Science and the Shroud of Turin:
Evidence of the Crucifixion and Resurrection of Jesus

In this article, we will investigate five major dimensions of the relic known as "the Shroud of Turin:"

1. Introduction to the Shroud of Turin (Section I).
2. Problems with the 1988 Carbon Dating and Eight Alternative Methods for Dating the Shroud (Section II).
3. The Bloodstains on the Shroud (Section III).
4. The Crucifixion and Death of the Man on the Shroud (Section IV).
5. The Image on the Shroud and the Resurrection of Jesus (Section V).

I.
Introduction to the Shroud of Turin

The Shroud of Turin can amplify our understanding and reinforce the rational validation of Jesus' crucifixion, death, and resurrection. It is the most unique image produced in human history. It has the further distinction of being by far the most scientifically investigated historical artifact. These tests have unveiled a preponderance of scientific evidence implying the Shroud's authenticity. Though the evidence is quite probative, it is not definitive, and additional scientific testing is needed to obtain greater certitude. As noted above, our faith does not rest on any artifact (or the scientific investigation of it), but rather on the apostolic testimony, the teaching of the Catholic Church, the New Testament scriptures, and the confirmation of the Holy Spirit in us and the rest of the faithful.

As we shall see, the authenticity of the Shroud was seriously questioned by a 1988 carbon dating which placed the Shroud's origin in the 15th Century. However, this carbon dating has recently been discredited by further analysis of the raw data from the tests as well as by the heterogeneous composition of fibers taken from the sample site. Though four new dating tests, and other extrinsic dating evidence point to a first century origin of the Shroud in Judea, additional testing must be done. As we shall see below (Section V.D), we must test for Cl-36 and Ca-41cosmogenic isotopes indicative of a nuclear reaction before doing another carbon dating. If the Shroud's image was produced by a low temperature nuclear reaction coming from the disintegration of all the atomic nuclei in the Shroud man's body, then carbon dating cannot be used to determine the date of the cloth.

Additionally, scientists have unveiled a host of mysteries surrounding the Shroud, which have confounded current models of scientific and naturalistic explanation. Regardless of whether we attribute these science-confounding mysteries to supernatural causation, this investigation of the Shroud will show it to be one of the most, if not *the* most unique and mysterious historical artifacts ever to have come to light. We may now turn to the Shroud itself.

The Shroud of Turin is a linen burial cloth fabricated by a herringbone, three-to-one twill pattern, measuring roughly 14 feet by 3.5 feet. It has a perfect three-dimensional,

photographic negative image of a crucified man, an image executed in such accurate anatomical detail that modern medicine can diagnose many of the injuries by analyzing it. Most intriguing of all, scientific tests have revealed the image was not produced by any kind of paint, dye, chemical, vapor, or scorching (see below Section V). The Shroud has 372 blood stains (159 on the front image and 213 on the back image) with AB+ blood type and enzymes indicating polytrauma which were embedded on the Shroud prior to the creation of the image. It tells the story of a crucifixion which resembles the unique crucifixion of Jesus of Nazareth by Roman authorities (see below Section IV).

The provenance of the Shroud is limited because its recorded history begins only when it surfaced in Lirey, France in 1353 in the hands of a French nobleman, Geoffroy de Charny, whose wife's ancestors were linked to one of the leaders of the Fourth Crusade—Othon de la Roche. Since that time, the journey of the Shroud to Turin, Italy (where it remains today) is quite certain. However, prior to 1353, we have only sightings of what appears to be the Shroud—for example in Palestine (from the New Testament—Jn 20:5), in Edessa Turkey (from the Roman emperor who laid siege to Edessa to obtain it in 943), and in Constantinople (from one of the leaders of the Fourth Crusade who saw it displayed in the church of St. Mary Blachernae in 1204—Robert de Clari). We can also trace its history by means of the indigenous pollen grains embedded in it from Palestine, Edessa, Constantinople, France, and Italy.[1]

In sum, the Shroud is a unique and mysterious historical artifact which through scientific testing appears to be the burial cloth of Christ revealing details that correspond to the unusual set of injuries described in the Gospels. It also contains evidence of a source of radiation and mechanical transparency suggestive of the resurrection of Jesus Christ. We will here give a brief survey of some of this evidence.

II.
Problems with the 1988 Carbon Dating and Eight Alternative Methods for Dating the Shroud

The 1988 carbon dating which placed the Shroud's age between 1260 to 1390 AD, convinced much of the scientific and religious world that the Shroud had been produced by a medieval forger, but as we shall see, the sample produced heterogeneity in the raw data of the carbon dating, invalidating it to establish a medieval timeframe. It also strongly disagrees with five other dating tests and three extrinsic methods of dating. When all of this is considered, the most probable date of the Shroud of Turin is in the 1st century, around the area of Palestine. We will explain these findings in three sections:

1. Problems with the 1988 Carbon Dating (Section II.A).
2. Five New Scientific Dating Methods (Section II.B).
3. Three Extrinsic Dating Methods (Section II.C).

[1] I give a more detailed explanation of the historical journey of the Shroud prior to 1353 in *God So Loved The World: Clues to Our Transcendent Destiny from the Revelation of Jesus* (San Francisco: Ignatius Press, 2016), Appendix One, pp. 369-375.

II.A
Problems with the 1988 Carbon Dating

Before explaining the new methods used to date the Shroud, which place it in the time of Christ, we should address the one test that does not seem to match these findings. A radiocarbon-14 test done in 1988 on a sample of the Shroud which placed it between 1260-1390 AD.[2] As a rule, Carbon-14 is a reliable way of measuring the age of an artifact, but several factors compromised the results of this particular test.

First, a single sample was drawn from a controversial place on the Shroud which may have had some fibrils or fibers associated with repairs to the cloth after the fire of Chambery in 1532. The original protocol for carbon dating recommended that seven samples be taken from different parts of the Shroud—parts that were not compromised by the fire of Chambery and other environmental factors. This was precisely what was *not* done. Instead, a single sample was taken from a part of the Shroud which may have been compromised by repairs after the fire of Chambery. Despite these baffling protocol failures, the peer-reviewed journal, *Nature*, published the results as if they were indisputable: "The results provide conclusive evidence that the linen of the Shroud of Turin is mediaeval."[3]

These findings were not "indisputable." After trying for decades to obtain the raw data from the carbon dating, French researcher, Tristan Casabianca and colleagues finally used a Freedom of Information Act request to obtain the raw data from the British Museum which finally relinquished the data after thirty years. Casabianca and colleagues made a statistical analysis of the data and found significant heterogeneity among the three parts of the samples as well as within each separate sample, meaning that these samples could not be used to accurately date the Shroud to the Middle Ages. They concluded as follows:

> Our statistical analysis shows that the 1988 carbon 14 dating was unreliable: the tested samples are obviously heterogeneous, and there is no guarantee that all these samples, taken from one end of the sheet, are representative of the whole fabric. It is therefore impossible to conclude [from the 1988 carbon dating] that the Shroud of Turin dates from the Middle Ages.[4]

There are two major hypotheses that may explain an errant dating by carbon-14 testing:

1. The sample had fibers from a later period embedded in it (which could have come from repairs after the fire of Chambery). Dr. Ray Rogers identified cotton and a medieval gum dye mordant in the sample used for dating. If the sample had large

[2] P.E. Damon, D.J. Donahue, B.H. Gore, A.L. Hathaway, Aj.J. T. Jull, T.W. Linck, P.J. Sercel, LJ. Toolin, C.R. Bronk, E.T. Hall, R.E.M. Hedges, R. Housley, I.A. Law, C. Perry, G. Bonani, S. Trumbore, W. Woelfli, J.C. Ambers, S.G.E. Bowman, M.N. Leese, M.S. Tite, "Radiocarbon dating of the Shroud of Turin," *Nature* 337 (1989): 611–615, https://www.nature.com/articles/337611a0

[3] Ibid.

[4] Tristan Casabianca, E. Marinelli, G. Pernagallo, B. Torrisi, "Radiocarbon Dating of the Turin Shroud: New Evidence from Raw Data," *Archaeometry* 61, no. 5 (2019): 1223-1231, https://onlinelibrary.wiley.com/doi/full/10.1111/arcm.12467

amounts of these 16th century materials, it would have adversely affected the C-14 test. According to Rogers:

> A gum/dye/mordant [(for affixing dye)] coating is easy to observe on radiocarbon [sample] yarns. No other part of the shroud shows such a coating. [This indicates that] The radiocarbon sample had been dyed. Dyeing was probably done intentionally on pristine replacement material to match the color of the older, sepia-colored cloth. The dye found on the radiocarbon sample was not used in Europe before about 1291 AD and was not common until more than 100 years later. Specifically, the color and distribution of the coating implies that repairs were made at an unknown time with foreign linen dyed to match the older original material. The consequence of this conclusion is that the radiocarbon sample was not representative of the original cloth. The combined evidence from chemical kinetics, analytical chemistry, cotton content, and pyrolysis-mass-spectrometry proves that the material from the radiocarbon area of the shroud is significantly different from that of the main cloth. The radiocarbon sample was thus not part of the original cloth and is invalid for determining the age of the shroud.[5]

2. Particle radiation might have significantly increased the C-14 content of the cloth. In the particle radiation hypothesis (explained below in Section V), there would have been a neutron fluence coming from the nuclear disintegration of the body. This neutron eradiation would have converted N-14 (indigenous to linen) into additional C-14.[6] Dr. Arthur C. Lind (nuclear physicists and expert in plasmas and polymers) and colleagues show that this additional C-14 stays within the cloth over the long term despite environmental factors, such as warming from a fire.[7] This would create the appearance that the cloth was much younger than it actually is.[8] If in fact the body did disintegrate with a blast of neutrons, protons, alpha particles, and gamma rays, then the significant increases in C-14 content would make any C-14 dating wholly unreliable—not merely the one done in 1988, but all subsequent C-14 tests.

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[5] Raymond N. Rogers, "Studies on the Radiocarbon Sample from the Shroud of Turin," *Thermochimica Acta* 425, nos.1-2 (2005): 189-194. Italics mine.

[6] "The neutron fluence that would be needed to cause the radiocarbon date to be medieval instead of first century is 8.3×10^{13} n $^{-}$ cm $^{-2}$ if the nitrogen content of the Shroud is about 570 ppm (Lind et al., 2010)."
Mark Antonacci, "Particle radiation from the body could explain the Shroud's images and its carbon dating," *Scientific Research and Essays* 7, no. 29 (2012): 2613-2623,
https://academicjournals.org/article/article1380798649_Antonacci.pdf
See also A.C. Lind, M. Antonacci, D. Elmore, G. Ganti, J. Guthrie, "Production of radiocarbon by neutron radiation on linen," *International Workshop on the Scientific Approach to the Archeiropoietos Images*, Frascati, Italy, (May 4-6, 2010): 255-262.

[7] Ibid., Lind et al.

[8] Antonacci, "Particle radiation from the body."

There are several tests that can be done to determine whether C-14 was created through a blast of neutrons and protons during nuclear disintegration of the body (see below Section V.D).

II.B
Five New Scientific Dating Methods

As stated above, a variety of dating methods place the origins of the Shroud much nearer to the first century—most recently, a Wide-Angle X-Ray Scattering test (Liberato De Caro, et al), and previously, a vanillin test (devised by Dr. Raymond Rogers) and three tests devised by Giulio Fanti—two opto-chemical spectroscopic tests and one mechanical compressibility and tension test. We will discuss each in turn.

Wide-Angle X-Ray Scattering test by Liberato De Caro, et al. Dr. De Caro (specialist in coherent diffractive imaging, crystallography, and solid state chemistry at the Institute of Crystallography and the National Research Council of Italy) and his colleagues developed, tested, and peer-reviewed a new technique in 2019 to measure the age of cellulose (intrinsic to linen) of ancient fabrics – a Wide-Angle X-Ray Scattering test. This new test was shown to accurately measure fabrics (dated by C-14 and other dating techniques) from 3,000 BC to 2,000 AD. On the basis of these results, they applied the technique in March 2022 to a sample of the Shroud of Turin that dated the shroud to 55-74 AD – slightly after the time of Jesus' crucifixion. They described the test and results, published in the peer-reviewed journal *Heritag*e, as follows:

> On a sample of the Turin Shroud (TS), we applied a new method for dating ancient linen threads by inspecting their structural degradation by means of Wide-Angle X-ray Scattering (WAXS). The X-ray dating method was applied to a sample of the TS consisting of a thread taken in proximity of the 1988/radiocarbon area (corner of the TS corresponding to the feet area of the frontal image, near the so-called Raes sample). The size of the linen sample was about 0.5 mm × 1 mm. We obtained one-dimensional integrated WAXS data profiles for the TS sample, which were fully compatible with the analogous measurements obtained on a linen sample whose dating, according to historical records, is 55–74 AD, Siege of Masada (Israel). The degree of natural aging of the cellulose that constitutes the linen of the investigated sample, obtained by X-ray analysis, showed that the TS fabric is much older than the seven centuries proposed by the 1988 radiocarbon dating. The experimental results are compatible with the hypothesis that the TS is a 2000-year-old relic, as supposed by Christian tradition, under the condition that it was kept at suitable levels of average secular temperature—20.0–22.5 °C—and correlated relative humidity—75–55%—for 13 centuries of unknown history, in addition to the seven centuries of known history in Europe. To make the present result compatible with that of the 1988 radiocarbon test, the TS should have been conserved during its hypothetical seven centuries of life at a secular room temperature very close to the maximum values registered on the earth.[9]

[9] Liberato De Caro, Teresa Sibilano, Giulio Fanti, Rocco Lassandro, Dr. Cinzia Giannini, and Gianluca Farinola, "X-ray Dating of a Turin Shroud's Linen Sample," *Heritage* 5, no. 2 (2022): 860-870. https://www.mdpi.com/2571-9408/5/2/47/htm

Evidently, the Shroud was not kept at a secular room temperature of 134°F for 700 years, because the secular temperature in Turin, Italy, averages between 46° F (in winter) to 83°F (in summer). Inasmuch as the technique has accurately tested multiple linen fabrics over a wide age range (3,000 BC – 2,000 AD) the estimated age of **55-74 AD** is probably correct. Multiple tests can be done on the same sample, and it is very likely that additional tests will be done on other samples. When this dating test is combined with Fanti's three dating tests given below (yielding an approximate age **90 AD**), it is very likely that the Shroud's date of origin is in the first century – well within the time of Jesus' crucifixion and resurrection – 33 AD.

Vanillin Test first performed by Dr. Raymond Rogers. In 2005, Dr. Raymond Rogers devised a vanillin test of the age of the Shroud, publishing his results in the peer-reviewed journal *Thermochimica Acta.*[10] Vanillin is an organic compound that, like C-14, decays with age. Linens from the Middle Ages typically retained 37% of their vanillin when tested, while older artifacts like the Dead Sea Scrolls had lost all of theirs. Comparison of the Shroud's results with these other linens established a possible age range of 1,300 to 3,000 years old (i.e., a date of origin between 715 AD-985 BC).[11] This is profoundly different from the 1988 carbon dating (even when effects of the fire of Chambery are considered) which moved Dr. Giulio Fanti to devise additional tests based on mechanical compressibility and tension as well as spectroscopic analysis. He devised three different tests—two for opto-chemical (spectroscopic/laser) analysis and one for mechanical compressibility and tension. The results follow.

Fourier Transformed Infrared Spectroscopy Test of Cellulose Degradation.[12] This test took nine ancient textiles of different ages (from Egypt, Israel, and Peru) as well as two modern fabrics, and tested them to establish the rate at which cellulose (another decaying compound) disappears over time. By applying this test to the Shroud and comparing it with the other known samples, a date of origin for the Shroud was set at 250 BC ± 200 years at a 95% confidence level.[13]

Raman Laser Spectroscopy Test for Cellulose Degradation.[14] Fanti devised a second opto-chemical test for decaying cellulose using a different method (Raman Lasers) to determine whether both methods fell within the same general age range. This provides corroboration of the results from each method as well as more accurate adjustment for the effects of the fire of Chambery (1532 in which the Shroud was involved). The result of the tests showed an age of the Shroud at about 30 AD ± 200 years at a 95% confidence level.[15]

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[10] Raymond N. Rogers, 2005, "Studies on the Radiocarbon Sample From the Shroud of Turin," *Thermochimica Acta* 425, no. 1-2 (January 2005): 192 (italics mine).
[11] Ibid.
[12] Giulio Fanti, "Mechanical and opto-chemical dating of the Turin Shroud," *Proceedings of the Paduan Scientific Analysis of the Shroud* 36 (2015), https://www.matec-conferences.org/articles/matecconf/abs/2015/17/matecconf_wopsas2015_01001/matecconf_wopsas2015_01001.html. See also G. Fanti, "Optical features of flax fibers coming from the Turin Shroud", IEEE-ATSI Workshop on Advances in the Turin Shroud Investigation, Bari, Italy, 2014, https://www.shs-conferences.org/articles/shsconf/abs/2015/02/shsconf_atsi2014_00004/shsconf_atsi2014_00004.html.
[13] Ibid.
[14] Fanti, "Mechanical and opto-chemical dating." See also G. Fanti, P. Baraldi, R. Basso, and A. Tinti, "Non-destructive dating of ancient flax textiles by means of vibrational spectroscopy," *Vibrational Spectroscopy* 67 (2013): 61-70, http://dx.doi.org/10.1016/j.vibspec.2013.04.001.
[15] Fanti, "Mechanical and opto-chemical dating." See also Fanti et al., "Non-destructive dating of ancient flax

Mechanical tests of compressibility and breaking strength.[16] These are tests that compare ancient fabrics on physical properties of the fibers, such as, how much tensile strength individual fibers retain over time. By correlating the Shroud fibers with other known ancient fabrics, an estimated date of origin can be obtained. Fanti used several samples from the Shroud and other ancient fabrics (of various ages), and then applied a least squares multi linear regression (MLR) to the measured mechanical data which shows a date of origin at 260 AD ± 200 years at 95% confidence level.[17]

Fanti then averaged the weighted results of the above three tests, and concluded as follows:

> [The two opto-chemical/spectroscopic] dates combined with the mechanical result, weighted through their estimated square uncertainty inverses, give a final date of the Turin Shroud of **90 AD** ±200 years at 95% confidence level.[18]

Fanti recommended that additional samples and tests be used to confirm the probable date of the Shroud determined above—90 AD, close to the time when Jesus was crucified (approximately 33 AD).[19] As noted above, such a test has been developed, tested, and peer-reviewed by Dr. De Caro and colleagues in March 2022, yielding an age of the Shroud between **55-74 AD**. Since the latter test has a much smaller margin of error than the opto-chemical/spectroscopic tests, it is more accurate.

At present, all contemporary scientific dating of the Shroud points to an age much earlier than the carbon-14 tests performed in 1988. It is unlikely that De Caro et al's dating test and all three of Fanti's distinct dating methods would be off by 1,300 years. Therefore, it is likely that the 1988 carbon dating is invalid (as shown in Casabianca's 2019 statistical analysis of the raw data). As noted above, this invalid carbon dating may be attributable to sixteenth century materials embedded in the carbon dating sample (Rogers 2005) and a neutron fluence which converted N-14 to C-14 in the linen cloth (Lind et al 2010). In light of this, we tentatively conclude that the Shroud originated well before the Middle Ages—in the first century AD. This is further confirmed by extrinsic dating methods, particularly the facecloth of Oviedo.

II.C
Three Extrinsic Dating Methods

In addition to the above dating methods, there are also extrinsic factors pointing to the Shroud's origin prior to the Middle Ages:

1. Congruences with the facecloth of Oviedo (Section II.C.1).

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textiles."

[16] See Fanti, "Mechanical and opto-chemical dating." See also, G. Fanti AND P. Malfi, "Multi-parametric micro-mechanical dating of single fibers coming from ancient flax textiles," *Textile Research Journal* (2013), SAGE Pub., http://dx.doi.org/10.1177/0040517513507366.

[17] See Fanti "Mechanical and opto-chemical dating." See also Fanti et al, "Multi-parametric micro-mechanical dating of single fibers."

[18] See Fanti, "Mechanical and opto-chemical dating."

[19] Ibid.

2. Pollen grains indicating the Shroud's origin in Jerusalem/Judea prior to Lirey, France in 1352 (Section II.C.2).
3. Possible imprints of Roman coins on the Shroud man's eyes (Section II.C.3).

II.C.1
Congruences with the Facecloth of Oviedo[20]

The Facecloth of Oviedo is a bloodstained cloth (without an image) that according to Scripture and tradition was wrapped around the face and head of Christ after his death (See Jn. 20:7). Use of a facecloth was customary to transport a body to a tomb particularly when the face was disfigured from torture or illness. This facecloth is also embedded with a predominance of pollen grains from Judea as well as some from Turkey and Spain (where it was deposited in the Cathedral of Oviedo in 718 AD).[21]

There is a precise provenance (historical record) of the Facecloth's journey from bishop to bishop—region to region from 616 AD in Turkey to 718 AD when it was placed in the Cathedral in Oviedo, Spain—where it remains till this day.[22] There is also a probable provenance of the Facecloth before 616 AD in Palestine which is confirmed by pollen grains embedded in the Facecloth. As on the Shroud of Turin, there are thirteen pollen grains from Israel, and four of them are unique to that region. [23] Meaning that the facecloth stayed in the Palestine area for a long time before it was moved toward Europe (See below Section II.C.2). This coincides with Bishop Pelagius' account of the facecloth's history. Mark Guscin sums up the historical record as follows:

> According to this history, the sudarium was in Palestine until shortly before the year 614, when Jerusalem was attacked and conquered by Chosroes II, who was king of Persia from 590 to 628. It was taken away to avoid destruction in the invasion, first to Alexandria by the presbyter Philip, then across the north of Africa when Chosroes conquered Alexandria in 616. The sudarium entered Spain at Cartagena, along with people who were fleeing from the Persians.[24]

The facecloth used to transport Jesus from the cross to the tomb is specifically mentioned in the Gospel of John: "[Peter] saw the strip of linen lying there, as well as the cloth that had

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[20] See Guillermo Heras, J.D. Villalain, J.M. Rodriquez, "Comparative Studies of the Sudarium of Oviedo and the Shroud of Turin," *III Congreso Internazionale de Studi sulla Sindone Turin* (1998): 1-17, https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.72.6775&rep=rep1&type=pdf.
See also Mark Guscin, "The Sudarium of Oviedo: Its History and Relationship to the Shroud of Turin," *Proceedings of the Nice Symposium on the Shroud of Turin* (1997), https://www.Shroud.com/guscin.htm#top.

[21] Ibid.

[22] I have outlined the history of the Sudarium of Oviedo in Appendix I of *God So Loved the World* (Ignatius Press 2016). The Sudarium has been in Oviedo since 718 where it remains to this day. However, its history prior to that time was traced by Bishop Pelagius in his *Book of the Testaments of Oviedo* and the *Chronicon Regum Legionensium* --1121. Pelagius discovered the line of bishops who received the Sudarium when it arrived in Cartagena (from Palestine) in 616 to its arrival in Oviedo in 718.
See Guscin, "The Sudarium of Oviedo."

[23] Emanuela Marinelli, "The Question of Pollen Grains on the Shroud of Turin and the Sudarium of Oviedo," Geological and Natural CC by the University of Rome *La Sapienza*,
https://www.Shroud.com/pdfs/marinelli2veng.pdf

[24] See Guscin, "The Sudarium of Oviedo."

been wrapped around Jesus' head. The cloth was still lying in its place, separate from the linen" (Jn. 20:6-7). The cloth wrapped around Jesus' head was in a place by itself because it was taken off of Jesus before he was placed in the linen cloth (the Shroud). This procedure corresponds to Jewish custom. The fact that the facecloth was not on Jesus' face at the time of His resurrection explains why there is no image on the facecloth. If the image was produced by a strong source of radiation throughout the body (as will be shown below in Section V), it is likely coincident with Jesus' resurrection which the gospel accounts and St. Paul indicate have a component of power and light (See Section V.E).

The sequence of events that took place after Jesus' body arrived at the tomb is clear:

1. When the body arrives at the tomb, his disciples removed the Cloth wrapped around his face, and lay it in a place by itself. This explains why only the bloodstains, but not the image, is on the Facecloth.
2. His body is then laid on half of the linen Shroud (on his back) and the other half of the Shroud is place over his head all the way down to his feet where it is secured. The blood on the body then makes contact with certain places on the Shroud, and stains it.
3. After the blood has stained the Cloth, an event occurs (which we now believe was a strong source of radiation and light) which caused a perfect photographic negative image (with 3-dimensional layering) to be imprinted on a non-photographically sensitive linen cloth.

We now turn to a brief analysis of the blood stains (which will be discussed in great detail below in Section III). Dr. Alan Whanger used Polarized Image Overlay Technique on photographs of both cloths and discovered 120 points of congruence in the blood stains on both cloths-- 70 points of congruence on the front portion (the face), and 50 points of congruence on the rear side (the back of the head and the nape of the neck). Additionally, there are significant points of congruence in fluid discharges (e.g., plural edema fluid from the nose). There are so many points of congruence between the wounds and fluid markings of both cloths that Guscin notes, "The only possible conclusion is that the Oviedo Sudarium covered the same face as the Turin Shroud."[25] The odds against a purely coincidental congruence of this magnitude (without the same face touching both cloths) is astronomical.

In view of the similarities in blood type and facial features, as well as the 120 points of congruence in the positioning of blood and fluids on the two cloths, it is difficult to avoid Guscin's conclusion – that the two cloths touched the same face of a man crowned with thorns and severely beaten.

Why is this significant for dating the Shroud? The Facecloth of Oviedo has a continuous traceable provenance (recorded history) starting in 616 AD (compared to the Shroud's documented history starting in 1349 AD). Furthermore, the Shroud came from Palestine in 614 AD which is confirmed by the preponderance of pollen grains on it from that region. Now, if the two cloths touched the same face after the same event (beating and crowning with thorns), it establishes that the Shroud must be at least as old as the Facecloth of Oviedo (prior to 616 AD).

[25] Ibid, 4.

This means that the Shroud must be at least 780 years older than the 1988 carbon dating indicated.

When we combine the evidence of the Facecloth of Oviedo with the above four dating methods of Dr. Raymond Rogers and Dr. Giulio Fanti, it gives strong probative evidence that the Cloth originated in First Century Palestine around the time of Jesus' crucifixion.

We now proceed to two other kinds of extrinsic dating methods that are not as strong as the facecloth of Oviedo, but nevertheless, add probative force to the combined evidence—the pollen grains showing that the Shroud originated in Jerusalem/ Northern Judea prior to Lirey, France (Section II.C.2), and the controverted existence of Roman Coins on the Shroud man's eyes (Section II.C.3).

II.C.2

The Presence of pollen grains discovered by Max Frei.

Max Frei was a Swiss botanist and criminologist who was arguably the foremost expert on pollen grains throughout the world. He took hundreds of samples from the Shroud and noted that three-fourths of them were likely of Palestinian origin –13 were unique to that region.[26] Emanuela Marinelli sums up the extensive work of Frei as follows:

> 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.[27]

Since the largest number of pollen grains (3/4) come from the region of Palestine (and remained exposed to the open air there longer than anywhere else), it is likely that Palestine was the place of the Shroud's origin.

Yet the story is even more interesting, because Frei identified unique pollen grains from the region of Turkey. As Marinelli indicates:

> This result [the unique grains from Palestine] 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.[28]

The presence of the pollen grains complements the above dating conclusions about the earlier

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[26] See Marinelli, "The question of pollen grains on the Shroud." See also Max Frei, "Note a seguito dei primi studi sui prelievi di polvere aderente al lenzuolo della S. Sindone," *Sindon* 23 (1976): 5-9, on p. 5; "Nine years of palynological studies on the Shroud," *Shroud Spectrum International* 3 (1982), pp. 2-7, on p. 3.

[27] See Marinelli, "The question of pollen grains on the Shroud," 3.
See also, M. Frei, "Il passato della Sindone alla luce della palinologia, in *La Sindone e la Scienza, Atti del II Congresso Internazionale di Sindonologia*," Turin, October 7-8, ed. Paoline (Turin, 1979), 191-200 and 370-378, on p. 198.

[28] See Ibid.

date of the Shroud's origin in two respects:

1. The probable place of origin was Palestine – not Europe.
2. The Shroud did not go directly from Palestine to Europe. It very probably traveled first to Anatolia (Turkey) and remained there long enough to accumulate pollen grains from the open air. It then traveled to Constantinople where it also accumulated pollen grains.

What does this mean? First, the medieval dating is highly unlikely, because we know the Shroud was in Lirey, France, about the same time that the C-14 test dates its origin. This would mean that the Shroud was only in Europe – specifically, France and Italy. However, this cannot be the case, because there are a large number of pollen grains from Palestine (many of which are unique to that region) and a large number of pollen grains from Turkey (and unique to that region). The presence of so many pollen grains from these other regions seems to indicate that the Shroud was in Palestine-Turkey for at least as long as it was in Europe, making a medieval dating highly unlikely. These conclusions fit well with conclusions concerning the Facecloth of Oviedo (which has an established historical record (confirmed by pollen grains) starting with Palestine prior to 616 AD).

II.C.3
The Possible presence of two roman coins on the Shroud man's eyes.

Some numismatists have identified partial imprints of coins on the eyes of the man on the Shroud, but this is controverted by some physicists who believe that a Roman lepton sized coin can be identified, but not the markings on that coin.[29] We will first examine the claims of those who believed the coin images are real, and then examine the criticism of those claims by materials experts.

In 1982, Fr. Francis Filas believed that he had identified on the eyes of the man in the Shroud images similar to those on roman leptons specially minted by Pontius Pilate in Jerusalem in 30 AD (±1 year). [30] Alan and Mary Whanger believed they had a positive correlation of these images (by polarized overlay photographic analysis) with collectors' leptons minted by Pontius Pilate in 30 (±1) AD. They describe their conclusion as follows:

> We have done this by means of the polarized image overlay technique that we developed which enables the highly accurate comparison of two different images and the documentation of the various points of congruence….Using the forensic criteria for matching finger prints, we feel that there is *overwhelming evidence* for the identification of the images and the matches with the coins [the special minting of Roman leptons by Pontius Pilate in 30 AD in Judea].[31]

[29] J.F. Thackeray, "Lepton coin diameters and a circular image on the Shroud of Turin," 2019, https://www.Shroud.com/pdfs/thackeray.pdf
[30] Francis Filas, *The dating of the Shroud of Turin from coins of Pontius Pilate* (Youngtown, Arizona: Cogan Productions, 1982).
[31] Alan D. Whanger, "A Reply to Doubts Concerning The Coins Over the Eyes," *shroud.com,* August 24, 1997, https://www.Shroud.com/lombatti.htm.

This photo overlay analysis was supported by a computer scientist Nello Balossino (of the Turin Faculty of Sciences) who succeeded in bringing out the sacrificial cup through computer filtering on the coin on the Shroud man's right eye.[32]

There are several enigmas on the coins that show them to be part of this special minting. According to T.V. Oomenn:

> Special coverage is given to a novel extraction of the images since 2000 by a Pilate Coins expert . The image used was a high resolution color image of the Shroud face. The right eye image shows an augur staff and the letters OY KAI AROC, and the left eye image shows the augur staff and the letters TIBERIOY. Obviously, both coins were issued by Pontius Pilate AD 30-31 and a good coin should have the complete set of letters, TIBERIOY KAICAPOC.[33]

Oommen's conclusion is further corroborated by numismatist Agostino Sferrazza who based his conclusion on the computer enhanced images developed by Nello Balossino.[34]

As noted above these correlations are controverted by some image and materials specialists who claim that the weave of the Shroud is to coarse to render clear images on a very small roman coin (like a lepton).[35] Don Lynn indicates that what was thought to be markings on a lepton was most likely a coincidental result of contrast manipulation of photographs. [36]

Notwithstanding Lynn's view, there is high probability that a coin almost identical in diameter to the special roman lepton minted in 30 AD is present on the eyes of the man in the Shroud. According to Thackeray:

> There is no significant difference (p=0.05) between the diameter of the Shroud's circular image (D1, measured as 14.5 mm) and the mean diameter of Pilate leptons (15.0 +/- 0.62 mm, n=22 measurements).[37]

Inasmuch as, the placement of coins on the eyes of the deceased was commonly practiced in first century Jerusalem[38] and the leptons and the objects on the mans eyes are identical to the mean diameter of Pilate leptons it is certainly possible that there are leptons of that kind on the eyes of

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See also D. Alan and Mary Whanger, "Polarized Image Overlay Technique: A New Image Comparison Method and its Applications," *Applied Optics* 24, no. 6 (1985): 766-772.

[32] Daniel Esparza, "Shroud of Turin coins may finally have been identified," *Aleteia*, April 26, 2017, https://aleteia.org/2017/04/26/Shroud-of-turin-coins-may-finally-have-been-identified/.

[33] T.V. Oommen, 2008, "Shroud Coins Dating by Image Extraction," Paper presented at the *Shroud Science Group International Conference The Shroud of Turin: Perspectives On a Multifaceted Enigma, Columbus, Ohio, August 14-18, 2008,* https://www.shroud.com/pdfs/ohiotvoommen.pdf.

[34] See Esparza, "Shroud of Turin coins may finally have been identified."

[35] Thackeray cites Don Lynn who indicated this in a personal communication to Barrie Schwortz (photographic expert during the STURP investigation).
See Thackeray, "Lepton coin diameters and a circular image on the Shroud of Turin."

[36] Ibid.

[37] Ibid.

[38] Ibid.

the man in the Shroud. The scholarly community remains divided about whether the purported images belong to such leptons or whether they are imagined by experts seeing similarities in computer enhanced images. Whatever the case, it is very likely that there is a coin almost identical in size to a Pilate lepton on the man's left eye.[39] As will be explained in Section V.C, images from the coins could have been imprinted on the Shroud through neutron radiation coming from the body.

II.D
Conclusion

Tristan Casabianca (who did the statistical analysis of the raw data of the Shroud's C-14 dating, showing its invalidity) presented a paper at a Shroud conference in Ancaster, Ontario, Canada in 2019. According to Joe Marino, he disclosed that of the forty-six Shroud papers in peer-reviewed journals, twenty-nine were against the 1988 C-14 medieval dating (in favor of the Shroud's ancient origin), twelve were neutral, and only five were in favor of the C-14 medieval dating (against the Shroud's ancient origin).[40] Some of the authors of the papers in favor of the C-14 test were associated with the labs who performed the tests.[41] Thus, the overwhelming number of peer-reviewed articles were against the 1988 C-14 medieval dating (favoring its ancient origin). This should give us sufficient grounds for continuing the exploration of the scientific evidence for the authenticity of the Shroud and its implications for the resurrection of Jesus.

III.
The Bloodstains on the Shroud

In addition to the image itself—which is anatomically accurate and a perfect photographic negative with three-dimensional layering—there are 372 blood stains on the Shroud.[42] The image was formed *after* the blood stains congealed on the cloth. According to Dr. Kitty Little (nuclear physicist at BEPO Reactor at Harwell):

> Another observation of considerable significance is that when blood was, or had been, present over the fibres, it also protected the underlying fibres from whatever caused the image. This means that the blood must have been in place before the image was formed.[43]

This means a potential forger would need to place all the blood stains on the cloth before there was an image on which to place them — unlikely, even before we add the question of how the

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[39] See Antonacci, 2012. "Particle radiation from the body," p. 2621.
[40] See Joe Marino, "The Radiocarbon Dating of the Turin Shroud in 1988 and its Aftermath -- an English language Bibliography," 2021, Academia.edu, https://www.academia.edu/48831028/The_Radiocarbon_Dating_of_the_Turin_Shroud_in_1988_and_its_Aftermath_an_English_language_Bibliography.
[41] Ibid.
[42] Kitty Little, "Formation of the Shroud's Body Image," *British Society for the Turin Shroud Newsletter* 46 (1997): 19, https://www.Shroud.com/bsts4607.htm.
[43] Ibid.

image itself was put on the Shroud without any paints, dyes, chemicals, vapors, or scorching.

The painstaking analysis of Alan Adler, John Heller, P.L. Ballone, and others show that the bloodstains on the Shroud are genuine, containing real hemoglobin, bilirubin, AB+ blood type, plasma-serum differentiation, human albumin, human whole blood serum, and human immunoglobins.[44] These typical characteristics of blood are not present in paints or dyes or any other non-blood chemical which assures that the stains on the Shroud are in fact real blood.

There are two other dimensions of the blood stains that are undetectable without contemporary scientific technology:

- The microscopically precise, invisible reactions around the more than 100 scourge marks throughout the body.
- The coagulated blood stains with serum surrounding borders and clot retraction rings that occur with actual wounds and blood flows, found throughout the front and back of the body, and revealed only by modern scientific technology.[45]

Additionally, Elvio Carlino and Giulio Fanti used atomic resolution analysis of nano particles in the blood that detected high levels of ferritin and creatinine—two enzymes which become synthesized when someone is undergoing a polytrauma. They concluded the following:

> Here we show how atomic resolution investigations unexpectedly discover a scenario of violence hidden at the nanoscale in the Turin Shroud fiber and also suggest an explanation for the controversial results so far obtained. Indeed, a high level of creatinine and ferritin is related to patients suffering of strong polytrauma like torture. Hence, the presence of these biological nanoparticles found during our TEM [Transmission Electron Microscopy] experiments point to a violent death for the man wrapped in the Turin Shroud. [46]

This bond of ferritin and creatinine cannot be reproduced by any dye, paint, or pigment which enables Carlino and Fanti to assert that it is almost certainly beyond the capacity of an ancient/medieval forger to produce:

This result [ferritin-creatinine bonds] cannot be impressed on the Turin

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[44] See John Heller and Alan Adler, "Blood on the Shroud of Turin," *Applied Optics* 19, no. 16 (1980): 2742-2744.
See also P.L. Baima Bollone, 2000, "The forensic characteristics of the blood marks," in *The Turin Shroud: Past, Present, and Future,* [International Scientific Symposium, Torino, Mar. 2-5, 2000], eds. S. Scannerini and P. Savarino (Torino, Italy: Effata Editrice, 2000), pp. 125-135.
See also Alan Adler, "The Nature of the Body Images on the Shroud of Turin," *Shroud.com*, 1999, https://www.Shroud.com/pdfs/adler.pdf.
See also Antonacci, "Particle radiation from the body.".

[45] Antonacci, "Particle Radiation from the Body," 2614.

[46] Elvio Carlino and Giulio Fanti, "Atomic resolution studies detect new biologic evidences on the Turin Shroud" *PLoS One* 12, no. 6 (2017), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5493404/#:~:text=Indeed%2C%20a%20high%20level%20of,wrapped%20in%20the%20Turin%20Shroud

> Shroud by using ancient dye pigments, as they have bigger sizes and tend to aggregate, and it is highly unlikely that the eventual ancient artist would have painted a fake by using the hematic serum of someone after a heavy polytrauma.[47]

In as much as an ancient forger would not be inclined to torture a person in order to obtain blood that would contain the synthesis of these enzymes, it seems most likely that the blood came from a man crucified in a way depicted by the image on the Shroud.

After the 1978 STURP investigation some scientists identify what seem to be anomalous features of some blood stains on the Shroud which could be construed to be "touch-ups" of the blood stains by a forger. Adrie van der Hoeven has made a comprehensive study of these anomalous features, and found that they validate rather than undermine the Shroud's authenticity. She summarizes her conclusions as follows:

> The anomalous features of the Shroud's bloodstains, instead of being evidence against their authenticity, turn out to be very strong evidence for their authenticity, as these anomalies are the consistent specifics of cold acid postmortem blood that formed pinkish red heme-madder lake on a cold-water-resistant madder-dyed cloth such as, most probably, the Shroud. …Microscopic and other observations preclude that a red madder lake or red madder dye was painted on to produce or retouch all bloodstains. Especially the fluorescent serum margins of some of the stains, the stains' lack of potassium, and the apparent formation of acid heme-madder lake stains in the right anatomical locations of the body image before this image—consisting of madderless image fibers—was formed, render it highly unlikely that the stains and body image were produced by a medieval artist. Shroud stains containing acid heme and lacking potassium, for lack of reasonable alternatives, virtually must have been formed by acid postmortem blood of which some was clotting and exuding its potassium-rich serum on a relatively cold surface, such as the cold skin of a dead body, possibly that of Jesus Christ. … A few experiments confirmed that much serum can drain from human blood on a cold surface and that human blood is able to form pinkish stains on starched and madder-dyed linen that remain pinkish while simultaneously formed bloodstains on pure linen turn brown.[48]

From the vantage point of biochemical analysis, then, every aspect of the bloodstains on the Shroud appears to be authentic.

In 2018, Matteo Borrini and Luigi Garlaschelli wrote an article claiming that they had used a blood pattern analysis approach to assess the authenticity of the blood stains from the

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[47] Ibid.

[48] A. van der Hoeven, "Cold Acid Postmortem Blood Most Probably formed Pinkish-Red Heme-Madder Lake on Madder-Dyed Shroud of Turin," *Open Journal of Applied Sciences* 5 (2015):705-746. https://www.scirp.org/pdf/OJAppS_2015113010464750.pdf.

chest, arms, and the lance wound in the side of the man on the Shroud. They found that the blood patterns on the Shroud were incompatible with blood patterns they produced on a live volunteer/mannequin, and concluded that these inconsistencies showed the Shroud to be the probable work of a forger. [49] In a report, to *Live Science*, Borrini noted:

> You realize these cannot be real bloodstains from a person who was crucified and then put into a grave, but actually handmade by the artist that created the Shroud.[50]

The Borrini and Garlaschelli "study" continues to receive attention on the web despite responses from scientists who are more qualified in blood chemistry and pathology. Two problems should be noted.

First, Borrini is anthropologist and Garlaschelli is a chemist—neither is an expert in blood, blood flow, blood patterns, and pathology. Their results conflict with experts in the field, such as Dr. Frederick Zugibe[51] (who has done multiple studies on blood flows and blood patterns on the Shroud over fifty years[52]) as well as Dr. Robert Bucklin's pathological studies during the 1978 STURP investigation.[53] Bucklin found no inconsistency between the different sets of wounds on the front and back and accounted for the direction of the flows that would have occurred before and after death.[54]

So how did Borrini and Garlaschelli come to their "new" findings? They used a questionable procedure (which has been shown to be inaccurate and is disallowed for court use today) called "blood pattern analysis." Essentially, they used a mannequin and placed artificial blood on areas where blood stains were found on the Shroud to register flow patterns, and for the lance wound they soaked a sponge in artificial blood and pushed it on a wooden stick against the side of the mannequin to register those flows. Needless to say, this is in no way rigorous, and pales in scientific examination methods when compared to the studies of Zugibe who used real cadavers of men with hemopericardium (blood accumulating in the pericardial sac), positioned vertically. These cadavers were lanced with a scalpel between the fifth and sixth ribs (as indicated on the Shroud).[55] It is inconceivable that anyone could think that Borrini's and Garlaschelli's use of a mannequin employing crude techniques to imitate wounds could replace the rigorous scientific examination with real cadavers carried out by Zugibe and others.

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[49] Matteo Borrini and Luigi Garlaschelli, "A BPA Approach to the Shroud of Turin," *Journal of Forensic Sciences* 64, no. 1(2018): 137-143, https://onlinelibrary.wiley.com/doi/10.1111/1556-4029.13867.
[50] Charles Choi, "Shroud of Turin Is a Fake, Bloodstains Suggest," *LiveScience*, July 18, 2018, https://www.livescience.com/63093-shroud-of-turin-is-fake-bloodstains.html.
[51] Frederick Zugibe was the chief medical examiner of Rockland County, New York from 1969 to 2002. Zugibe was one of the United States' most prominent forensics experts, known for his research and books on forensic medicine
[52] Frederick Zugibe, *The Crucifixion of Jesus, Completely Revised and Expanded: A Forensic Inquiry* (New York: M. Evans and Company Inc., 2005), pp. 98-196.
[53] Dr. Robert Bucklin is an experienced pathologist who has examined over 25,000 bodies for autopsy over 50 years, and has subjected the image/blood stains of the man on the Shroud to contemporary autopsy studies. His studies coincide with those of Frederick Zugibe. See, Robert Buckling, "An Autopsy on the Man of the Shroud," *shroud.com*, 1997, https://www.Shroud.com/bucklin.htm.
[54] Ibid.
[55] Zugibe, *The Crucifixion of Jesus*, pp. 98-196 and pp. 241-258.

The second problem with Borrini's and Garlaschelli's "study" is the bold, but quite incorrect statement of Borrini that "the bloodstains were handmade by an artist and put on the Shroud."[56] The painstaking analysis of Heller[57], Adler[58], and Ballone[59] show conclusively that every blood stain on the Shroud is in fact real blood with AB+ blood type, and van der Hoeven[60] shows that all of the anomalous aspects of the bloodstains are in fact real blood—not produced by a forger. Evidently, Borrini and Garlaschelli ignored the many peer-reviewed articles on the bloodstains by the above four authors, and made a claim that is patently false about the bloodstain evidence to which we have direct investigative access today!

We conclude with the scathing critique of the shotty method and false assumptions of Borrini and Garlaschelli elucidated by Dr. Alfonso Sánchez Hermosilla (forensic M.D. and forensic anthropologist) Dr. Hermosilla shows significant BPA analysis comparison errors between the living subject (used by B&G) and an actual living body with blood proceeding from wounds with a beating heart as well as significant differences between the blood samples used by B&G and the blood of a living subject who later died and was put into a different position. After pointing out six other critical errors, he concludes as follows:

> The experiment does NOT even remotely reproduce the conditions in which the blood stains of the Turin Shroud have occurred. In these circumstances, the conclusions of the article are TOTALLY devoid of scientific value. The authors of the article, given their inexperience and lack of the minimum necessary knowledge, have committed serious errors in planning and interpreting the results of their "experiment". The article is not suitable for publication in a specialized scientific journal; it is assumed that people who have assessed the suitability of the article should have the necessary knowledge and experience. In the case in question, either they do not possess it, or have ignored it for unknown reasons.[61]

Inasmuch as the blood is real, and the image was created after the blood stains were embedded on the Shroud (which would have been almost impossible for a medieval forger to accomplish), the Shroud seems to have enveloped a real man who was crucified in a way similar to the unique crucifixion of Jesus of Nazareth. This is our next subject.

IV.
The Crucifixion and Death of the Man on the Shroud

Though the Shroud appears to date back to first century Palestine and the blood is authentic, containing enzymes indicative of a polytrauma, can we be even more certain that the Shroud is the burial cloth of Jesus Christ? We can – from a pathological examination of the bloodstains and

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[56] Choi, "Shroud of Turin Is a Fake."
[57] See Heller and Adler, "Blood on the Shroud of Turin,"
[58] See Adler, "The Nature of the Body Images on the Shroud of Turin."
[59] See Bollone, "The forensic characteristics of the blood marks."
[60] See van der Hoeven, "Cold Acid Postmortem Blood."
[61] Matteo Borrini and Luigi Garlaschelli, "Answer to the Article 'A BPA Approach to the Shroud of Turin,'" *shroud.com,* July 18, 2018, https://www.Shroud.com/pdfs/Hermosilla%20EN.pdf.

image on the Shroud and a scientific examination of how the image on the Shroud was produced (Section V). The pathological study of Dr. Pierre Barbet[62] and the updated studies of Dr. Frederick Zugibe[63], Dr. Robert Bucklin[64], and Drs. Mateo Bevilacqua, Michele D' Arienzo, and Raffaele De Caro[65]show two kinds of evidence linking the image-blood on the Shroud with the crucifixion of Jesus:

1. Evidence of Roman (rather than medieval) weapons/customs—such as, a Roman legionnaires lance, a Roman flagrum (whip), and Roman crucifixion techniques.
2. Evidence of the unique features of Jesus' crucifixion as described in the New Testament—crown of thorns, pierced with a lance, and whipped to the permitted limit.

We will examine these features in five areas of injury and torture manifest on the Shroud—crowning with thorns (Section IV.A), pierced with a lance (Section IV.B), scourged multiple times (Section IV.C), nailed through the hands and feet (Section IV.D), and dislocated shoulder from falling with a large blunt object (Section IV.E).

IV.A
Crowning with Thorns

The man on the Shroud was severely wounded by a crown made with long thorns (the Syrian Christ thorn[66]) penetrating the scalp and the bone around his head. It was woven so that the crown would penetrate (like a cap) the top of the man's head as well as the forehead, temples, and back of the head. The thorns were long enough to penetrate the nape of his neck.[67] These thorns would have produced excruciating pain because the scalp and skull area is concentrated with nerves and blood vessels, and the crown used on the man on the Shroud was woven to maximize the number of thorns per cubic inch.[68] The Shroud shows the considerable bleeding that would have been produced by this kind of crown. According to Zugibe:

> [The effects of this crowning] is very dramatically depicted in the Turin Shroud, which shows images representing rivulets and seepage points running down the forehead and confirms that the crown of

[62] Piere Barbet, *A Doctor at Calvary - The Passion of Our Lord Jesus Christ as Described by a Surgeon* (P.J. Kenedy & Sons, 1953).
[63] Zugibe, *The Crucifixion of Jesus*, pp. 98-196.
[64] Bucklin, "An Autopsy on the Man of the Shroud."
[65] M. Bevilacqua, G. Fanti, M. D'Arienzo, and R De Caro, "Do we really need new medical information about the Turin Shroud?" *Injury* 45 (2014): 460–464, https://www.injuryjournal.com/article/S0020-1383(14)00115-6/fulltext. See also M. Bevilacqua and M. D'Arienzo, "Medical News from Scientific Analysis of the Turin Shroud," *MATEC Web of Conferences* 36, https://www.researchgate.net/publication/307773215_Medical_News_From_Scientific_Analysis_of_the_Turin_Shroud.
[66] Frederick Zugibe, *The Cross and the Shroud: A Medical Examiner Investigates the Crucifixion* (Cresskill New Jersey: McDonagh & Co., 1981), p. 25.
[67] See Stephen Jones, "Were Crowned with Thorns #5: Bible and the Shroud: Jesus and the Man on the Shroud: Shroud of Turin Quotes," October 19, 2015, https://theShroudofturin.blogspot.com/2015/10/were-crowned-with-thorns-5-bible-and.html.
[68] See Zugibe, *The Cross and the Shroud*, p. 33.

thorns was plaited in the shape of a cap and not a circlet.[69]

This last point brings up a question – why would a medieval forger depict an image of Jesus with a capped crown of thorns when he and the people for whom he was making the forged image would have had no example or precedent of such a crown from the gospels, or medieval art or history? This seems contrary to a forgers project of making a *convincing* image of the gospel accounts.

The crown of thorns is completely unique to Jesus' crucifixion and no evidence of such a crime has been found in the considerable literature on crucifixion. As Zugibe indicates:

> The effect of this type of pain was probably not understood by Pilate because parodies of this type [mock crowning with thorns] were not a usual prelude to crucifixion, and none have ever been related in the vast literature on crucifixion.[70]

The reason that the mock crowning uniquely occurred in Jesus' crucifixion was the charge leveled against him by the chief priests — He claimed to be king of the Jews. There are no other criminals in the vast literature of Roman crucifixion accused of such a crime. Without this context, the mock crowning would be inexplicable. If the Shroud originated in first century Palestine (as the above dating evidence suggests) then the uniqueness of this kind of crucifixion implies that the Shroud is very probably the burial cloth of Jesus Christ.

IV.B
Pierced with a Roman Lance

The man on the Shroud was pierced on the right side between the fifth and sixth ribs at an upward angle by a spear resembling the Roman lancea (lance) carried by Roman militia.[71] It left an elliptical wound "corresponding exactly to excavated examples of the leaf-shaped point of the *lancea*."[72] Dr. Robert Bucklin (forensic pathologist and autopsy specialist) indicates that the wound exuded both blood and a watery substance (detectable on the Shroud) which might have been produced by the chest cavity filling up with a clear fluid during a time of stress.[73]

St. John reports this feature of Jesus' crucifixion, making special note of the surprising combination of blood and then water flowing from the wound, which would not have been expected by his first century Jewish audience. The occurrence is so astonishing that St. John has to insist that it was seen by a reliable eyewitness:

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[69] Ibid, p. 35.
[70] Ibid, p. 24.
[71] See William Meacham, James E. Alcock, Robert Bucklin, K.O. L. Burridge, John R. Cole, Richard J. Dent, John P. Jackson, Walter C. McCrone, Paul C. Maloney, Marvin M. Mueller, Joe Nickell, Adam J. Otterbein, S.F. Pellicori, Steven Schafersman, Giovanni Tamburelli, and Alan D. Whanger, "The Authentication of the Turin Shroud: An Issue in Archaeological Epistemology," *Current Anthropology* 24, no. 3 (1983): 283-311, https://www.Shroud.com/meacham2.htm.
[72] Ibid.
[73] See Bucklin, "An Autopsy on the Man of the Shroud."

> But one of the soldiers pierced his side with a spear, and at once there came out blood and water. He who saw it has borne witness—his testimony is true, and he knows that he tells the truth—that you also may believe (Jn. 19:34-35).

Is it really possible for blood and water to flow from the side of a man who was pierced with a lance on the right side between the fifth and sixth ribs? It seems so *prima facie,* because blood partially admixed with a watery substance is detectable at the site of the lance wound on the Shroud. Where could this watery substance come from? Frederick Zugibe made an extensive study of eleven theories, using his vast experience in pathology as well as tests on cadavers. He concluded as follows:

> …the spear pierced the right atrium of the heart, hence the blood, and the water resulted from the pleural [the cavity next to the lungs] effusion from the brutal scourging and was contributed to by congestive heart failure from the position on the cross. The sudden thrust of the spear with a quick, jerking motion to pull it out would certainly bring blood out first on the spear and would be followed immediately by the pleural effusion from the pleural cavity.[74]

Why is this important for showing the authenticity of the Shroud as the burial cloth of Jesus? First, there is no account of blood and water flowing from the side of a crucified man except in the Gospel of John, and this occurrence was so astonishing, that St. John had to insist on it coming from a reliable eye witness. The occurrence seems surprising to this very day, so much so that biblical exegetes (unfamiliar with the evidence on the Shroud) have asserted that it is merely symbolic of the waters of baptism. Thus, the Shroud shows a remarkable coincidence of blood mixed with a watery substance at the exact spot (between the fifth and sixth ribs on the right side) where a spear could be thrust at an upward angle to produce this result.[75] The fact that this coincidence produces the unexpected result reported by the evangelist indicates both the likely authenticity of the Shroud and the accuracy of St. John's gospel account of the crucifixion.

Secondly, there is no report in the vast literature on roman crucifixion of a spear being thrust into a crucified man, because the roman legions did not want to put the criminal out of his misery quickly and incisively; rather, they wanted him to suffer a long excruciating execution. However in the unique case of Jesus, the soldiers were under a time constraint, because the sabbath was approaching and the chief priests and people wanted the bodies to be removed before sundown (Jn. 19:31). When the soldiers came to Jesus, they found that he was already dead, and to save themselves the trouble of breaking his knees, they simply thrust a lance into his side to assure that he really was dead (Jn. 19: 32-34).

In sum, the lance wound on the right side of the man in the Shroud shows many features unique to Jesus' crucifixion—the lance wound itself, the effusion of blood and a watery substance detectable on the Shroud, and a positioning on the right side between the fifth and sixth ribs that would have given rise to the exuding of blood followed by a clear "watery" substance.

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[74] Zugibe, *The Cross and the Shroud,* p. 127.
[75] See Ibid.

IV.C
Scourged Multiple Times

The man on the Shroud was scourged approximately 39 times by two individuals (one on his left and a slightly taller individual on his right) by a Roman flagrum having three thongs with dumbbell shaped lead pellets (*plumbatae*) at the end of the thong. This left 117 lash marks (39 strikes times 3 thongs per strike) which covered the man's back, thighs, and calves, and reached around to his sides and the lateral parts of his chest.[76] This is precisely the instrument and the manner used by Roman legionnaires for the purpose of torture and execution for serious crimes. The flagrums used on the man on the Shroud are almost the same as those found in archaeological digs at Pompeii and Herculaneum.[77]

Three of the gospels specifically mention scourging—Mt. 27:26, Mk. 15:15, and Jn. 19:1. Luke indicates only that Pilate "punished" Jesus. Scourging of criminals for serious offenses was common roman practice, even for those facing crucifixion. However, the man on the Shroud was given an unusually large number of lashings—thirty-nine lashes inducing 117 stripes this was the maximum allowable by Jewish law, but the romans would not have believed this limit to be important. So, why would this number be excessive for the romans? As noted above, the romans wanted criminals to suffer a long excruciating ordeal, but the 117 stripes would have created so much blood loss and weakness that it would surely have led to an early "merciful" death on the part of the criminal. As reported in the gospels, the scourging had precisely this effect – Jesus was already dead after only three hours when most crucifixions took much longer – from ten hours to two days.

So, why did the romans scourge Jesus so many times? Giving rise to what was sure to be a quick and more incisive death? The gospel supplies the answer. Pilate wished to scourge Jesus to the point of death so that the crowds would be satisfied that Jesus had been punished for his blasphemy, but Pilate did not want to kill him. Evidently, Pilate was concerned that Jesus had not committed anything like a capital crime (deserving of death) according to roman law; So, in John's gospel he has Jesus scourged miserably to satisfy the crowds. However, despite Pilates's two protestations of Jesus' innocence, they demanded his crucifixion (Jn. 19:1-16).

We conclude with the question about the supposed medieval forger. How did he know about the precise dimensions of a roman flagrum and its three thongs? When there was no evidence of such whips in the medieval period? How did he know about the dumbbell shaped metal pieces at the end of each thong? How did he know about the roman custom of whipping from two sides? And why did he select 117 stripes? He had no reports of any of these things from the gospels, or medieval art or history.

IV.D
Nailed Through the Hands and Feet

[76] See Stephen Jones 2013 "The Shroud of Turin: 3.3. The man on the Shroud and Jesus were scourged," July 15, 2013, http://theShroudofturin.blogspot.com/2013/07/the-Shroud-of-turin-33-man-on-Shroud.html.
[77] See Ibid.

According to Frederick Zugibe, the man on the Shroud was fixed to the cross with a nail proceeding from the palm (in the thenar furrow) angled 10-15 degrees downward toward the wrist which naturally guides the nail toward "the area created by the metacarpal bones of the index and second finger and the capitate and lesser multiangular bones of the carpus (wrist) called the "Z" area."[78] This is a remarkably sturdy area that can sustain the weight of a human body and the exit wound is precisely at the place indicated by the hand on the Shroud. Additionally, this position of the nail explains the lengthening of the fingers apparent on the man in the Shroud.[79]

Dr. Pierre Barbet did not think the nail could proceed through the palm because the soft fleshy tissue would not be capable of sustaining the weight of a human body, and so he conjectured that the nail would have to have proceeded from the front of the wrist to the back of the wrist. Zugibe's explanation is preferable, because it explains the lengthening of the fingers as well as the angle of the exit wound in the back of the wrist area. It also happens to agree with the implied position of the nail wounds on the *hands* (rather than the wrists) of the risen Christ in the gospel of Luke (24:39) and the gospel of John (20:20; 20:25-27).

This brings up yet another question about our medieval forger. Evidently he would have known from the gospels and from the medieval artistic tradition that the nail would have gone into the palm, but how did he know to make the exit wound come out in the wrist area to depict it properly on the Shroud? Did he have special knowledge of human anatomy and roman crucifixion practices?

The nail moving through this channel would have injured the median nerve and peripheral nerves which would have caused excruciating pain in a condition called "causalgia." Zugibe describes the pain as follows:

> The pain is described as a peculiar burning sensation that is so intense that even gentle contacts like clothing or air draft cause utter torture. The patient becomes completely preoccupied with avoiding any contact and holding the limb in a particular way. This condition can completely destroy the morale of most stoic individuals.[80]

We now proceed to the nail wounds in the feet. It is difficult to determine whether the feet were nailed side by side to the stipes or one foot on top of the other by a single nail.[81] Zugibe favors the two-nail, side by side hypotheses because it would have been easier for the roman soldiers to accomplish.[82] The feet were probably strapped flush to the stipes, and then nailed to the upright to the top of the foot through the heel. No support was necessary for criminals to push themselves up—the feet would have felt glued to the upright. [83] Once again, the pain would have been excruciating, Zugibe describes it as follows:

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[78] Zugibe, *The Cross and the Shroud*, p. 65
[79] See Ibid.
[80] Ibid, p. 76.
[81] See Ibid.
[82] See Ibid, p. 79.
[83] See Ibid, p. 85.

> The pain in Jesus' feet would have been severe with the iron nail pressing against the plantar nerves like "red hot pokers," similar to that suffered by the median nerve injuries during nailing of the hands. Even a slight movement would incite the incessant, burning pains. After a short period of time on the cross, the severe cramps, the numbness, and the coldness in the calves and thigs, caused by the compression by the bent knees, would force him to push up occasionally and attempt to straighten his legs. This would continue periodically throughout the entire period that Jesus was on the cross.[84]

IV.E
Dislocated Shoulder from Falling with a Large Blunt Object

In 2015, Drs. Mateo Bevilacqua, Giulio Fanti, Michele D'Arienzo, and Raffaele De Caro (three of whom are specialists in injury and pathology) published a study in the prestigious *Journal of Injury* which brought to light several new aspects of the crucified man on the Shroud.[85] Most importantly, they were able to explain the lowering of the right shoulder 10-15 degrees, the hyperextension of the arms, the left twist in the neck, and the retraction of right eye in the orbit. All of these injuries point to the fact that the man on the Shroud had a large blunt object on his shoulder, and when he fell forward, the blunt object hit him so hard that it caused a dislocated shoulder and paralysis in the upper right side. [86] They summarized their results as follows:

> This Man shows, on the right side, shoulder lowering, flat hand and henophthalmos, revealing a violent blunt trauma, from behind, to neck, chest and shoulder, with the entire brachial plexus injury and muscular damage to the neck bottom with the head bent forward and turned to the left, on the cross, as he had a stiff neck. Most likely, falling the body forward, the chest trauma caused a heart and lung contusion with hemothorax.[87]

This combination of injuries is very well explained by the circumstances surrounding Jesus' crucifixion. The gospels make clear that Jesus started the journey by carrying his own cross (Jn. 19:17), but the synoptic gospels indicate that along the way, the soldiers compelled Simon of Cyrene to carry the cross for him (Mk. 15:21 and Lk. 23:26). Why would the soldiers have done this? Certainly they did not want to ease the burden of the man they intended to torture. The research of Bevilacqua, Fanti, D'Arienzo, and De Caro give a very probable answer:

> The person whose figure is imprinted on the Shroud is believed to have collapsed under the weight of the cross, or the "patibulum" as it is referred to

[84] Ibid, p. 87.
[85] See Bevilacqua, et. al., "Do we really need new medical information about the Turin Shroud?"
[86] See Ibid.
[87] Bevilacqua, etc. al., "Medical News from Scientific Analysis of the Turin Shroud."

> in the study, the horizontal part of the cross. The Man of the Shroud … fell "forwards" and suffered a "violent" knock" "while falling to the ground." "Neck and shoulder muscle paralysis" were "caused by a heavy object hitting the back between the neck and shoulder and causing displacement of the head from the side opposite to the shoulder depression. In this case, the nerves of the upper brachial plexus (particularly branches C5 and C6) are violently stretched resulting in an Erb-Duchenne paralysis (as occurs in dystocia) because of loss of motor innervation to the deltoid, supraspinatus, infraspinatus, biceps, supinator, brachioradialis and rhomboid muscles.[88]

The scrapes on the man's knees confirm the fall – lurching forward, which caused the heavy blunt object to give a severe blunt trauma to the neck, shoulder, and back. At that point, the man's upper body (right side) would have been paralyzed, rendering him incapable of carrying the cross. This is why the soldiers pressed Simon of Cyrene into service. They were not easing Jesus' burden; they had to deal with His upper body paralysis. This injury explains the hyperextension of the arms of the Turin Shroud man, a feature which was formerly thought to be anatomically incorrect—this injury would have exacerbated the pain of the man when he hung from the cross, and it would have made his breathing difficult thereby shortening his life.

We now return to our hypothesized medieval forger. How did he get all of the anatomical facts about the blunt force trauma resulting from a forward fall with a heavy object on the back. The gospels don't mention a fall, but it makes sense in Jesus' case. He had over 2/10ths of a mile to carry His cross and He had loss a tremendous amount of blood by receiving the maximum number of lashes. How did the medieval forger put all the details together with the accuracy of a contemporary pathologist—the 10-15 degree lowering of the right shoulder, the hyperextension of the arms, the eye receding in the right orbit, the scraped knees, and the neck twisted to the left? If he was trying to portray Jesus, how did he know that Jesus fell? This hypothesis seems to be very unlikely—beyond belief for anyone with scientific/medical knowledge.

IV.F
Conclusion

We may infer from the data on the Shroud that Jesus' crucifixion (virtually identical on the Shroud and in the Gospel accounts) was incredibly painful. The crowning with thorns on the top of the head where the nerves and blood vessels are densely packed would have been very painful leading to excessive bleeding. The scrouging would have been excruciating, and the iron dumbbell-shaped fragments, would have torn his flesh to pieces. Carrying the cross from the praetorium to Golgotha led to a fall with severe blunt force trauma that dislocated his shoulders, hyperextended his arms, and exacerbated His pain on the cross. The nailing to the cross would have damaged two major nerves causing incredible pain every time Jesus tried to lift himself to breathe. Such torments are barely conceivable to anyone who has not been tortured.

The fact that the blood evidence on the Shroud so closely resembles the unique features of

[88] Anonymous, "New study shows Man of the Shroud had "dislocated" arms," *LaStampa*, December 30, 2019, https://www.lastampa.it/vatican-insider/en/2014/05/08/news/new-study-shows-man-of-the-shroud-had-dislocated-arms-1.35751980.

Jesus' crucifixion in the Gospel accounts gives warrant for its authenticity. When this is combined with exact anatomical accuracy, and Roman weaponry and crucifixion customs with which a medieval forger would not have been acquainted, it is not unreasonable to infer that this cloth could well be the burial cloth of Jesus Christ. This will be further confirmed in our examination of the image and its implications for Jesus' resurrection.

V.
The Image on the Shroud and Evidence of the Resurrection

The highly precise, detailed, three-dimensional photographic negative image on the Shroud is unique among images in the history of humankind. As we shall see, it is quite doubtful that a medieval forger – or for that matter, any contemporary forger unfamiliar with nuclear or high energy physics could reproduce its precise photographic negative features on the uppermost surface of the fibrils of the cloth, superimposing it over preexisting bloodstains. Even if one used a recently dead body and placed the precise wounds of Jesus' crucifixion on it (described above in Section IV), the dead body would not have produced the image on the Shroud unless the forger could induce a significant amount of radiation by one of the very unconventional means described below – instantaneous disintegration of the nuclei of the atoms throughout the whole body (producing a shower of particle radiation) or producing significant amounts of directional vacuum ultraviolet radiation of several billion watts through pulsations of less than one-forty billionth of a second (as in ARF excimer lasers). Inasmuch as these two methods of image production from a dead body are not only beyond nature but also current science and technology, it is quite certain that the Shroud's image was not produced by a forger. But I am getting ahead of myself. How do we know that such bursts of either particle radiation or ultraviolet radiation were needed to produce the image on the Shroud?

There are about forty-five aspects of the image on the Shroud and the condition of the cloth and blood that require explanation because they are either unique to the Shroud, incapable of explanation by traditional physical, chemical, or biological processes, or seem to be in conflict with one another:

- thirty-two primary image features.
- eight secondary image features.
- Seeming imprints of coins and flowers that are extrinsic to the body.
- The bright red color of all blood residues and stains.
- The excellent condition of the cloth after more than seven centuries.
- The absence of damage to the bloodstains on the cloth which would have resulted from the removal of the body wrapped by the cloth.
- The equal intensity of the images on the frontal surface and the dorsal surface of the Shroud when the body was in a supine position pressuring the dorsal section.

The proposed cause of the image on the Shroud will have to explain the 32 primary enigmatic image features and the eight secondary enigmatic image features (see below Section V.B). If this proposed cause can also explain other enigmas on the Shroud concerned with the blood and the strength and longevity of the cloth, so much the better (Section V.C). As we shall see, the only explanation that can come close to explaining these unique and enigmatic

features is *radiation.*

Since the STURP investigation (1978), radiation was suspected as the most likely explanation for image formation, because other physical explanations – such as liquids, rubs, vapors, and scorching could not explain some of the most obvious characteristics of the Shroud.[89]

For example, the fact that the image is limited to the uppermost surface fibrils (a few microns) of the frontal and dorsal surfaces of the cloth (and does not even penetrate into the middle of the fiber) and that its precision does not "leak" into adjacent fibers precludes liquids, vapors, and rubs all of which would penetrate into the middle of fibers, spangle, and diffuse to adjacent fibers.[90] Furthermore, the cloth did not make contact with every part of the body, meaning that the source of the image would have to not only act at a distance, but encode information about relative distance in the image on the Shroud. This is precisely what radiation does. In the words of Dr. Luigi Gonella (former scientific advisor to the Holy See):

> An agent acting at a distance with decreasing intensity is, almost by definition, radiation. The limitation of the cloth darkening to the outermost surface pointed to a non-penetrating, non-diffusing agent, like radiant energy.[91]

In two remarkably synthetic and brilliant papers, physicist Dr. John Jackson proposed that all known enigmatic aspects of the Shroud of Turin's image formation could be explained by two unconventional phenomena:[92]

1. The body as a whole (both inside and on the surface) would have to have emitted

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[89] In a comprehensive paper that tested all of these possibilities, physicists John Jackson, Eric Jumper, and William Ercoline tested all eight major possibilities using laboratory conditions to replicate a non-radiation means of duplicating the image on the Shroud. They compared the results of the above attempts with the macroscopic and microscopic features of the Shroud image, and argued that none of techniques tested can simultaneously reproduce its main features, from the 3-D property to the coloration depth, to the resolution of the spatial details. They concluded from this that it could not be the work of an artist or a forger.
See J. Jackson, E. Jumper, W. Ercoline, "Correlation of image intensity on the Turin Shroud with the 3-D structure of a human body shape," *Applied Optics* 23, no. 14 (1984): 2244-2270, https://www.osapublishing.org/ao/abstract.cfm?uri=ao-23-14-2244

[90] Ibid.
See also J. Jackson, E. Arthurs, L. Schwalbe, R. Sega, D. Windisch, W. Long, E. Stapaerts, "Infrared laser heating for studies of cellulose degradation," *Applied Optics* 27, no. 18 (1988): 3937-3943, https://opg.optica.org/ao/abstract.cfm?uri=ao-27-18-3937.
See also E.J. Jumper, AD Adler, JP Jackson, SF Pellicori, JH Heller, JR Druzik JR, 1984, "A comprehensive examination of the various stains and images on the Shroud of Turin," in *Advances in Chemistry*, No. 205, *Archaeological Chemistry—III*, ed. J.B, Lambert, (American Chemical Society, 1984), pp. 447-476.

[91] Luigi Gonella, "Scientific investigation of the Shroud of Turin: problems, results and methodological lessons," in *Turin Shroud – Image of Christ?* (Hong Kong, 1987), pp. 29-40, 31.

[92] John P. Jackson, "Is the Image on the Shroud Due to a Process Heretofore Unknown to Modern Science?", *Shroud Spectrum International* 34 (1990): 3-29.
See also John P. Jackson, "An Unconventional Hypothesis to Explain all Image Characteristics Found on the Shroud Image," in *History, Science, Theology and the Shroud*, ed. Aram Berard (St. Louis: Man in the Shroud Committee of Amarillo, 1991), pp. 325-344.

radiation which would have caused rapid dehydration of the uppermost fibrils of the cloth – the darker impressions coming from places closest to the body and the lighter impressions coming from places further away. This radiation would allow action at a distance (imaging in places where the cloth made no contact with the body) and a very precise photographic negative image.[93]

2. As the body was emitting radiation, it would have had to simultaneously become mechanically transparent (i.e., having no physically or chemically solid or resistant properties) allowing the cloth to fall into the body at least 3/16ths of an inch. This would explain the 3-dimensional imaging as well as the images of some of the bones on the frontal and dorsal surfaces inside the body relative to the flesh surrounding them.

Since John Jackson published the two conditions necessary to explain the primary image features on the upper surface of the fibrils, the precise photographic negative image and the three dimensional imaging of the surface and inside of the body, two major radiation hypotheses have been proposed and experimentally verified: the ultraviolet radiation hypothesis and the particle radiation hypothesis.

First, we consider *the ultraviolet radiation hypothesis (John Jackson and Paolo Di Lazzaro)*. These two physicists proposed that directional (collimated) ultraviolet (high frequency/intensity) radiation was responsible for the imaging. Di Lazzaro (Chief of Research for the Italian National Research Agency for New Technologies – ENEA) delivered this radiation through exceedingly short pulsations (one forty-billionth of a second). In order to produce these very brief pulses, Di Lazzaro and his team[94] used ARF excimer lasers in a laboratory. Di Lazzaro speculated that in order to obtain sufficient radiation from the entire body, it would take about 14,000 ARF excimer lasers which would deliver radiation at the magnitude of several billion watts for one forty-billionth of a second. In 2010,[95] he reproduced the straw-yellow coloration on the uppermost surface of the fibrils in precise images on a cloth with similar spectral reflectants to the Shroud.[96] It also resembled the Shroud's unique image features in many other ways.[97] He summarized his results as follows:

Our results showed that Jackson was right. The radiation in the far

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[93] See Jackson, "Is the image on the Shroud due to a process heretofore unknown to modern science?"
See also Jackson, "An unconventional hypothesis."

[94] See Paolo Di Lazzaro, "Shroud-like coloration of linen by ultraviolet radiation," *shroud.com,* May 2, 2015, https://www.Shroud.com/pdfs/duemaggioDiLazzaroENG.pdf.
Paolo Di Lazzaro, 2012, "Could a burst of radiation create a Shroud-like coloration? Summary of 5-Years Experiments at ENEA Frascati," Paper presented at *1st International Congress on the Holy Shroud in Spain—Valencia Centro Espanol de Sindonologia (CES), Valencia, Spain, April 28-30, 2012*, https://www.academia.edu/4028955/Could_a_burst_of_radiation_create_a_Shroud-like_coloration_Summary_of_5-years_experiments_at_ENEA_Frascati.
See also G. Baldacchini, P. Di Lazzaro, D. Murra, and G. Fanti, "Coloring lines with excimer lasers to simulate the body image of the Turin Shroud," *Applied Optics* 47, no. 9 (2008): 1278-1285, https://opg.optica.org/ao/abstract.cfm?uri=ao-47-9-1278.

[95] See Di Lazzaro, "Shroud-like coloration of linen by ultraviolet radiation."
https://www.Shroud.com/pdfs/duemaggioDiLazzaroENG.pdf

[96] See Ibid.

[97] See Ibid.

> ultraviolet is able to create a Shroud-like coloration on linen fabrics. Jackson was right as well considering this 'radiative hypothesis' outside current paradigm and known scientific phenomena, because we measured the amount of radiation energy and the ultra-short duration of laser pulses required to achieve a Shroud-like linen coloration, and these parameters cannot be generated by any natural phenomenon known to date.[98]

In addition to the short burst of vacuum ultraviolet radiation, the body of the man on the Shroud would have to have become mechanically transparent so that the features on the inside of the body could be brought into three-dimensional proportionality with features on the surface. The ultraviolet radiation hypothesis of Jackson and Di Lazarro do not explain how this would occur, but only that it must occur for the Shroud to have images from inside the body. In contrast to this, the particle radiation hypothesis *does* explain both the source of the radiation and the mechanical transparency of the body (see below). One last point must be made. Jackson and Di Lazzaro admit that there is no known natural way of producing this kind of ultraviolet radiation (at the far end of the spectrum) which opens upon the possibility of a supernatural cause.

We now turn to the second possible explanation of the Shroud's image -- t*he Particle Radiation Hypothesis (Dr. Kitty Little and Dr. Jean-Baptiste Rinaudo).* In 1995, Dr. Jean-Baptiste Rinaudo[99] (biophysicist at the Centre de Recherches Nucléaires Médicales) and Dr. Kitty Little[100] (nuclear physicist at the U.K.'s Atomic Energy Research Establishment at Harwell) independently proposed the likely cause of Jackson's double effect – the instantaneous disintegration of the nuclei of the atoms composing the body of the man in the Shroud.

As will be explained below (Section V.A), such instantaneous atomic disintegration would produce *low temperature* particle radiation – a shower of protons, alpha particles, deuterons, neutrons, electrons, and gamma rays (all of which play a part in explaining the many enigmas of the Shroud) on both the frontal and dorsal surfaces of the Shroud with equal intensity.

At the moment of disintegration, the body would have become mechanically transparent allowing the frontal cloth to pass through the body and the dorsal part of the cloth to be drawn up through a created vacuum into the dorsal part of the body. This profusion of nuclear particles/rays and the simultaneous mechanical transparency of the body not only fulfills the two requirements of John Jackson (given above), but also explains *all* unique, enigmatic, and seemingly contradictory features in the Shroud of Turin image. It also explains all non-image enigmas concerned with the bloodstains, the cloth, and possible images from extrinsic objects such as coins and flowers. As we shall see, the profusion of neutrons would also elevate the C-14 content in a linen cloth significantly, giving the appearance of a considerably younger age in a C-14 test.

Rinaudo and Little have shown that the particle radiation from this kind of nuclear

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[98] Ibid. 2.
[99] John Rinaudo, 1995, "Protonic model of image formation on the Shroud of Turin," Paper presented at *The Third International Congress on the Shroud of Turin, Turin, Italy, June 5-7, 1998.*
[100] See Kitty Little, "The formation of the Shroud's body image."

disintegration (at low temperature – 170 degrees Fahrenheit) gives rise to straw-yellow coloration and other distinctive image features on linen cloths similar to the Shroud.[101] As in the ultraviolet radiation hypothesis of Jackson and Di Lazarro, the particle radiation hypothesis has no known natural cause. There is no known natural agent that can induce instantaneous disintegration of stable atomic nuclei in an entire body. Since the particle radiation hypothesis is more comprehensive in its explanatory power – covering not only the primary and secondary enigmatic image features, but also the mechanical transparency of the body and the enigmas in the blood, cloth, and C-14 content, preference is given in this article to that hypothesis. We will examine it in detail in the following three subsections:

1. What is the Particle Radiation Hypothesis (hereafter "PRH")? (Section V.A)
2. How does the PRH Explain the Enigmas of the Shroud's Image? (Section V.B)
3. How does the PRH Explain the Enigmas on the Shroud's Bloodstains, Cloth, and Carbon Dating? (Section V.C)

I am most grateful for the work of Mark Antonacci who has detailed the research on the particle radiation hypothesis in his article, "Particle Radiation from the Body Could Explain the Shroud's Images and its Carbon Dating,"[102] and his book, *Test the Shroud on the Atomic and Molecular Level.*[103] In the remainder of this section, I will be using many of his explanations and references to articulate this remarkably comprehensive hypothesis of the Shroud's enigmas.

V.A
What is the Particle Radiation Hypothesis (PRH)?

In this section we will show that particle radiation is the only explanation that accounts for 45 primary and secondary image features, as well as enigmas concerned with the cloth's longevity, the blood stains' bright red color, and other enigmas concerned with the cloth. As noted above, in 1995, Dr. Jean-Baptiste Rinaudo[104] and Dr. Kitty Little[105] independently proposed the likely cause of Jackson's double effect – the instantaneous disintegration of the nuclei of the atoms composing the body of the man in the Shroud. This nuclear disintegration would give rise to a shower of particles at low temperatures (approximately 170 degrees Fahrenheit) that would not destroy the cloth.[106] Electrical energy would be in the range of 3 million watts, accompanied by a very bright light.[107]

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[101] See John Rinaudo, "Protonic model of image formation on the Shroud of Turin."
See also Little, "Formation of the Shroud's Body Image."
[102] See Antonacci, "Particle Radiation from the Body."
[103] See Mark Antonacci, *Test the Shroud: at the Atomic and Molecular Level* (Brentwood, TN: Forefront Publishing Company, 2016).
[104] See Rinaudo, "Protonic model of image formation on the Shroud of Turin."
[105] See Little, "Formation of the Shroud's Body Image."
[106] See Ibid.
[107] Dr. Kitty Little produced the straw like coloration and other effects similar to the Shroud on cellulose fibers (resembling those on the Shroud) with the reactor at Harwell running at about 3-3.5 million watts, at temperatures between 70-90˚ Celsius (between 150-194˚ Fahrenheit). We may assume from this that the disintegration of the nuclei of the atoms of the man in the Shroud could have produced the coloration and precision we find on the image in the Shroud with similar wattage and temperatures, leaving the cloth undamaged. See Ibid. See also, Kitty Little, "Photographic Studies of Polymeric Materials," Chapter 4, in *Photographic Techniques in Scientific Research*, Vol. III (Academic Press, 1978), p. 171.

The instantaneous disintegration of the atomic nuclei would have given rise to trillions of neutrons and gamma rays as well as protons and alpha particles. Since the cloth fell straight down receiving heavy charged particles (protons and alpha particles) only from the part of the body directly underneath it, a highly detailed negative image would be encoded on the cloth.[108] As the cloth fell into the area of the disintegrating body, the heavy charged particles (protons and alpha particles) would have stopped when they hit the uppermost surface of the frontal and dorsal parts of the cloth, causing dehydration and conjugated carbonyls[109] that would ultimately lead to the straw-yellow coloration of the cloth with the characteristics of a highly detailed 3-dimensional photographic image.[110] These effects of heavy charged particles (e.g., protons and alpha particles) have been confirmed in the laboratory by Dr. Kitty Little.[111]

What about the other particles released in the disintegration of atomic nuclei – neutrons (heavy but uncharged), electrons (charged but not heavy), and gamma rays? These particles/radiation are not responsible for the image, because they easily pass through the linen cloth and would not be stopped at the cloth's surface (as protons and alpha particles). Nevertheless, they explain several unusual features of the Shroud[112]:

1. How the Shroud could have been taken off the body without breaking, distorting or smearing any of blood stains (explained below in Section V.C.1).
2. The bright red color of the blood stains on the cloth (explained below in Section V.C.2).
3. It's unusual strength and non-friability and its longevity (explained below in Section V.C.3).
4. Increases in C-14 on the Shroud giving the appearance of a much younger date of origin (explained below in Section V.C.5)

As we shall see, the particle radiation explanation (through low temperature disintegration of atomic nuclei) best explains Dr. John Jackson's two requirements for the cause of the Shroud's image. It also explains all 45 unusual and enigmatic features of the image, cloth, and blood. No other explanation does this.

V.B
How does the PRH Explain the Enigmas of the Shroud's Image?

It would take an entire volume to give a detailed explanation of all 45 unique, enigmatic, and conflictual features on the Shroud's image, blood, and cloth requiring that we limit ourselves to a brief consideration of only the major enigmatic features. For additional

[108] See Antonacci, "Particle radiation from the body."
[109] Conjugated carbonyls occur when double-bonded carbon atoms formed after single-bonded atoms (within the linen fibers) broke apart. See Ibid, p. 2613.
[110] See Ibid
[111] See Ibid, p. 2618.
See Rinaudo, "Protonic model of image formation on the Shroud of Turin."
See Little, "Formation of the Shroud's Body Image."
See Little, "Photographic Studies of Polymeric Materials."
[112] See Antonacci, "Particle Radiation could explain," pp. 2621-2622.

information, interested readers can consult Mark Antonacci's article, "Particle Radiation From the Body Could Explain the Shroud's Images and Its Carbon Dating" or his book, *Test The Shroud on the Atomic and Molecular Level.* We begin with Antonacci's compilation of enigmatic features of the Shroud's *image* (the bloodstains, cloth, and carbon dating will be discussed below in Section V.C). Antonacci's list follows:

- lack of fading
- lack of foreign materials or particulates
- straw yellow coloration
- only topmost superficial fibers of threads encoded
- individual fibers encoded
- fibers colored 360° around circumference
- only outer layers of individually encoded fibers are colored
- no coloration inside of fiber
- fibers colored with similar intensity
- oxidation and dehydration of fibers
- containing conjugated carbonyls (double-bonded carbon atoms formed after single-bonded atoms within linen fibers were broken apart)

– [image was] developed over time

- accelerated aging of the body image
- stability to water and heating
- insolubility to acids, redox and solvents
- gross mechanical properties of linen intact
- microscopically corroded appearance of fibers
- lower tensile strength of fibers
- reduction of the cloth's fluorescence
- lack of residue
- highly attenuating or absorbing agent
- agent operated over skin, hair (coins and flowers)
- non-diffuse image with sharp boundaries
- equal intensity for frontal and dorsal images
- lack of two-dimensional directionality
- negative images with left/right and light/dark reversals which develop into
    - highly resolved, photographic quality images
    - without any magnification
    - with skeletal and dental features
    - three-dimensionality
    - encoded through the space between the body and the cloth
    - in a straight-line vertical direction.[113]

Protons, alpha particles, deuterons, and other heavy charged particles (which would be part of low-temperature particle radiation emitted by atomic disintegration) explain all of the above image features concerned with coloration – the straw-yellow color, the encoding of only the uppermost fibrils of the cloth (the non-penetration of the coloration into the middle of the fibers and the middle of the cloth), coloration 360˚ of the circumference, and oxidation and

[113] Antonacci, "Particle Radiation from the body could explain," p. 2613.

dehydration of fibers.[114] Only radiation can explain these features, because liquids, dyes, rubs, and scorching cannot do so. In a comprehensive paper, physicists John Jackson, Eric Jumper, and William Ercoline tested the eight alternative possibilities using laboratory conditions to replicate a non-radiation means of duplicating the image on the Shroud. They compared the results of these tests with the macroscopic and microscopic features of the Shroud image, and showed that none of the techniques tested can simultaneously reproduce its main features, from the 3-D property to the coloration depth, to the resolution of the spatial details. They concluded from this that it could not be the work of an artist or a forger.[115]

At this juncture, we know that radiation was necessary to produce the image, but was it *particle* radiation (Little and Rinaudo) or *ultraviolet* radiation (Jackson and Di Lazzaro)? Matters of coloration and encoding information at a distance (where there is no contact between the body and cloth) favor both hypotheses equally, however the considerations discussed below are better explained by the PRH.

Let us now consider the enigma that the Shroud's frontal and dorsal sections have encoded information from the body with equal intensity. This is highly unusual because there is pressure from the body lying in a supine position on the dorsal part of the cloth. However, the PRH explains this, because the body loses its mass and a vacuum is created during nuclear disintegration. The radiation moving in both directions would therefore encode the cloth with equal intensity on the top and the bottom.[116]

Furthermore, there is information inside the body which is encoded with three-dimensional layering on both the frontal and dorsal sections of the cloth – particularly skeletal features such as finger bones, bones extending over the palm, part of the skull at the forehead, the left thumb, parts of the backbone and teeth. The PRH explains this because in nuclear disintegration, as the body loses its mass, a vacuum is created. This vacuum would draw the frontal section of the cloth into the front part of the body and the dorsal part of the cloth into the back end of the body with equal intensity. As both sections of the cloth are drawn in, the particles emanating from the nuclear disintegration would encode the frontal and dorsal sections in layers as they moved toward the center. This remarkable three-dimensional layering of information on the frontal and dorsal parts of the Shroud have been confirmed through a VP8 analyzer. As Antonacci notes:

> The Shroud's truly proportional, full-length, and three dimensional frontal body image was first demonstrated with a VP8 image analyzer indicating a direct correlation between the lightness and darkness at each point on the Shroud's body image with their respective distances from the underlying body.[117]

Dr. Kitty Little showed how the heavy charged particles (protons, alpha particles, and deuterons) flowing out of nuclear disintegration would not only form the three-dimensional

[114] See Ibid., p. 2614.
[115] See Jackson, et. al., "Correlation of image intensity on the Turin Shroud."
[116] See Antonacci, "Particle Radiation from the body."
[117] Ibid. p. 2616.

highly precise image on the cloth but would do so only on the uppermost surface fibrils.[118] She also showed how these heavy charged particles would

> break many of the bonds of the molecular structure of the cellulose… thereby causing some of the single-bonded carbon atoms attached to hydrogen or oxygen to, thereafter, re-form with other carbon atoms into double-bonded, or conjugated, carbonyl groups.[119]

Jean-Baptiste Rinaudo also produced conjugated carbonyl groups by using low-temperature proton radiation on linen samples.[120] There are large numbers of these double-bonded conjugated carbonyl groups throughout the image on the Shroud.

Another enigmatic dimension of the Shroud's image is that it does not fluoresce under ultraviolet light. Linen naturally fluoresces under ultraviolet light, but this does not occur on the Shroud in the image areas -- only the background areas show natural fluorescing under UV light. Dr. Jean Baptiste Rinaudo showed that linen would lose its natural fluorescing characteristic when irradiated with 1.4 MeV (1.4 million electron volts) or less.[121] This low temperature proton radiation would be a result of a nuclear disintegration of the kind described by Dr. Kitty Little.

Rinaudo's experiments on proton irradiation of linen also showed several other enigmatic features manifest on the Shroud. As Antonacci describes it:

> The protons produced uniform superficial coloration on cloth whose fibers and threads lacked any cementation or added pigments or materials of any kind. Where body image fibers crossed, underlying fibers were protected and remained white, as found on the Shroud; in addition, the inner part of the straw-yellow image fibers remained white, like the image fibers on the Shroud. The scientists were also able to duplicate the microchemistry results of dehydratively oxidized, degraded cellulose, as is also found with the Shroud's body image.[122]

Once again, particle (i.e., proton) radiation explains the Shroud's unique image. Antonacci shows that the PRH also explains the secondary image features on the cloth. Recall, the PRH predicts that as the body disintegrates the frontal part of the cloth would fall flat into the disintegrating body and the dorsal part would be drawn flat by a vacuum into the back of the body. This flat collapse explains eight secondary features in the image —gaps in the sides of the man's face and the upturned beard likely explained by a chin band to keep the mouth closed, the vertical lines running down from the man's chin, motion blurs coming from the cloth collapsing through the beard area, encoded neck features, displaced hair images, motion blurs that produced a very faint image of the face on the left side of the main image, the small distortion at the

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[118] See Little, "Formation of the Shroud's Body Image."
[119] Antonacci, "Particle Radiation from the Body," p. 2617.
[120] See Rinaudo, "Protonic model of image formation."
[121] See Ibid.
[122] Antonacci, "Particle Radiation From the Body Could Explain," p. 2618.
See also Rinaudo, "Protonic model of image formation."
See John Rinaudo, "A sign for our time," *Shroud Sources Newsletter*, May/June 2-4, 1996: 2-4.

femoral quadriceps, and the length of the fingers which were curved but encoded on a flattened surface.[123]

In conclusion, particle radiation of heavy charged particles (such as, protons, alpha particles, and deuterons) can explain all 32 primary image features listed at the beginning of this section. The flat collapse of the burial Shroud into the instantaneously disintegrating body not only explains the three-dimensional interior imaging, but also all secondary images. Therefore, the PRH explains all forty major enigmas of the Shroud's image. As we shall see in the next subsection the PRH also explains non-image enigmas concerned with the blood stains, the cloth, and the carbon dating.

V.C
How does the PRH Explain the Enigmas on the Shroud's Bloodstains, Cloth, and Carbon Dating?

Recall from above, that the disintegration of the atomic nuclei in the body (as specified in the PRH) not only produces mechanical transparency, but also a flow of heavy charged particles (protons, alpha particles and deuterons) *and* a flow of other particles – neutrons (heavy uncharged particles), electrons (light charged particles), and gamma rays. As noted above, the heavy charged particles (and mechanical transparency) are responsible for all forty enigmatic *image* features. We now turn to the other particles – neutrons, electrons, and gamma rays, in conjunction with mechanical transparency which explain all five non-image enigmatic features of the Shroud. We will discuss each in turn.

1. The Body's Disappearance and the Unbroken Blood Marks. As noted above, blood from the body was transferred on to the cloth, but somehow the body was removed from the Shroud without breaking or distorting any of the blood marks. We know that the body had to have left the Shroud within two-three days after the death of the man because there are no signs of decomposition manifest on the Shroud (signs of decomposition after three days are very evident on burial cloths). Now here is the enigma – "If the cloth had been removed from the body by any human or mechanical means - some, most or all of these intimately encoded blood marks would have been broken or smeared."[124] So, if human and mechanical means were not used to removed the body, how did it become separated from the Shroud? The PRH explains this quite well, because the process of the nuclear disintegration of the body would not have disturbed the blood stains already transferred to the Shroud.[125] There does not appear to be any other way of explaining this enigma without obvious notable effects on the Shroud's blood stains.

2. The bright red color of the blood stains. The bright red color of the bloodstains on the Shroud are inexplicable because blood turns dark brown and then black in a relatively short time in open air. This red coloration was thought to be explained by the high content of bilirubin in the blood, but the brightness of the blood on the Shroud did not vary according to

[123] See Antonacci, "Particle radiation from the body," p. 2620.
[124] See Ibid., p. 2619.
[125] See Ibid.

the bilirubin content. The explanation was discovered by Dr. Carlo Goldoni who experimented with blood irradiated by neutrons.[126] According to Antonacci:

> [Goldoni] concluded that when blood marks are first exposed to neutron irradiation and then to ultraviolet light (such as the Shroud would naturally receive from sunlight during exhibitions) it resulted in the blood marks having a bright red coloration… [this coloration] existed regardless of the blood's bilirubin content. [127]

Once again the PRH supplies a coherent explanation to a longstanding enigma – the neutron radiation arising out of the nuclear disintegration of the body would irradiate the bloodstains, making the blood very bright when exposed to UV radiation (like the sun).

3. The excellent condition of the Shroud and its resistance to degradation. Another longstanding enigma about the Shroud is its excellent condition – non-friability, pliability, and resistance to oxygenation and chemical reaction. This was noticed by Drs. Roger and Marion Gilbert during the STURP investigation.[128] These features would be enigmatic even if the Shroud were only 700 years old (according to the1988 carbon dating). Once again, the PRH supplies the explanation. Recall that during nuclear disintegration, about half the particles emitted are heavy-charged particles (e.g., protons and alpha particles) that do not penetrate the Shroud – or even the fibers of the Shroud. They affect only the uppermost surface of the fibers, making those fibers (in the image) more friable (brittle and crumbly – *less* substantial). The other half of the particles of nuclear disintegration are not heavy and charged – for example, neutrons are heavy but uncharged and electrons are charged, but not heavy, and gamma rays (the highest form of photon energy are not heavy). These particles easily penetrate the linen cloth and move through it. Some of them hit the long-chain cellulose molecules in non-crystalline (weaker) regions, causing them to break, and then to crosslink with crystalline (stronger) structures which would strengthen the cloth – making it more substantial and pliable while increasing its resistance to solubility, oxygenation, and chemical reactions.[129] According to Dr. Kitty Little:

> Given a high crystallinity such as one would expect to find in good quality linen… this type of cross-linking also reduces solubility and susceptibility to oxygenation and other chemical reactions, which would account for the lack of degradation and 'aging' that might be expected in a material 2,000 years old, and that had been subjected to repeated handling and ill-treatment.[130]

4. Possible imprints of coins and flowers. As noted in Section II.C.3, there appear to be Roman coins on the eyes of the man in the Shroud. It was common practice to use such coins

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[126] Neutron irradiation causes collision displacement, transmutation and ionization effects in materials, resulting in changes of material microstructure and properties. It is commonly used to discover properties of materials and the efficacy of devices.
[127] Antonacci, "Particle radiation from the body," p. 2621.
[128] Roger Gilbert Jr. and Marion Gilbert, "Ultraviolet-visible reflectance and fluorescence spectra of the Shroud of Turin," *Applied Optics* 19, no. 12 (1980): 1930-1936.
[129] See Antonacci, "Particle Radiation from the body," p. 2622.
[130] Little, "Formation of the Shroud's body image."

to prevent the eyelids from opening during rigor mortis.[131] It is highly probable that there are coins of the diameter of Roman leptons on the eyes of the man in the Shroud,[132] but the images on these coins have been called into question. Computer enhanced images of the coin imprints on the Shroud suggest that they are Roman leptons coming from a special minting by Pontius Pilate in 29 AD. As noted above, some scientists believe that the cloth is too coarse to admit of such fine imaging, but this is not certain, because we have not sufficiently explored the refinement of surface imaging by heavy charged particle radiation. We have seen how fine the images of Jesus' hair, beard, and skeletal structure are, so we might say that the jury is out.

Notwithstanding this, we must still answer the question of how imprints of a coin could make their way on to the cloth, because the coins are extrinsic to the body, and the body is the source of the radiation. In other words, how did the radiation come out of the coins as well as the body? Once again, the PRH supplies the explanation. Recall from above that a neutron shower is one of the results of the disintegration of atomic nuclei in the body. These neutrons would have flowed out of the man's eyes, and some of them would have hit copper nuclei (in the bronze coins), giving off a heavy charged particle, e.g., a proton, alpha particle, or a deuteron – which would have created an image on the cloth in the precise way that the body's heavy charged particles created it's image. As Antonacci explains it:

> When a neutron hits the nucleus of copper, the primary component of ancient bronze coins, the nucleus can absorb the neutron and give off either a proton, alpha particle, deuteron, or a low-energy gamma ray. Each of these particles …encodes superficial images on the cloth and, if they were given off the coin's surface, could encode the coin's features. Similarly, flowers contain trace amounts of heavier elements such as iron, calcium, and potassium. When any of the countless neutrons hit these three heavier elements, each could also absorb the neutrons and give off protons and alpha particles. Any protons or alpha particles given off the flowers' surfaces would also encode a superficial image on the Shroud.[133]

If heavy charged particle radiation can make intelligible imprints on coarse fabric, then the identification of the sacrificial cup, the augur staff, and the Greek letters OY KAI AROC would indicate coins minted by Pontius Pilate in 30 AD on the Shroud man's eyes.

5. The Carbon Dating of the Shroud. The PRH gives a likely cause for an errant C-14 dating of the Shroud. Recall from above that a shower of countless neutrons would emerge out of the instantaneous disintegration of all the atomic nuclei in the Shroud man's body. Dr. Arthur C. Lind and colleagues show that such neutron irradiation of a linen cloth filled with indigenous N-14 (nitrogen) would have converted the N-14 into C-14. This would significantly elevate the C-14 content in the cloth, making the age of the cloth (by C-14 testing) appear much younger.[134] Furthermore, this additional C-14 would take the place of the converted N-14 and remain in the cloth for hundreds or thousands of years. It would also be resistant to high

[131] See Thackeray, "Lepton coin diameters."
[132] See Ibid.
[133] See Antonacci, "Particle Radiation from the body," p. 2621.
[134] See Lind, et. al., "Production of radiocarbon."

temperatures (As in the fire of Chambery) and all cleaning methods used to prepare the linen for C-14 dating.[135] A.C. Lind and colleagues calculated the very small amount of neutron irradiation it would take to lower the age of the Shroud sample by 1,300 years. Antonacci summarizes Lind's results as follows:

> The neutron fluence that would be needed to cause the radiocarbon date to be medieval instead of first century is 8.3×10^{13} $n \cdot cm^{-2}$ if the nitrogen content of the Shroud is about 570 ppm. This neutron fluence over the 4.4 × 1.1 m^2 area of the Shroud is 4×10^{18} neutrons, which weigh only 0.67 µg.[136]

This is a very small fraction compared to the weight of the man on the Shroud, making it likely that the carbon dating was made to appear younger by a significant factor—even 1,300 years.

V.D.
Confirming the Particle Radiation Hypothesis

Currently there is very good reason to believe that the particle radiation hypothesis is superior to the ultraviolet radiation hypothesis, because it explains many more of the forty-five enigmas on the image, blood, cloth, and carbon dating of the Shroud. Furthermore, the PRH explains both of Jackson's requirements for a perfect *three-dimensional* photographic negative image which records the interior of the body on both the frontal and dorsal sides:

1. *Radiation* to explain action at a distance and tri-dimensional photographic negative imaging.
2. Mechanical Transparency of the Body, allowing the cloth to penetrate the frontal part and the dorsal part (by vacuum) to encode the interior of the body (e.g., the backbone).

Instantaneous disintegration of the body's atomic nuclei in the PRH would explain *both* the source of radiation and the cause of mechanical transparency while the ultraviolent radiation hypothesis explains only the radiation (but not the mechanical transparency).

As noted above, both the PRH and the URH appear to require supernatural causation, because there is no natural explanation for either hypothesis:

- The simultaneous disintegration of every atomic nucleus in an entire human body producing a low temperature nuclear reaction (the PRH).
- The production of 6-8 billion watts of ultraviolet radiation from all points of the body (the URH).

The remarkable ability of the PRH to explain *every* known enigma on the image, blood, cloth, and carbon dating is very probative, but we can gain greater certitude by looking for

[135] See Ibid.
[136] See Antonacci, "Particle Radiation from the body," p. 2619.

remnant isotopes (beyond C-14) that would be created in a nuclear reaction (such as nuclear disintegration).[137] Two such isotopes are Cl-36 (a radioactive cosmogenic isotope of chlorine created from nuclear reaction) and Ca-41 (a cosmogenic nucleus created in nuclear reaction).[138] If these radioactive/cosmogenic isotopes are found in abundance (above their very insignificant levels in natural linen) they, along with C-14 abundance would almost certainly indicate a nuclear reaction similar to nuclear disintegration. This would confirm the strong likelihood of the PRH.[139]

In view of the above, there is a good possibility that the PRH will be validated by the discovery of cosmogenic/radioactive isotopes in the Shroud. However, if such validation does not occur, we would still have to find another source of radiation (such as, ultraviolet radiation) and another cause of mechanical transparency. This combination of requirements points to the strong likelihood of supernatural causation of the enigmatic image, blood stains, and cloth.

V.E
Does the Image Indicate a Resurrection Similar to that of Jesus?

There is general agreement among scholars that the apostles of Jesus experienced him as risen from the dead, supernaturally transformed. Gary Habermas, who made an extensive study of scholars across the board—from conservative to radical—concluded as follows:

> The latest research on Jesus' resurrection appearances reveals several extraordinary developments. As firmly as ever, most contemporary scholars agree that, after Jesus' death, his early followers had experiences that they at least believed were appearances of their risen Lord.[140]

Habermas goes on to say that most scholars believe for good reason that the apostles were not collectively imagining Jesus, but rather experienced him as physically mediated in the world and transformed in appearance.[141] Some scholars believe he appeared as light (e.g., Reginald Fuller[142]) but most scholars believe that he appeared as a spiritually transformed and glorified body (e.g., N.T. Wright[143]). Wright indicates that the idea of spiritual transformation of embodiment is a central Christian mutation of Second Temple Judaism. Early Christians adhered very closely to the implicit doctrines of Second Temple Judaism (which were developed throughout the period of the Second Temple from about 530 BC to 70 AD). However, in a few cases Christians departed radically from that body of doctrine. Several of those Christian mutations concern the resurrection. Two of them are germane to this study:

1. The Jewish doctrinal consensus held that the risen body would be a continuation of

[137] See M. Antonacci, 2018. "Can contamination be detected on the Turin Shroud to explain its 1988 dating?", Paper presented at *The International Workshop on the Scientific Approach to the Archeiropoietos Images*, *Frascati, Italy, May 4-6*, pp. 239-247.
[138] See Ibid.
[139] See Ibid.
[140] Habermas, "Mapping the Recent Trend toward the Bodily Resurrection Appearances of Jesus," p. 79.
[141] See Ibid., pp. 87-89.
[142] See Reginald Fuller, *The Formation of the Resurrection Narratives* (New York: Macmillan Company, 1971).
[143] See N.T. Wright, *The Resurrection of the Son of God* (Minneapolis, MN: Fortress Press, 2003).

physical embodiment, but Christians changed it to a spiritual and glorified (transformed) embodiment.
2. The Jewish doctrinal consensus held that the resurrection was a less important doctrine, but the Christians held that it was the central doctrine upon which everything else is grounded (see, for example, 1 Cor. 15:16-19).

Wright asks, "Why would the early Christians make these changes to the Jewish doctrinal consensus when they did not want to break from the synagogue—why would they have risked a doctrinal rift when they continued to respect the doctrines of their forefathers?" His answer is that there had to be a cause that was powerful and influential enough to make them depart from a doctrinal consensus to which they basically adhered. That powerful and influential cause had to be more than an empty tomb. It had to be an experience of a spiritually transformed and glorified Jesus—an appearance that was continuous with his former embodiment, but radically transformed in spirit, power, glory, and light (see for example 1 Cor. 15:43; Acts 9:3, 22:6).

So how does the origin of the image suggest the resurrection of Jesus? Let us return to John Jackson's two requirements for image formation—a powerful source of radiation (which would have given off a bright light) and mechanical transparency—something akin to becoming spiritual (St. Paul calls it a "spiritual body" [*pneumatikon soma*]—1 Cor. 15:44). The combination of powerful radiation giving off light—i.e., from nuclear disintegration/reaction in the PRH or several billion watts of energy in the URH—with mechanical transparency suggestive of "becoming spiritual" corresponds with the testimony of the Gospels, St. Paul, and the Acts of the Apostles, particularly with respect to the Christian mutations of Second Temple Judaism. Perhaps we might say that the radiation, light, and mechanical transparency that caused the image on the Shroud was the gateway to a risen body transformed in spirit, power, light, and glory.

VI.
Conclusion

The likelihood of the Shroud being a forgery—medieval or otherwise—is positively miniscule. There are four significant challenges to this hypothesis that are almost insurmountable:

1. *The problem of radiation and mechanical transparency.* Inasmuch as Jackson's two requirements for a very precise three-dimensional photographic negative image with encoding of the interior of the body on both the frontal and dorsal sides are completely beyond natural causation and even contemporary human causation, we must wonder how a medieval forger could produce this immense source of radiation from a dead human body while making that body mechanically transparent (explained above in Section V).
2. *The problem of how the body was removed from the Shroud.* Even if we suppose that an ingenious medieval forger took a live victim and used the roman tools/weapons to perfectly replicate Jesus' crucifixion, and then wrapped the dead man's body in a cloth soon after, we confront the problem of how the Shroud could have been taken off that dead body without breaking, distorting or smearing, most or all of the 372 blood stains on the Shroud. There is currently no known human or mechanical method to do this,

implying that the body literally disappeared from within the Shroud without disturbing those blood stains (explained above in Section V.C.1).

3. *The blood stains prior to the image.* Recall that the blood stains appeared on the Shroud before the image. Even if we suppose that the medieval forger had contemporary anatomical information so as to produce the positioning of the blood stains perfectly, we have to wonder just how he placed those blood stains on the Shroud before there was any image on which to position them with perfect anatomical precision. We also need to explain how he made an anatomically precise human body image to perfectly overlay on these preexisting blood stains. Again, this seems to be beyond even a contemporary forger's capabilities (explained above in Section III).
4. *Pollen grains and blood characteristics not available to a medieval forger.* The first mystery is how a medieval forger could have obtained the pollen grains indigenous to Jerusalem and northern Judea. Recall, that of the pollen grains taken from the Shroud, three quarters of them were from Israel (specifically from sediment deposits from 2000 years ago near the Sea of Galilee) including 13 that are unique to that region (explained above in Section II.C.1). Secondly, we must explain how a medieval forger placed the invisible/undetectable blood elements on the Shroud—"the microscopically precise, invisible reactions around the more than 100 scourge marks throughout the body [and] the coagulated blood stains with serum surrounding borders and clot retraction rings that occur with actual wounds and blood flows, found throughout the front and back of the body, and revealed only by modern scientific technology."[144] The only way the forger could have done this is to kill a live victim in precisely the way that Romans would have scourged and crucified a man in the unique way described of Jesus in the Gospels. This gives rise to a host of questions raised above in Section IV, which will be reviewed immediately below.

How did our hypothesized forger know the following? Aware only of crowns that were circlets, he inexplicably made his crown of thorns with a top that was intended by the Romans to inflict maximum pain. Without knowing what a Roman lance looked like, he replicated it perfectly (with its elliptical leaf-like blade) and, without knowing the anatomical particulars of the right atrium and pleural cavity, he positioned the spear injury at the precise place (between the fifth and sixth ribs) for a spear to exact blood and a watery substance (which he depicted perfectly on the Shroud). Without knowledge of what a Roman flagrum (whip) looked like, he replicated the three thongs with their dumbbell shaped lead fragments at the end perfectly, and then portrayed the lashing according to roman custom, moving from right to left to right etc. Having no Gospel evidence of a fall or the anatomical effects of a fall with a large object on the shoulders, he perfectly portrayed the five elements of the blunt force trauma that would have occurred in a fall—the lowering of the shoulders by 10 to 15 degrees, the hyperextension of the arms, the recession of the right eye into its orbit, the left twist in the neck, and severe scraping of the knees. Finally, without knowing how the Romans would have attached the hands and feet to a cross (without the body pulling away), he portrayed the exit wound from the nail that went through the palm but exited through the wrist with remarkable precision. Even if we conjecture that the forger used a live victim, and forced him to go through everything that Jesus underwent, how would he know how to carry this out in a particularly Roman way? Are we really to believe that any forger could have done this before our present age?

[144] Antonacci, "Particle Radiation from the Body," p. 2614.

In conclusion, all the above scientific tests, studies, and corroborative evidence do not constitute a formal scientific proof for the authenticity of the Shroud as the burial cloth of Jesus Christ or the supernatural origin of its image. However, it does provide significant evidence for an informal inference (along the lines described by John Henry Newman). An informal inference puts together a series of different sets of evidence, each of which is antecedently probable that complement and corroborate one another toward a single conclusion. Such inferences do not constitute a formal metaphysical (deductive) proof or a formal scientific proof, but a mutually corroborative informal basis for probable truth. This allows for future modification of any of the individual, antecedently probable sets of evidence without the consequence of falsifying the conclusion. The mutually corroborative nature of the different sets of evidence give probative force according to the number and diverse kinds of evidence pointing to the same conclusion.

So what can we say about the Shroud of Turin? To begin with, the 1988 carbon dating is problematic because of heterogeneity detected in the statistical analysis of its raw data (Casabianca et al[145]). This problem may well be explained by sixteenth century material in the sample used for C-14 dating and the strong possibility that the cloth was irradiated by neutrons from a nuclear disintegration/reaction which converted the N-14 intrinsic to the cellulose of the cloth into an abundance of C-14 (lowering the apparent age of the Shroud by a significant factor—even by more than one thousand years).[146] Given this, there are six major sets of evidence, mutually corroborating each other that point to the authenticity of the Shroud as the burial cloth of Jesus:

1. Four other dating tests (using methods other than C-14) — Wide-Angle X-Ray Scattering Test (De Caro, et al), Fourier transformed Infrared Spectroscopy, Raman Laser Spectroscopy Test for Cellulose Degradation, Mechanical tests of compressibility and breaking strength—which indicate a probable date of origin for the Shroud between 55 AD (De Caro, et al) and 90 AD (Fanti, et al) (see references in Section II.B above).
2. Two external dating methods (see Section II.C above):
    a. 120 points of congruence between the blood stains on the Shroud and those on the Facecloth of Oviedo indicate that the two cloths touched the same face. Since the Facecloth of Oviedo has a definite historical record dating back to 616 A.D., it is highly likely that the Shroud must also date back to 616 A.D. or before. (See the references in Section II.C.1)
    b. The pollen grains do not give a date of origin, but rather a place of origin—Jerusalem/northern Judea because the majority (3/4ths) of pollen grains come from this area, thirteen of which are indigenous/unique to the area. The Facecloth of Oviedo also was in Palestine prior to 616 AD. The 1988 carbon dating dates the origin of the Shroud to the time when it appeared in Europe, meaning that it originated and remained *only* in Europe. However, this cannot be the case, because as the pollen grains indicate, the Shroud spent a substantial time in Palestine and another substantial time in Turkey, which would have lasted at least as long as its stay in Europe. This means that the Shroud must be much older than 700 years old. (See references in Section II.C.2).
3. The blood stains on the cloth are authentic and came from a victim who was tortured (indicated by the high content of bilirubin and the synthesis of ferritin and creatinine). The

[145] See Casabianca, et. al., "Radiocarbon Dating of the Turin Shroud."
[146] See Lind, et. al., "Production of radiocarbon."

blood stains were produced by a victim who was positioned vertically for an extended time (as in a crucifixion) indicated by the vertical axis of the serum separation from the plasma. These blood stains could not have been applied to the cloth by a forger because the blood preceded the image on the cloth and contained blood elements and characteristics which are only revealed by modern technology. This means the forger would have had to have crucified a live victim with Roman tools and customs in the same way as Jesus (see Section III above).

4. The Shroud portrays the image and blood of a man who was crucified precisely according to Roman custom, using a Roman legionnaire's lance (with elliptical, leaf-like shape) and two Roman flagrums (according to Roman custom) and nailed to the cross according to Roman custom. Though the Gospels do not mention a fall of Jesus, the Shroud portrays all five characteristics of blunt force trauma of a man who fell to his knees with a heavy object on his right shoulder. This seems to be beyond the knowledge of a medieval forger. Furthermore, the image and blood stains are anatomically perfect in themselves and their relative positions to one another. Much of this data would have been beyond a medieval forger (see above Section IV).
5. The cloth was detached from the dead body by an unknown means. If any human or mechanical means had been used to take the Shroud off the body, it would have broken, distorted, or smeared most or all of the 372 blood stains on the Shroud. This points to the mechanical transparency (produced by nuclear disintegration in the PRH or some other cause of mechanical transparency) which seems to require a supernatural cause (see above Sections V.C and D).
6. The image was produced by a source of significant radiation (e.g., particle radiation or ultraviolet radiation) that would have given off bright light. It was also produced by a mechanically transparent body. These two requirements are not only beyond the capacity of a medieval forger, but also a contemporary forger, and all known natural causation. Particle radiation from the simultaneous disintegration of all atomic nuclei (producing a low temperature nuclear reaction) is the probable source of the radiation and mechanical transparency. Even if this is disproved, there would have to be another source of radiation and mechanical transparency which would be equally beyond a medieval forger, a contemporary forger, and purely natural causation. Whatever the case, the light, radiation, and transparency of the body are suggestive of the resurrection of Jesus indicated in the Gospels, St. Paul, and the Acts of the Apostles (in spirit, power, glory, and light) and seemingly produced by a supernatural cause (see above Section V.E).

By now it will be clear that these six distinct sets of data complement and mutually corroborate one another. Some of the data sets may be modified in the future, but the combination and corroboration of evidence manifest in the image, the blood, and the cloth along with the pre-616 AD dating entailed by congruences with the blood stains on the facecloth of Oviedo, strongly suggests this is the burial cloth of Jesus Christ whose resurrection imprinted the image of his crucified body on the Shroud. If this is correct, then the Shroud validates the accuracy of the Gospel accounts of Jesus' passion and resurrection, while the Gospel accounts point to the identity of the man in the Shroud.