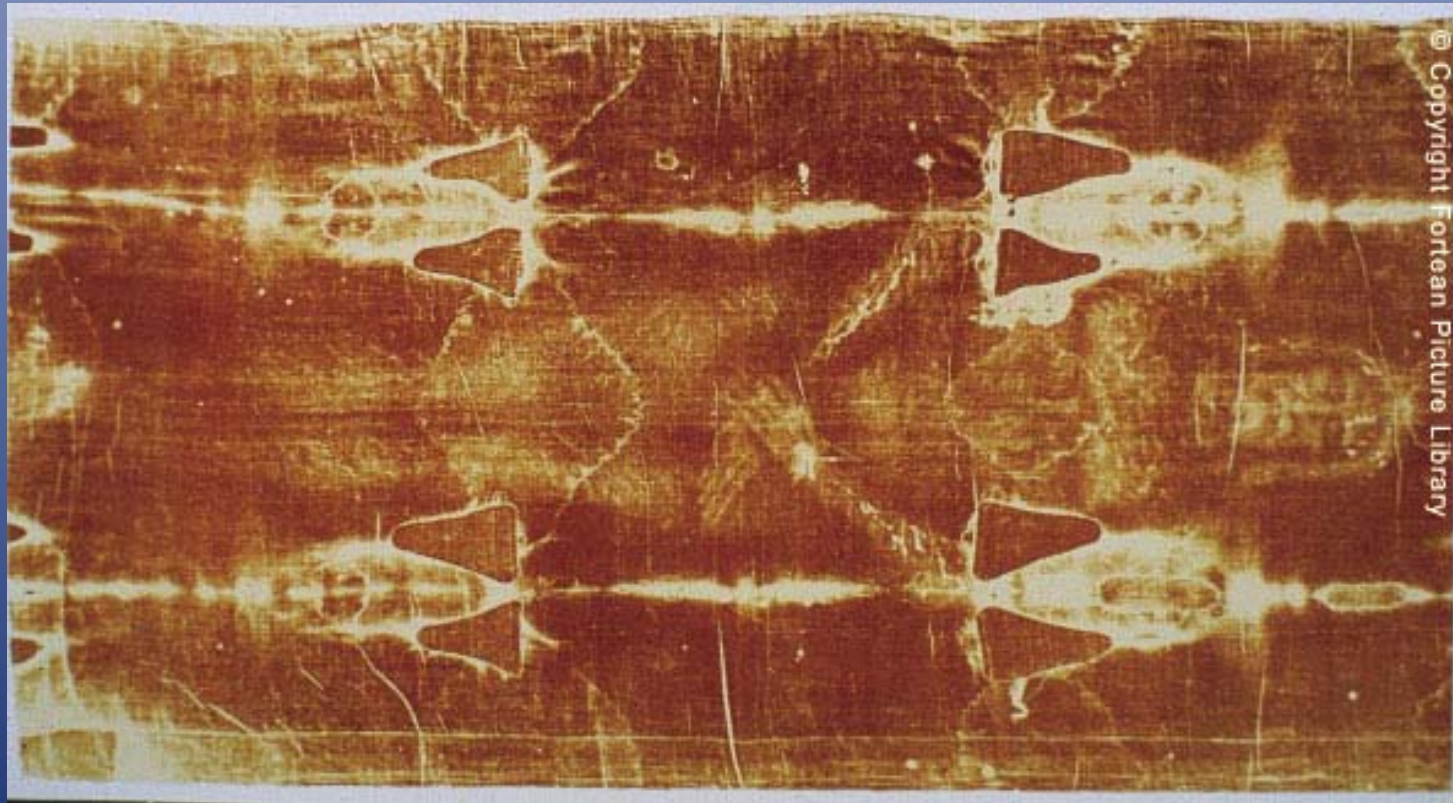


Importance of C14 Dating



- The main and most fascinating application of ^{14}C dating is in archaeology and anthropology where the measurement of its ratio to that of stable carbon establishes the time at which an organic system died.
- ^{14}C is the most important radioisotope in biological and medical studies

Carbon Dating the Shroud



Appearance

- linen cloth measuring 4.6 x 1.1 meters
 - Corresponds to Philetaric cubits used in 1st century Palestine
- Herringbone twill with 3:1 weave
 - Probably of Syrian design
- Flax fibrils entwined with cotton fibrils
 - Denotes that it was made on loom before
 - The cotton is *Gossypium herbaceum*
 - Origin in the Middle East
- Contains pollen grains from 58 species of plants
 - Majority are indigenous to the Dead Sea/Turkey area

Conclusion: Shroud was manufactured in the Middle East in the 1st century

Image on Shroud

- Male
- 6 feet tall
- Bearded
- Distinctive markings of Roman flagrum
- Bloodstains from wounds on wrists, feet, head, and left thoracic area
- Pooling of blood under small of back and feet
- Swelling under eyes
- Parts of beard missing



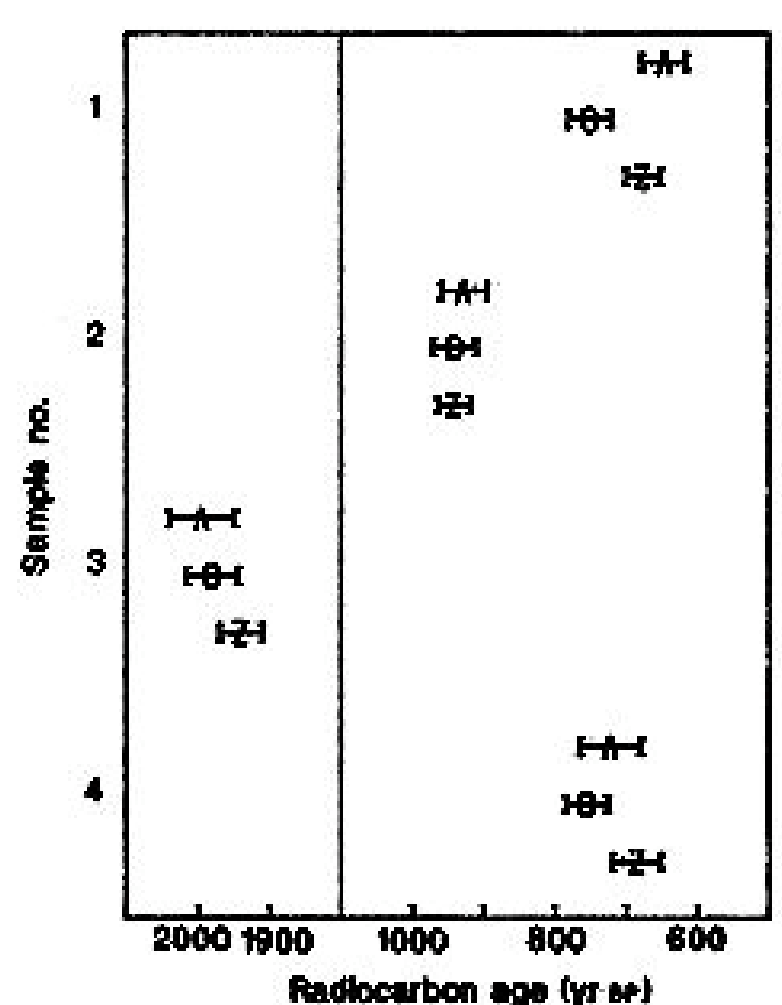
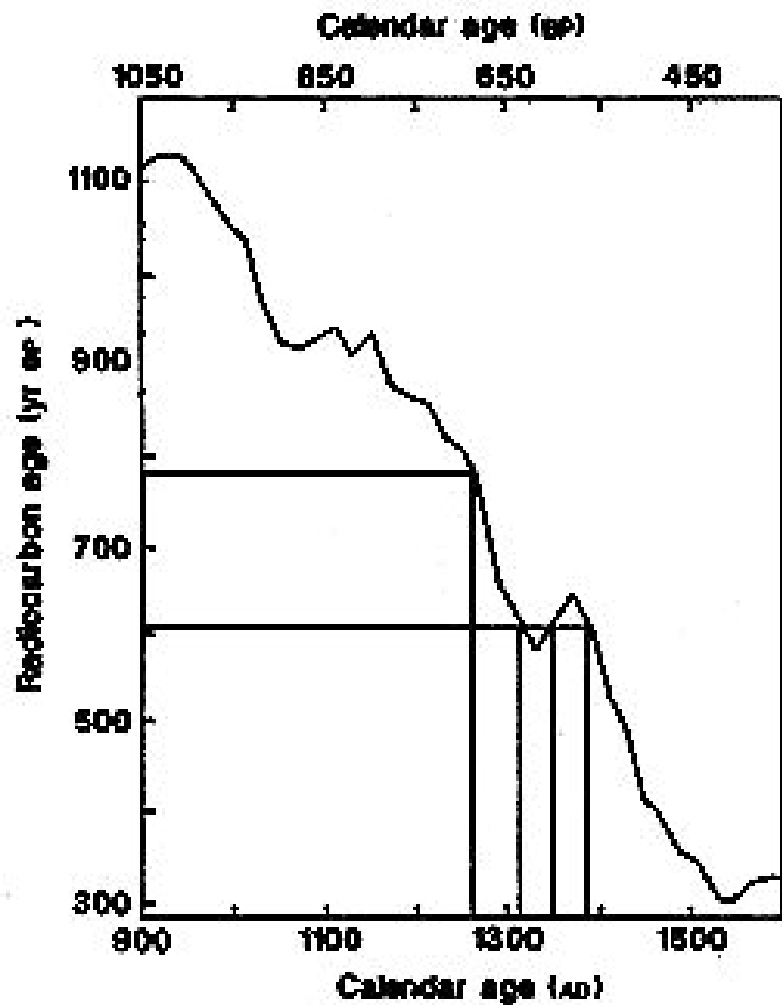
Analysis of Bloodstains

- McCrone detected iron oxide on shroud
 - Thought it was from artist's paint
- X-ray fluorescent conducted by STURP
 - Determined iron oxide was not responsible for image
- Dr. Heller and Adler applied pleochroism, birefringence, and chemical analysis
 - Discovered the iron oxide was not remnants of paint
- Dr. Adler applied microspectrophotometric analysis on the shroud
 - Found traces of hemoglobin
 - The bloodstains are not paint but real blood
 - The bloodstains were applied to the cloth before the image

1988 Radiocarbon Dating

- At first, wouldn't allow radiocarbon dating
 - Samples required for testing were too large
- Finally, permission was granted for testing
- 12 samples were split up among 3 laboratories
 - Zurich, Oxford, Arizona

Lab Results

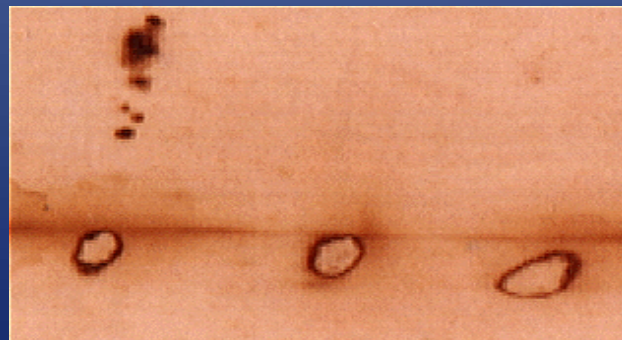


Results

- According to results, shroud was dated between **1260 CE and 1390 CE**
- Fueled discussion of medieval forgery
- Possible margin of error
 - Natural processes that affect the outcome of radiocarbon dating

Damage to the Shroud

- On December 4, 1532, a fire broke out in chapel that housed the shroud
- The heat melted some of the silver encasement
 - Particles of silver dripped onto the shroud, contaminating it
- Rescued and doused, but burn holes still visible



Experiments of Accuracy

- Dr. Kouznetsov conducted experiments with artifacts to see if heat changed radiocarbon date
 - Used ancient linen cloth from Israel dated at 200 CE
- Exposed the cloth to heat
 - Linen was now dated at 1400 years later

Contamination of the Shroud

- Extra C14 deposits can be due to bacteria and fungi
- Researchers Mattingly and Garza-Vermes looked for biogenic varnishes
 - Heavy contamination was found on the shroud

Disproving the
Medieval Radiocarbon Date

Theories of Authenticity

Fire of 1532



- Exposure to the Cathedral fire in 1532 (and the burning of candles and incense before the shroud throughout the ages) saturated the Shroud with contaminants causing it to appear younger in the Carbon-14 analysis.

Interweaving

- Most Plausible Theory
- Sample tested in 1988 was taken from the left hand edge
- Possible that the Shroud (particularly along the edges) was repaired during the 16th Century with strands woven into the ancient material

Weaving Analysis



- 3 different weaving experts (in a blind analysis)
- Identified disparate weave patterns
- Indicated touching up to prevent unraveling

Theoretical Carbon-14 Date

- Assumptions
 - Sample was composed of new (16th century) and old (2000 years) material
 - 60% new, 40% old
- If Patchwork was done, the calculated date would have been about AD 1210
- Date consistent with mean date AD 1200 found by Oxford lab

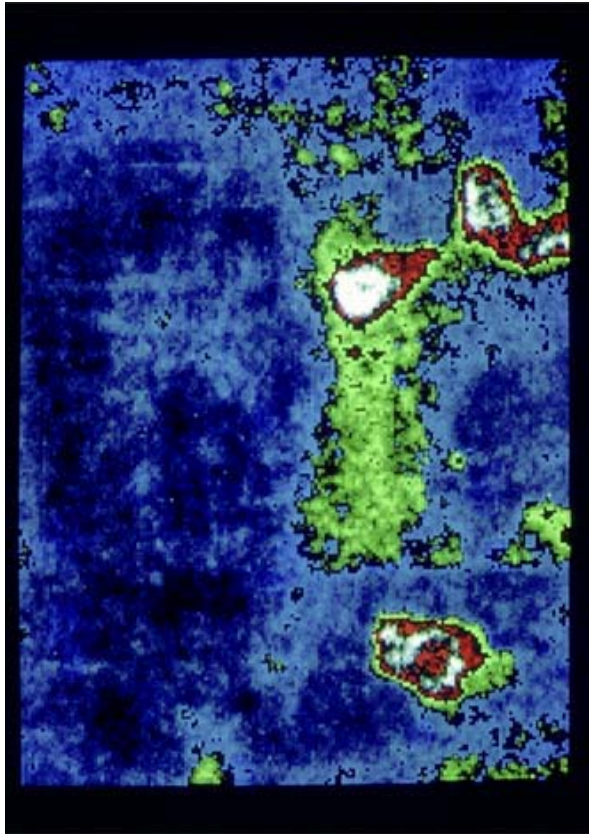
Chemical Evidence

- Madder dye/mordant/gum mixture had been wiped onto the strands on the corner of the Shroud the sample was taken from
- Indicates Repair
- Mixture didn't reach France or England until the 16th century
- Further evidence for the hypothesized repair date

Ohio State University Press Conference

- August 15, 2008
- Team of Scientists from Los Alamos National Laboratory
- Studied strands from directly adjacent to the 1988 sample to test hypothesis that radiocarbon dated material could not be from original linen because it contained cotton
- Analysis supported theory
- During analysis one of the threads came apart and formed two separate pieces – pieces which had different chemical compositions

Blood or Pigment?



- Walter McCrone (scientist in charge of 1988 radiocarbon dating) claimed to have found evidence of pigments
- Other scientists deny the presence of pigments and instead assert that the Shroud is stained with blood
- The Truth? Controversial

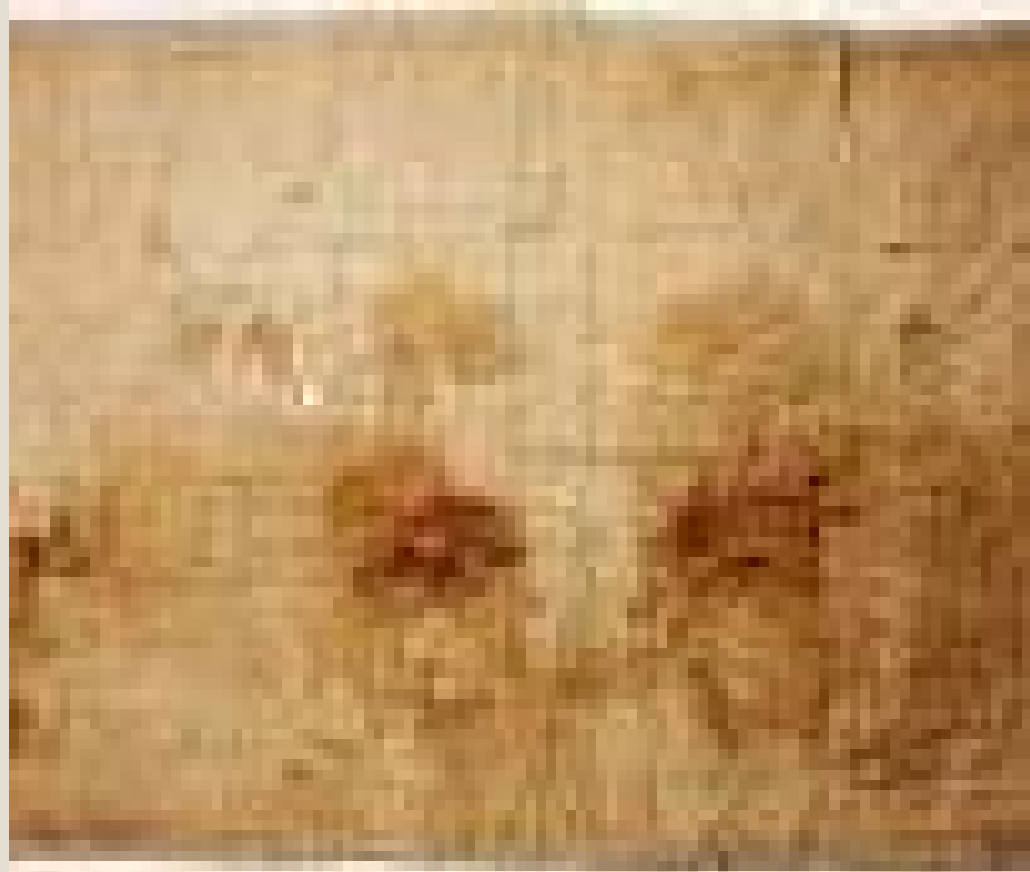
The Argument for Blood



- ❖ Prof. Alan Adler (Chemistry, Western Connecticut State University) is an expert in this field and concluded the blood is real
- ❖ John Heller also concluded the blood is real.
- ❖ Baima Bollone found heme porphyrin and globulin in flakes from Shroud
- ❖ X-ray fluorescence revealed excess iron in

Sudarium of Oviedo

The Facecloth of Christ?



Pollen

Reported pollen grains on the Shroud from plants that could only be found in and around Jerusalem. Comparison of the shroud with the Sudarium of Oviedo revealed it to be embedded with pollen grains from the same species of plants as found on the Shroud.



Points of Congruence

- Comparison of different artifacts with the Shroud of Turin
 - Sudarium of Oviedo
 - Byzantine Gold Coins
 - Icon from Monastery of St. Catherine
- Points of Congruence between them seem to indicate that the shroud provided a model for the others
- These images have earlier recorded dates than the Shroud, thus they support the theory that it is older than the age arrived at after radiocarbon dating

Comparison 1

SHROUD OF TURIN



BYZANTINE COIN A.D. 692

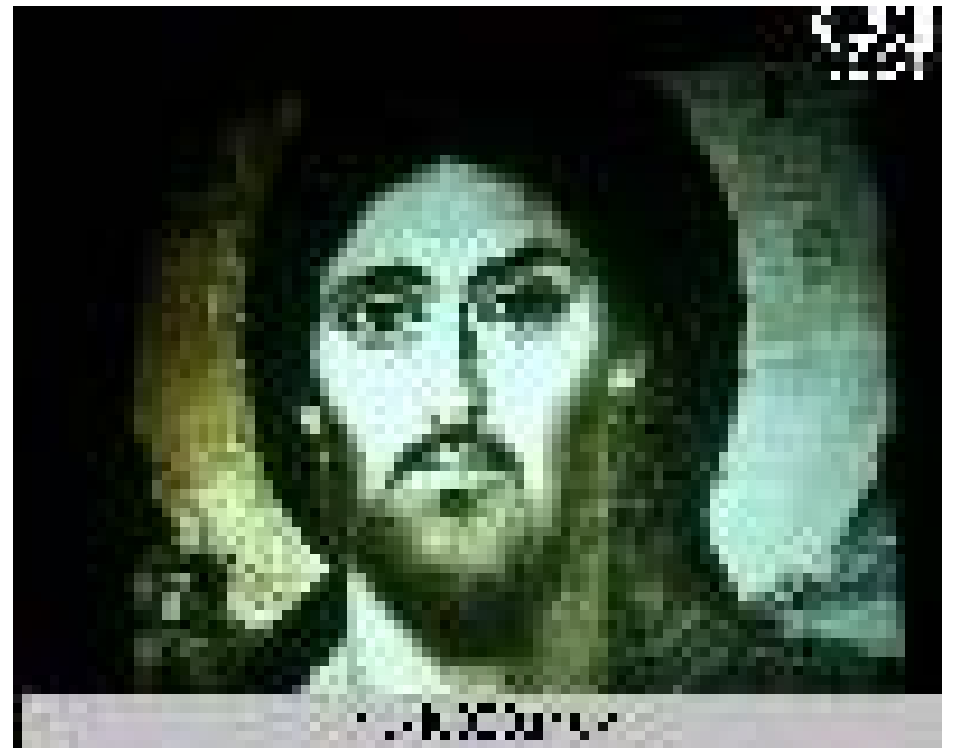


Comparison 2

SHROUD OF TURIN



CHRIST PANTOCRATOR
ICON A.D. 550



Comparison 3

SHROUD OF TURIN



**BYZANTINE GOLD SOLIDUS
COIN A.D. 692-695**



Continuing Studies

- John Jackson, physicist at Colorado University and relic on the Shroud has secured the support of an Oxford lab
- Negotiations are underway with the Vatican to allow for re-dating
- Nothing will be done before the next display of the Shroud in 2010

Sources

- H.E. Gove. *From Hiroshima to the Iceman*. Institute of Physics, Briston & Philadelphia. 1999. 6-12, 155-167.
- Higham, Thomas. “Radiocarbon Web-info.” <http://www.c14dating.com/>.
- *Radiocarbon Dating of the Shroud of Turin*. Nature, Vol. 337, No. 6208 (1989) 611-615.
- R.E. Taylor. *Radiocarbon Dating: An Archaeological Perspective*. Department of Anthropology, University of California, Riverside. 1987.