

Date of the Shroud of Turin

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Abstract

According to the historical documents, Jesus died about 30 or 33 A.D. For the Shroud of Turin to be the authentic burial cloth of Jesus, it would have to date to this period. This paper evaluates various types of evidence to determine whether the Shroud could date to the early first century. Many people believe that the date for the Shroud was firmly established in 1988 when it was carbon dated to 1260-1390 A.D. This paper summarizes 15 date indicators for the Shroud, all of which are consistent with a first century date except the carbon dating, and explains why the carbon date of 1260-1390 should be rejected: 1) there are multiple objections to a 1260-1390 date for the Shroud including the impossibility of forming such an image on cloth during the Middle Ages, and 2) a proper statistical analysis of the data from the 1988 carbon dating indicates that an unexpected factor probably altered the (C^{14}/C^{12}) ratio of the Shroud samples so that the measured date was not the true date. It is suggested this unexpected factor is neutron absorption. The Hungarian Pray Codex or Manuscript is also used to prove that the Shroud existed before the 1260 lower limit of the carbon dating. Though this study does not prove the Shroud to be authentic, it is concluded there is no evidence that would prohibit the Shroud from being the authentic burial cloth of Jesus.

1. Introduction

The ultimate question regarding the Shroud of Turin is, “Could it be the authentic burial cloth of Jesus?” There is general agreement that a continuous history exists for the Shroud of Turin after it was shown as in Lirey, France, about 1355-1356. However, some dispute the existence of this cloth prior to this date. When the Shroud was carbon dated in 1988 to 1260-1390 A.D., most people believed this result. Therefore, people reasoned that it could not be authentic. However, several considerations have convinced most Shroud researchers today that the conclusion of the carbon dating is faulty. Convincing evidence indicates the burial cloth of Jesus was in existence long before 1260 A.D., and that the Shroud of Turin is the same cloth that was accepted as the burial cloth of Jesus prior to 1200 A.D.

2. History of the Shroud

Jesus’ burial cloth was originally found by Peter and John in the tomb after Jesus’ crucifixion in Jerusalem (John 20:3-9). It was one of the few things left behind by Jesus and it had his blood on it, therefore it is very unlikely to have been ignored, reused, burned, or thrown out. Due to its importance, it probably would have been protected from moisture, insects, and intentional destruction. Under these conditions, the linen Shroud would have decayed only by oxidation and dehydration, which are very slow processes, so it could easily have survived for thousands of years. There are many examples of linen lasting much longer than 2000 years.

Several items found on the Shroud of Turin indicate it was in Jerusalem: 1) DNA from the area of Israel, 2) pollen unique to the Jerusalem area, and 3) a small chip of limestone identified as “Jerusalem limestone” based on its impurities. Many of the early believers, when

they fled Jerusalem to avoid persecution, went to Antioch (Acts 11:19) so it became the center for Christian outreach (Acts 11:26, 13:1-4). A tradition preserved in the writings of Athanasius (298–373 A.D.) indicates that prior to the destruction of Jerusalem in 70 A.D., Christian relics, including the icon of our Lord, were brought from Jerusalem through Pella to Syria, perhaps to Antioch. Ancient texts and an inscription indicate Jesus' shroud may have been involved in the conversion of King Abgar the Great of Edessa in Mesopotamia probably in the second century.

The apostle Paul may have used the Shroud for apologetic purposes in Galatia. In Galatians 3:1, Paul says "You foolish Galatians, who has bewitched you, before whose eyes Jesus Christ was publicly portrayed as crucified?" (NASB, ESV). The word translated "publicly portrayed" is translated as "clearly portrayed" in the NKJV and the NIV, as "vividly portrayed" in the HCSB, and as "pictured" in many other translations. Many translations and commentaries assume Paul had preached to them so clearly and forcefully about Christ's crucifixion it was as though he had shown them a picture of Christ's crucifixion. Thus, they interpret it in a figurative sense, but it can also be understood in a literal sense, that Paul held up an object that publicly and clearly pictured Christ's death before their "very eyes" (NIV). If this literal sense is what Paul meant, then what better object to hold up before their "very eyes" than Jesus' burial cloth with his blood and possibly his image on it? It would have dramatically communicated the certainty and meaning of Jesus' death to the Galatians. The Greek word at issue in Gal. 3:1 is "proeographa", from which we get the English word "graphic". It can be translated as portrayed or pictured, which allows for the use of a physical object as a visual. It can also be translated as placarded or signboarded, which emphasizes the use of a physical object containing a message to be communicated in a public place. This literal sense is used in various translations, so we should allow for this as a possibility:

- "... you before whose eyes Jesus Christ was openly displayed on the cross!", New English Bible, Revised English Bible
- "... before whose eyes Jesus Christ was placarded publicly as the crucified one? New Testament Expanded Translation by Kenneth S. Wuest
- "a placard ... with a picture on it", The Living Bible
- "...a signboard with a picture of Christ", New Living Translation

It is believed that Jesus' burial cloth was later brought into Byzantium, which was later called Constantinople and now Istanbul. It was probably brought into Constantinople about 574 A.D. as a cloth called the "Image of God Incarnate". This is because, starting in 692 A.D. and continuing for 500 years, Byzantine coins were minted containing an image of Jesus with many similarities to the image on the Shroud of Turin. The image was also frequently copied in Byzantine art. The earliest surviving example is the Christ Pantocrator painting from St. Catherine's Monastery at Sinai, which has been dated to about 550 A.D.

An alternate hypothesis which explains how Jesus' burial cloth arrived in Constantinople is that it was taken to the city in 944 as the Image of Edessa, which was probably also called the Mandylion. In 1203-1204, the French crusader Robert de Clari wrote that Jesus' burial cloth "raised itself upright" every Friday in the My Lady Saint Mary Church in the Blachernae district in Constantinople. It probably rose out of a box via some type of pulley mechanism. It may have been sold by Byzantine emperor Baldwin II to his cousin, King Louis IX of France, between 1237 and 1261. Others believe it may have been stolen from Constantinople in the sack of the city in 1204. We have no evidence that it was in Constantinople after 1204.

In about 1355-1356 it was exhibited as the burial cloth of Jesus by the French knight Geoffrey de Charny in Lirey, France. Geoffrey de Charny was the grandson of Jean de Joinville, a principle adviser to King Louis IX. Though it is often said that the Shroud only dates to about 1355 A.D., a correct understanding is that the continuous history of the Shroud only goes back to about 1355, however, the above evidence indicates it was well known previously. In 1453, it was sold by Geoffrey de Charny's granddaughter to Louis, the Duke of Savoy. It was then gradually transported across France till it came into Turin, Italy, in 1578 where it is to this day. What is believed to be the history of Jesus' burial cloth is shown in Figure 1. This figure shows the route from Lirey to Turin in a solid line because this route is historically well attested, but the routes from Jerusalem to Edessa to Constantinople to Lirey are in dashed lines for the exact routes are not known.

This historical evidence, when combined with the results of the scientific investigation of the Shroud, is sufficient to convince most researchers that the Shroud of Turin is likely the authentic burial cloth of Jesus. No other explanation is consistent with all the historical and scientific evidence.

3. The Hungarian Pray Manuscript

One of the best indications the Shroud of Turin was in Constantinople prior to the carbon date of 1260-1390 is the Hungarian Pray Codex or Manuscript. This document was discovered by György Pray in 1770 and is the oldest manuscript in the Hungarian language, with a date of 1192 to 1195 A.D. It is kept in the National Szechenyi Library in Budapest.

To understand the relevance of this document to the Shroud, it is helpful to understand the so-called "poker holes" on the Shroud and the weave of the fabric used for the Shroud. Four sets of four holes in an L-pattern can be seen in each quadrant of the Shroud (Figures 2 and 3). These holes were evidently formed when the Shroud was folded in half on the short side and then folded in half on the long side. Perhaps something hot such as burning coals fell onto the folded cloth, burning through each layer of the cloth in sequence. These holes have a characteristic pattern: three holes in a straight line and a fourth hole at a 90-degree angle to the straight line. Holes in this same pattern also appear on a copy of the Shroud painted in 1516 A.D., so these holes predate the fire in the church where the Shroud was located in 1532.

The fabric used for the Shroud is linen made from the long vertical fibers from the stem of the flax plant. The weave of this linen is a 3-to-1 herringbone twill with the threads having a reverse twist. Figure 4 is a closeup of the Shroud fabric and shows how the threads are woven together. It also shows that the threads create a stair-step appearance, as indicated by the black lines in Figure 4. The right half of this stair-step pattern is longer than the left half, approximately in a ratio of three to one, because of the 3-to-1 ratio of the herringbone twill. The "poker holes" and this stair-step pattern in the weave help us to understand the Pray Manuscript.

One page of the Pray Manuscript is of special interest to the study of the Shroud. This page contains two scenes. The upper scene on the page shows Jesus' burial, and the lower scene is after his resurrection. In the upper scene, shown in Figure 5, three men, probably the apostle John, Nicodemus, and Joseph of Arimathea, are preparing Jesus' body for burial. Several things are of particular interest:

- Jesus' body is depicted nude, contradictory to modesty and normal curtesy that ought to be shown, especially to Jesus as a respected rabbi and reputed miracle worker, Messiah, and Son of God.
- There is a long cloth under his body. The man on the right appears to be holding a long role of cloth, which may be part of Jesus' burial Shroud, part of which is under his body.
- His face has features as on the Shroud, with beard, long nose, and long hair – longer on one side than the other.
- His arms are crossed at the wrists over his groin area.
- His fingers are clearly shown but his thumbs are not. This feature is curious as it is contrary to paintings of Jesus' crucifixion that were painted in the Middle Ages.

These features are consistent with the Shroud, so are best explained by the artist having an awareness of the features of the image on the Shroud, whether he had personally seen it or not. In particular, the thumbs folded under the palms on the Shroud is probably the only credible explanation for the two hands in the Pray Manuscript not showing the thumbs.

The lower scene on the page (Figure 6) is after Jesus' resurrection. It shows an angel on the left and three women on the right with Jesus' empty burial cloth in front of them. There are several reasons that the item in front of them is Jesus' burial cloth. The top piece of this cloth is folded back so the blood, represented inside crosses, can be seen on the inside of the bottom cloth. The crosses are a typical Christian symbol. The stair-step pattern on the top cloth represents the herringbone weave of the Shroud of Turin, as shown in Figure 4. Some claim that the stair-step pattern on the Pray Manuscript is essentially different from the weave on the Shroud. This claim is based on the stair-step pattern on the Pray Manuscript being entirely in a 1-to-1 horizontal-to-vertical ratio, whereas the weave on the Shroud shows a 1-to-1 ratio on the left side and a 3-to-1 ratio on the right side, as shown by the black lines in Figure 4. There are several reasonable explanations for this inconsistency between the Pray Manuscript and the Shroud: 1) perhaps the artist of this page of the Pray Manuscript did not personally see the Shroud but depended on information from others, 2) if he had seen it, perhaps he did not study it in sufficient detail to reproduce it correctly, or 3) if he had seen it and studied it in sufficient detail, perhaps he had forgotten the details.

Notice this stair-step pattern is on the right and left sides of this top cloth, but this pattern is broken in the middle. When looked at carefully, what appears to be a knife can be seen at the top edge of the top cloth with sections of the cut cloth around it. An enlarged view of this knife is shown in Figure 7. This knife was apparently used to cut something from the top cloth, leaving a hole in the herringbone pattern. The left-most woman has a more prominent halo, or nimbus, around her head, indicating her prominence among the three women. Most surprising, on her right arm can be seen a side view of a man's head probably with a beard, as shown in Figure 8. Evidently, the angel has cut the image of the man's face/head from the top portion of the cloth and given it to the woman on the left, who is probably Mary. This indicates the top part of this cloth contained the image of the face/head. Thus, this picture depicts Jesus' burial Shroud that would have contained an image of Jesus' face.

That the Pray Manuscript depicts the Shroud is confirmed by a closer look at Figure 6, as in Figure 7, which shows that the Pray Manuscript contains the same four-hole pattern as the Shroud of Turin (Figures 2 and 3). This proves that the Pray Manuscript is depicting the Shroud of Turin. Since the Pray Manuscript is dated to 1192 to 1195 A.D., this indicates the Shroud's existence was well known prior to the carbon date for the Shroud⁶ of 1260-1390 A.D. Since the

one sigma standard deviation⁶ of the uncertainty on the uncorrected carbon date is 31 years, the difference between the carbon date and the Pray Manuscript (1260 – 1195 = 65 years) is $65 / 31 = 2.1$ sigma below the carbon date range of 1260-1390. Since the range of 1260-1390 is a two-sigma range, and the date for the Pray Manuscript (1192-1195) is an additional 2.1 sigma lower, it is more than four-sigma below the carbon date. The normal acceptance criterion is two-sigma, so the possibility this difference (1260 - 1195 = 65 years) could occur due to a random measurement error should be rejected. This means the carbon date of 1260-1390 should be rejected based on the Hungarian Pray Manuscript dating to 1192-1195.

Some have tried to argue that the scene in Figure 6 does not show Jesus' burial cloth but instead shows a sarcophagus in which Jesus was buried. A sarcophagus is a box-like funeral receptacle for a corpse, usually carved in stone, and usually displayed above ground. Much of iconography by the middle ages had replaced Jesus' burial tomb with a sarcophagus. In this explanation, the bottom cloth in Figure 6 is said to be the bottom box of the sarcophagus, and the top cloth in Figure 6 is said to be the lid of the sarcophagus with Jesus' burial shroud crumpled on the lid to the right of the angel's foot. This explanation is used to argue against the Shroud's existence before 1260, based on the belief that carbon dating accurately determined that the Shroud dates to 1260 to 1390. Sections 5 and 6 will explain why the carbon date of 1260-1390 is no longer credible, so this motivation to prove the Shroud did not exist before 1260 is no longer reasonable.

The claim that Figure 6 shows Jesus' sarcophagus rather than Jesus' burial Shroud cannot be correct because it fails to explain several features of the picture:

- The lower and upper cloths show no thickness, contrary to the clear three-dimensionality of the sarcophagus, and often its lid, in most iconography. Examples are shown in Figure 9.
- The upper cloth appears as though it could be attached to the lower cloth at the far-left side of the picture, contrary to the lid being clearly separate from the sarcophagus box in iconography (Figure 9).
- A cross is a typical Christian symbol. The bottom cloth in the picture (Figure 6) is covered with crosses of what is now a reddish-orange color that apparently depicts Jesus' blood. In iconography, the inside of Jesus' sarcophagus shows no blood because Jesus' blood would have been on his burial cloth, as shown on the Pray Manuscript, not on the inside of a sarcophagus (Figure 9).
- The four holes, three in a straight line and the fourth at a 90-degree angle (Figures 6 and 7), is a very unusual pattern and is nicely explained by the holes on the Shroud of Turin, but has no explanation if this is the lid of a sarcophagus (Figure 9).
- The stair-step pattern on the top cloth (Figure 6) can be easily explained by the herringbone weave of the Shroud (Figure 4) but in iconography, sarcophagus lids do not show this pattern (Figure 9).
- The knife laying on the top cloth (Figure 7) and the image of the face/head held by the woman on the left (Figures 6 and 8), presumably Mary, have no adequate explanation if this is a sarcophagus (Figure 9). If this picture shows Jesus' burial cloth instead of a sarcophagus, then the image of the face/head was evidently cut out of the top cloth with the knife, possibly by the angel, and given to Mary. This means the image of the face/head was on the top cloth as on the Shroud.

Some have also tried to argue that this image is not the Shroud of Turin because the L-shaped pattern of four holes has been rotated by 90-degrees relative to the pattern on the Shroud, but this reasoning is not adequate because: 1) this unusual pattern of circles would have no reason to be included in the picture if it were not depicting the same cloth as the Shroud of Turin, 2) perhaps the artist had not seen the Shroud himself or had seen it but had forgotten exactly how the angle of the L-shaped pattern of holes was oriented, and 3) there are other examples in the picture where the artist appears to be somewhat geometrically challenged. The conclusion is the Hungarian Pray Manuscript, which is dated to 1192 to 1195, depicts what we now call the Shroud of Turin. This proves the Shroud existed significantly before the carbon date of 1260-1390.

4. Date Indicators for the Shroud

There are at least 15 date indicators for the Shroud, 14 of them are consistent with the time of Jesus. Only the carbon date (1260-1390) is not. These dating techniques are listed below starting from the technique that gives the most recent date, then proceeding back to older dates.

1. Three samples cut from the lower corner of the Shroud in 1988 were carbon dated at three laboratories, with the average of the laboratory average values being 1260 A.D. \pm 31 years. This is the raw or “uncorrected” value. When this value was corrected for the changing concentration of C^{14} in the atmosphere, a range of 1260 to 1390 A.D. was obtained. This is a two-sigma range, which means there should be a 95% probability that the true value is within this range. The next two sections explain why this conclusion (1260-1390) should be rejected, i.e. have no credibility.
2. Coins were often rubbed onto the Shroud and jewelry such as rings would have often contacted the Shroud. This left micro-particles of gold and gold-alloy metals on the Shroud. The composition of these micro-particles has been analyzed and found to be consistent with the history of the composition of coins and jewelry during the Byzantine empire.¹ This probably indicates the Shroud existed long before the fall of Constantinople in 1204 A.D.
3. As discussed above, the Hungarian Pray Manuscript contains a colored diagram that can be identified as the Shroud of Turin based on several features, especially the L-shaped pattern of four holes that is also on the Shroud. The Pray manuscript is historically dated to 1192 to 1195 A.D., which proves the Shroud existed by this date, which proves the Shroud existed prior to the carbon date of 1260-1390.
4. It is believed that the spinning wheel was invented in Asia by the 11th century and had spread to Europe by the 13th century. Since the Shroud is made of hand-spun thread, rather than thread made on a spinning wheel, the threads that compose the Shroud were probably spun before the spinning wheel arrived in Israel perhaps in the 12th century.

1. Giulio Fanti and Claudio Furlan, “Do gold particles from the Turin Shroud indicate its presence in the Middle East during the Byzantine Empire?”, *Journal of Cultural Heritage*, volume 42, March-April 2020, pages 36-44

5. The international standard for length at the time of Jesus was the Assyrian cubit which was equal to about 21.6 inches (54.9 cm). The dimensions of the Shroud in this unit is 7.97 by 2.02 cubits. When held up for display, the Shroud was normally held by the long side of the cloth with the lower side of the cloth hanging free. This would have caused the width to increase slightly during each such display, thus probably causing the length to decrease slightly. This means that the original dimensions of the Shroud were very likely 8 by 2 cubits, consistent with the standard in the first century.² Thus, the size of the Shroud indicates that it was made in ancient times when the cubit was used as the common unit of measurement.
6. Ancient coins that contain the same image as the Shroud of Turin go back to about 692 A.D. The Shroud could not have been copied from the coins, or from any other item, because the image on the Shroud was not produced by pigment, liquid, scorch, or photography, based on analysis by the Shroud of Turin Research Project (STURP) in 1978. This indicates the coins must have been copied from the Shroud, thus showing that the Shroud existed by about 692 A.D.
7. The face or head cloth of Jesus that Peter and John found in the Tomb on Sunday morning after Jesus' burial is believed to be in Oviedo, Spain. It is called the Sudarium of Oviedo because the Greek word in John 20:7 for it is 'soudarion', and it is in Oviedo, Spain. It is 84 x 53 cm (33 x 21 inches) and does not contain an image. This is evidently because it was not on the face when the body disappeared from within the Shroud. Both the Shroud and the Sudarium contain blood that is consistent with it being human blood of type AB. Several researchers believe that the shape of the blood stains on the Sudarium correspond to the Shroud locations on the head that were bleeding. Thus, there is good evidence that the Shroud of Turin and the Sudarium of Oviedo covered the same body. There is a definite history for the Sudarium that dates it to 570 A.D. in Jerusalem. It left Palestine in 614 and arrived in Spain a few years later. It went to northern Spain in 718 and was taken to Oviedo in 840 where it has remained ever since. The evidence that the Sudarium and the Shroud covered the same body indicates that the Shroud can also be dated back to at least 570 A.D.
8. Ancient paintings and other works of art that contain the same image as the Shroud of Turin go back to about 550 A.D. For the reasons stated above, the Shroud could not have been copied from the ancient paintings, so the paintings must have been copied from Shroud. This means that the Shroud must have been in existence by about 550 A.D.
9. The image on the Shroud is that of a crucified man. Specifics of this image indicates that it was made at a time when there was current knowledge of Roman crucifixion:
 - Paintings in the Middle Ages show the nails going through the palms, but experiments indicate that nails through the palms will not support the weight of the body due to the lack of bones above this location. The Shroud shows that the nails were in the wrist, which will support the weight of the body.

2. Steven E. Jones, <http://theshroudofturin.blogspot.com/2014/09/dimensions-of-shroud-turin-shroud.html>

- Paintings in the Middle Ages prominently show the thumbs. But when the nails go through the wrist, they crush the main nerve for the hand. This would have automatically folded the thumbs under the palms. Again, the Shroud gets it right, even though it is contrary to the culture of the Middle Ages.
- The scourge marks are consistent with the design of a Roman flagrum.
- The side wound is the size and shape of the tip of a Roman thrusting spear.

Constantine the Great, the first Christian emperor, abolished crucifixion in the Roman Empire in 337 A.D. out of veneration for Jesus Christ, its most famous victim. The details of crucifixion would have gradually been forgotten after this date. Thus, the image on the Shroud was probably made earlier than about 400 A.D.

10. Ancient traditions indicate the burial cloth of Jesus was taken to Edessa, Turkey, in the first or second centuries.
11. There is a 3.2-inch wide piece of linen that is sewn onto the main piece of the Shroud along the long side of the Shroud. According to expert opinion, the stitch used to connect this side piece onto the main piece was made by a professional and is a unique stitch. The most similar stitch is on a piece of cloth found at Masada, which was destroyed in 73 to 74 A.D. Thus, this stitch is strong evidence that the Shroud dates to the first century.
12. The image on the Shroud is that of a naked man who was crucified exactly as the Bible says that Jesus was crucified. The image could not be due to an artist or forger because the image is not due to pigment, liquid, scorch, or photography. The only other option is that the body that was wrapped in the Shroud in some way made the image. Since no normal human body can encode an image of itself onto a piece of cloth, many Shroud researchers conclude that it must be the authentic burial cloth of Jesus. The ancient historical texts indicate Jesus probably died either in 30 or 33 A.D., so the Shroud must also date to 30 or 33 A.D.
13. A photograph of the face on the Shroud taken by professional photographer Giuseppe Enrie in 1931 indicates a possible coin over one eye. With computer enhancement, three letters on the coin seem to be apparent. These letters and the shape of the coin appear to indicate that it is a Roman Lepton minted by Pontius Pilate in 29 to 32 A.D. This evidence is tentative, as it is found primarily on one photograph and could be the result of the image enhancement. But with confirmation, this dating technique could become definitive.
14. Giulio Fanti developed three different types of physical tests to determine how flax fibers change with age.³ These tests were then applied to the Shroud to determine its age. The resulting ages are:
 - Fourier Transform Infrared Spectroscopy (FTIR): 300 B.C. \pm 400 years
 - Raman Spectroscopy: 200 B.C. \pm 500 years

3. Pages 204, 207, and 246 of Giulio Fanti and P. Malfi, "The Shroud of Turin, First Century After Christ", 2015, Pan Stanford Publishing

- Tensile strength of flax: 400 A.D. \pm 400 years

The stated uncertainty values are two sigma values, equivalent to a 95% probability range. The average of the three tests is 33 B.C. \pm 250 years for the Shroud of Turin, which is consistent with Jesus' death about 30 or 33 A.D.

15. Fibers from the Shroud show damage from sources of natural background radiation. Using microscopic analysis of the Shroud fibers, chemist Ray Rogers found that the radiation damage to the Shroud fibers indicates that the Shroud "is quite old, similar to flax fibers from the Dead Sea Scrolls",⁴ which are dated to about 250 B.C. to 70 A.D. This indicates that the Shroud of Turin should also date to about the same period.

5. Objections to the 1260-1390 Date for the Shroud

The characteristics of the image are so unique it is impossible for the image to have been made in 1260-1390 because the technology did not exist, and still does not exist. This is indicated by the failure of all modern attempts to produce an image of the face, using only materials and abilities available to people in the Middle Ages, that is macroscopically and microscopically correct. The STURP team that performed non-destructive experiments on the Shroud for five days in 1978 concluded that the image: 1) is not due to pigment, 2) has no carrier, 3) has no clumping of material between the fibers or threads, 4) shows no capillarity (soaking up of a liquid), 5) shows no cracking of the image along the fold lines, 6) has no brush strokes, and 7) has no stiffening of the fabric. This means the image could not be due to paint, dye, stain, acid, or any organic or inorganic liquid. Lack of fluorescence under ultraviolet light proves the image was not made by a scorch from a hot object. The presence of 3D information in the image proves the image was not made by a photographic process. The image is extremely superficial: 1) only the top two or three layers of fibers in a thread are discolored, and 2) the discoloration in a fiber is only about 0.2 microns thick around the circumference of the fiber, which is about 15 to 20 microns in diameter, with the inside of the fiber not discolored. The discoloration in the fibers is caused by some of the single electron bonds of carbon in the cellulose in the linen being changed to double electron bonds in a pattern that forms the image of a crucified man. These features of the image are very difficult to explain but suggests it might have been caused by an extremely brief intense burst of radiation from the body which discolored the fibers by an electrical discharge from the tips of the fibers.⁵ The technology required to produce these characteristics is beyond our current understanding of science.

There are many reasons the Shroud of Turin and its image could not have been made between 1260 and 1390 A.D., as determined by the 1988 carbon dating of the Shroud. It is not credible that an artist or forger in 1260-1390 would:

- Create a negative image without pigment, chemicals, liquid, or scorch that contains 3D information related to the vertical body-to-cloth distance.
- Produce fiber discoloration by a change from single to double electron bonds in cellulose that produce the image of a crucified man.

4. Raymond N. Rogers, "The Shroud of Turin: Radiation Effects, Aging, and Image Formation" June 2005, page 5.

5. Robert A. Rucker, "Holistic Solution to the Mysteries of the Shroud of Turin", July 16, 2020, available on the research page of www.shroudresearch.net.

- Produce the image using details of first-century flogging and crucifixion.
- Put the nails in the wrists with thumbs folded under, contrary to paintings from the Middle Ages.
- Add pollen to the Shroud that is unique to Jerusalem.
- Add pollen from a plant with long thorns around the head on the Shroud.
- Put a microscopic amount of dirt in abrasions on the nose and one knee.
- Put a microscopic chip of “Jerusalem limestone” onto the Shroud.
- Use a unique stitch to attach the 3.2-inch side piece to the main Shroud that is most like a stitch found only at Masada, which was destroyed in 73 to 74 A.D.
- Know or be able to put bilirubin and nanoparticles of creatinine and ferritin into the blood that indicate the body had gone through torture.

6. Explanation for the Carbon Dating of the Shroud

In 1988, samples were cut from the lower corner of the Shroud of Turin for carbon dating. The result of this process was a date range of 1260 to 1390 A.D., with a 95% probability that the true date falls within this range.⁶ This is often assumed to be the strongest evidence that the Shroud dates to the 13th or 14th century and so could not be the burial cloth of Jesus. However, there are many reasons that this date should be rejected.⁷ Carbon dating involves a two-step process. The carbon-14 to carbon-12 (C^{14}/C^{12}) ratio of a sample is first measured. This measured ratio is then used to calculate a date for the sample assuming the C^{14}/C^{12} ratio has only changed due to decay of the C^{14} . Proper statistical analysis of the data resulting from the 1988 carbon dating of the Shroud indicates there was probably an unexpected factor that altered the C^{14}/C^{12} ratio in the samples. This means the C^{14}/C^{12} ratio for the samples was correctly measured, but because this ratio had been altered by an unexpected factor, the calculated date was not the true date for the Shroud. This difference between the calculated date and the true date is called a systematic error or bias. Because the magnitude of this error cannot be determined, the conclusion of the 1988 carbon dating of the Shroud should be rejected, i.e. the date of 1260-1390 A.D. should be given no credibility. Three recent statistical analysis of the data from the 1988 carbon dating of the Shroud agree with this conclusion.⁸

Several options have been proposed for the cause that altered the C^{14}/C^{12} ratio of the samples, including heat and smoke from the fire in 1532, contamination, bioplastic film, an invisible reweave, and carbon monoxide. All these options have significant problems. Another option which would cause the carbon date to be different from the true date is neutron absorption. This is believed to be the earliest documented proposal to explain why the carbon

6. P.E. Damon and 20 others, “Radiocarbon Dating of the Shroud of Turin”, *Nature*, February 16, 1989.

7. Robert A. Rucker, “The Carbon Dating of the Shroud is Explained by Neutron Absorption”, July 16, 2020. This paper is an abridgment of “Understanding the 1988 Carbon Dating of the Shroud”, July 16, 2020, also by Robert A. Rucker.

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date may not be the true date.⁹ This explanation nicely correlates with the above concept that the image on the Shroud was produced by an extremely brief intense burst of radiation from the body⁵. Experiments have shown that protons can cause discoloration on linen similar to what is seen on the Shroud.¹⁰ If charged particles, such as protons, were emitted from the body to form the image, then it is possible that neutrons were also emitted in this burst of radiation because there is a similar number of neutrons and protons in the body. For example, about 10% by weight of a human body is hydrogen. About 99.98% of hydrogen atoms have only a proton in the nucleus of the atom (H^1), and about 0.02% of hydrogen atoms have both a proton and a neutron in the nucleus. The form of hydrogen that contains both a proton and a neutron is called deuterium or heavy hydrogen (H^2). Therefore, if protons in the radiation burst resulted from splitting of deuterium nuclei, then an equal number of neutrons and protons would be emitted. Deuterium is of special interest because it requires the minimum energy to split its nucleus into separate neutrons and protons.

The human body is made of organs, which are made of proteins. These proteins are composed of molecules containing atoms, which contain neutrons, protons, and electrons. Based on the elemental composition of a human body, a body with a weight of 79 kg (175 lbs) contains about 2×10^{28} neutrons. To analyze a hypothesized neutron emission from the body, nuclear analysis calculations were performed using the MCNP (Monte Carlo N-Particle) computer software. These MCNP calculations determined that if 2×10^{18} neutrons were emitted homogeneously in the body, it would cause a 16% increase in the C^{14} content at the 1988 sample location by the $[N^{14} + \text{neutron} \rightarrow C^{14} + \text{proton}]$ reaction. This 16% increase would cause the carbon date to shift from 30 A.D. to 1260 A.D., thus explaining the 1988 carbon dating of the Shroud. As one example, to produce 2×10^{18} neutrons would require only 0.0004% of the deuterium (heavy hydrogen, H^2) nuclei in the body to fission, since each deuterium nucleus contains one neutron and one proton. Emission of 2×10^{18} neutrons is only one neutron for every ten billion neutrons in the body ($2 \times 10^{18} / 2 \times 10^{28} = 1 \times 10^{-10}$).

7. Conclusion

Traditions, historical documents especially the Pray manuscript, and images in art and on Byzantine coins indicate that the Shroud of Turin was well known and revered in the Byzantine empire, long before the carbon date of 1260-1390. The impossibility of making the image in 1260-1390, and the proper statistical analysis of the data obtained in the 1988 carbon dating of the Shroud indicates the 1260-1390 date for the Shroud should be rejected. Tradition and multiple date indicators for the Shroud argue that it could be from the first century. The stitch that holds the side piece to the main Shroud probably dates this seam to the first century. This date is confirmed by experiments in Fourier Transform Infrared Spectroscopy, Raman Spectroscopy, and the tensile strength of flax. These three methodologies, in combination, date the Shroud to 33 B.C. \pm 250 years. This range includes the time of Jesus' death, which is about 30 or 33 A.D. Thus, these considerations indicate that there is no evidence that would prohibit the Shroud of Turin from being the authentic burial cloth of Jesus, and there is much evidence that is most consistent with the Shroud being authentic.

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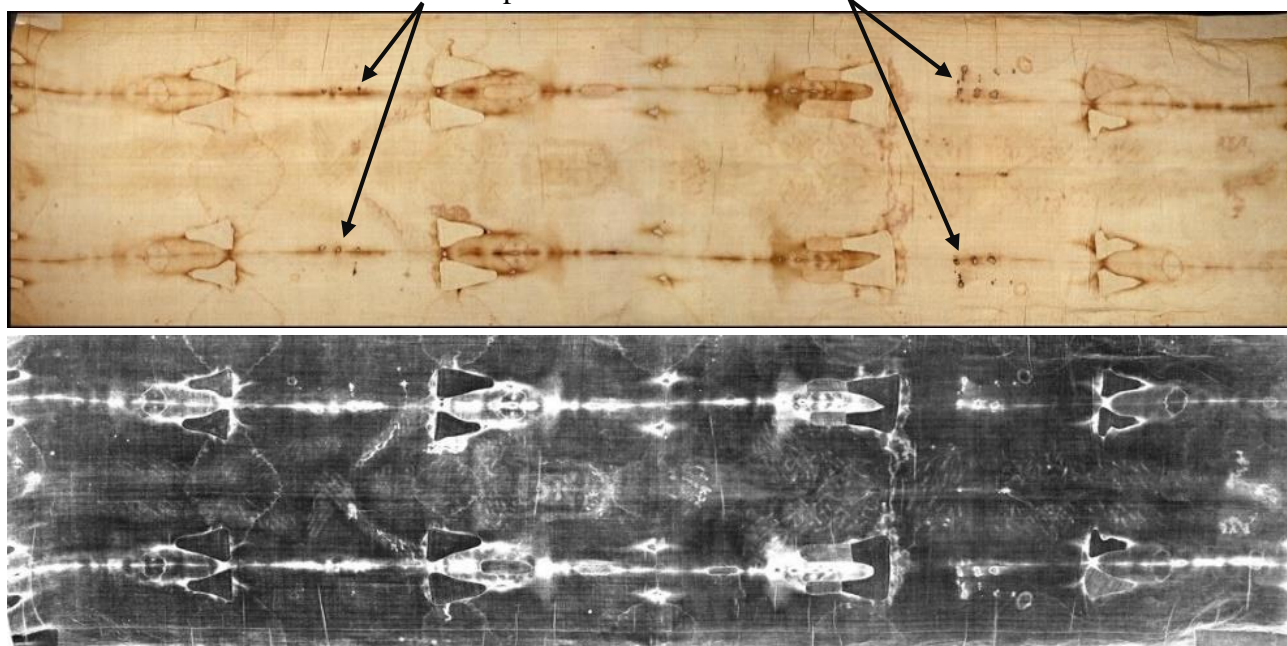
9. Thomas J. Phillips, "Shroud Irradiated with Neutrons?", *Nature*, Vol. 337, No. 6208, page 594, February 16, 1989, published in the same edition of *Nature* as Damon.

10. Arthur C Lind, "Image Formation by Protons", available at <https://www.testtheshroud.org/articles>

Figure 1. History of the Shroud



Figure 2. Shroud as Seen (Top) and the Camera Negative (Bottom),
L-Shaped Pattern of Burn Holes



Figures 2 to 8 are © Barrie M. Schwartz Collection, STERA, Inc.

Figure 3. L-Shaped Pattern of Burn Holes in Each Quadrant



Figure 4. Stair-Step Pattern in the 3-to-1 Herringbone Weave of the Shroud



Figure 5. Top of Page from the Hungarian Pray Manuscript



Figure 6. Bottom of Page from the Hungarian Pray Manuscript



Figure 7. Knife and L-Shaped Hole Pattern on the Shroud

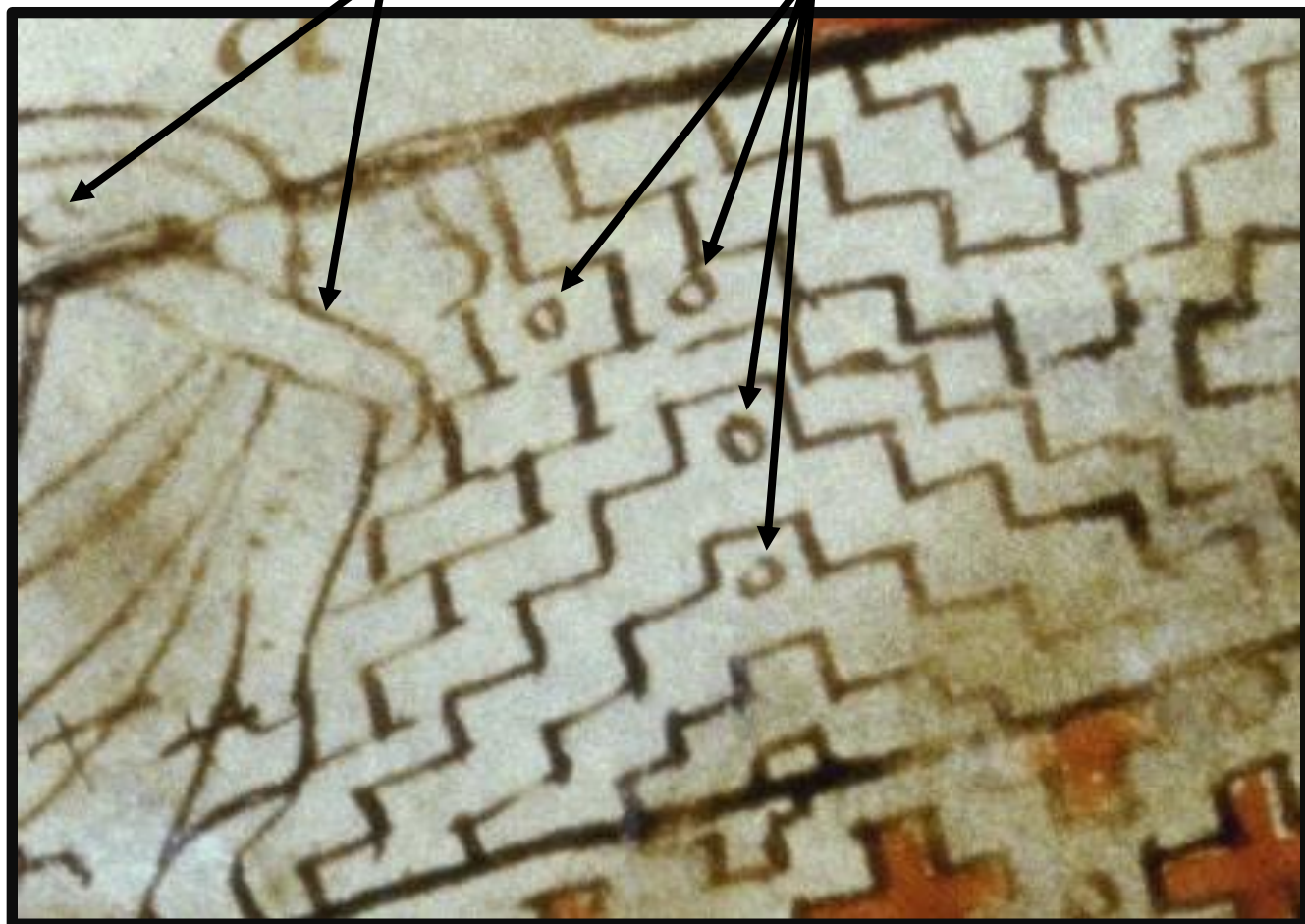


Figure 8. Image of the Face Held by the Woman on the Left



Figure 9. Examples of a Sarcophagus in Iconography

