Can gamma rays in the tomb explain the Shroud's mysterious image and its false C-14 dating?

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In 1988, the Turin Shroud was radiocarbon dated to a range of 1260–1390 AD by three laboratories that were very renowned in the field. However this dating, obtained through carbon-14 (C-14) measurements, remains very controversial as many other scientific and historical data demonstrate a much older origin.

Shortly after the publication of the test report in 1989, Thomas Phillips and Father Jean-Baptiste Rinaudo hypothesised that neutron irradiation of the Shroud could have produced additional C-14 atoms in the cloth, which would have biased the radiocarbon dating measurements to produce a result which was much younger than its true age. In addition, Rinaudo proposed that proton radiation could have caused a discolouration of the fabric to produce the image on the Shroud [1].

To test his hypothesis, Father Rinaudo conducted various experiments that produced evidence which supports many aspects of his hypothesis. He successfully demonstrated that excess C-14 is created when linen fabric is exposed to neutron radiation, reducing the apparent age of the material when measured using radiocarbon dating techniques. Rinaudo also showed that proton irradiation can produce a superficial discolouration of linen fibres. He exposed samples of linen fabric to proton radiation and found that a specific radiation intensity [2] produced a superficial yellowing of the fabric which was equivalent to that observed on the Shroud in the area of the nose and calf (see Fig.1). Moreover, the discolouration only penetrated the surface fibres of the fabric to a depth of 20 to 40 micrometres [3]. This again was similar to the depth of discolouration present in Shroud image fibres.

According to Rinaudo, the neutrons and the protons were produced by the disintegration of deuterium[4] which is present in small quantities in the human body. Unfortunately, one of the problems with this hypothesis is that deuterium requires a huge and destructive energy input to create the density and efficiency of neutron and proton radiation needed to produce the Shroud's image and radiocarbon dating characteristics. However, there are other potential sources of neutron and proton emissions and as we will see, these could potentially have been triggered by gamma radiation in the tomb, generated by a natural meteorological phenomenon.

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1. Father Rinaudo's hypothesis is outlined in BSTS Newsletter Issue No. 38 (August/September 1994). See Theory no. 3 in *'Three theories of how the radiocarbon age of the Shroud may have become `younger' than its true age'*.
2. 1.4 MeV protons at 0.5 and 0.25 μCb/cm2
3. Depth measured later as about 200 nm. See *Microscopic and Macroscopic Characteristics of the Shroud of Turin Image Superficiality*, Fanti, G., et al (2010), https://doi.org/10.2352/J.ImagingSci.Technol.2010.54.4.040201. Calculated range of protons in cellulose of linen: few hundred nm. See *Hypothetical photo-nuclear effects, dating and imaging on the Shroud of Turin*, Laude J. P. (2022) https://doi.org/10.1117/12.2620953
4. Deuterium is an isotope of hydrogen with a nucleus containing one proton and one neutron.

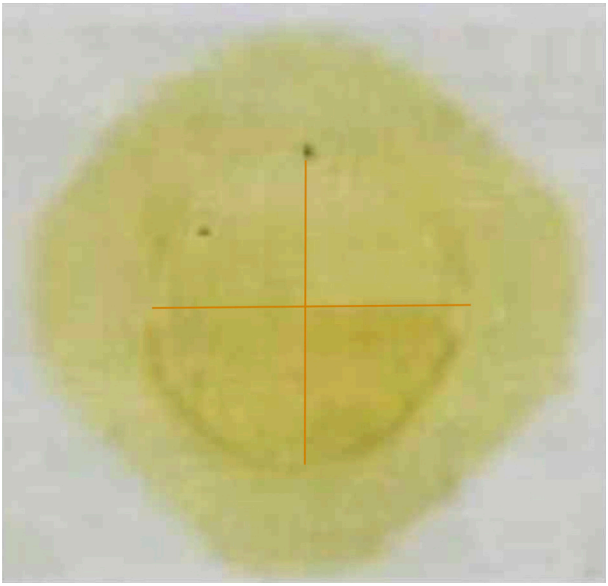

Figure 1. Sample of linen used in experiments conducted by Jean-Baptiste Rinaudo in 1992 to test the effects of exposure to 1.4 MeV proton radiation. The quadrants top-right, top-left, bottom-left and bottom-right were subjected to exposures of 0.06, 0.12, 0.25 and 0.5 μCb/cm2 respectively. The discolouration seen in the bottom-left and bottom-right quadrants match that observed on the Shroud in the area corresponding to the calf and nose respectively.

Radiation generated by Thunderstorms

The lightning discharges associated with violent thunderstorms release large amounts of energy. Extremely violent storms can produce Terrestrial Gamma-ray Flashes which generate high-energy gamma radiation with sufficient energy to eject neutrons from the nuclei of certain atoms [5]. Neutrons are produced when these gamma rays interact with the nuclei of deuterium but they are also produced when they react with oxygen, nitrogen, carbon and calcium, which along with hydrogen, are the elements that make up 97% of the mass of a human body. The action of high-energy gamma rays on all the atoms of a human body could produce as much as 20,000 times more neutrons than radiation acting on the body's deuterium alone.

Nitrogen and oxygen are also the main components of the atmosphere, whilst the limestone rock in the rock tombs of Jerusalem contains calcium. These neutrons can then induce reactions with nitrogen atoms, causing the release of protons whilst also transforming the nitrogen to carbon-14.

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5. Electrons and penetrating gamma energies of up to 20 MeV and more can be reached in certain Terrestrial Gamma Flashes and in the relativistic electron braking radiation of lightning dis charges from certain thunderstorms.

Figure 2. Typical Lightning discharge recorded by the European Space Agency Lightning Imager. Lightning discharges from extremely violent thunderstorms results in high-energy gamma radiation which interacts with certain atoms to produce neutrons.

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Skin tissue has a high nitrogen content and so many protons are released by the skin when this is exposed to neutron radiation. As Rinaudo showed, proton radiation can cause the pale, superficial discolouration of linen fibres similar to those that produce the negative, three-dimensional image observed on the Shroud. This superficiality is due to electrically-charged protons having a very limited range of travel compared to neutrons and so they can only penetrate flax fibres to a depth of a few micrometres. In air, the range is greater but is still just a few centimetres, depending on the energy of the protons [6]. This means that the proton radiation is at its most intense where the linen of the Shroud is in contact with the body, for example at the nose, hands and knees, and the radiation intensity quickly decreases with increasing distance between the skin and the linen fabric. Since the amount of discolouration corresponds with the radiation intensity, distance information is effectively encoded in the image, as observed in the Shroud's 3D properties.

Lightning is also accompanied by a strong electric field between the storm clouds and earth. This electric field would cause all protons released to follow a vertical path, which is needed to produce the realistic, high resolution image of the body that is visible on the Shroud.

6. A proton range of 1.03/2.31/4 centimetres in dry air has been calculated for energies of 0.58/1.0/1.4 MeV.

It's therefore plausible that intense gamma radiation produced by lightning strikes in violent storms could lead to both neutron and proton emissions, which are capable of producing both the image on the Shroud and an increase in the amount of carbon-14 present in the fabric, causing the age as measured by radiocarbon dating to be much younger than its true age. So could an intense thunderstorm have been responsible for these characteristics?

Meteorological phenomena coinciding with the crucifixion

There is certainly some evidence that the crucifixion of Jesus was accompanied by extreme meteorological phenomena. According to the Gospel of Luke, *'Now it was about the sixth hour, and there was darkness over all the earth until the ninth hour. Then the sun was darkened, and the veil of the temple was torn in two.'* [7]. The Gospel of Matthew adds more detail *'Then, behold, the veil of the temple was torn in two from top to bottom; and the earth quaked, and the rocks were split'* [8].

These details recorded in the Bible appear to be consistent with the effects produced by an extremely violent storm. Thunderstorms are often accompanied by heavy and dense clouds which can darken the sky and obscure the sun. There are also examples of so-called 'Super Lightning', in which the atmosphere discharges lightning bolts which are 1,000 times stronger than usual, [9] whilst energetic storms known as Storm-Quakes have been shown to be capable of producing earthquake-like seismic activity. [10] Scientists have also conducted laboratory tests that indicate that natural lightning can cause rocks and bedrock to break. [11]

We cannot be sure that Super Lightning or 'Storm Quakes actually occurred following the death of Jesus. It's also true that the evangelists Matthew and Luke do not use the word 'storm' when describing these events. However, it is clearly possible that all the effects described in the Gospel passages quoted above were the result of an exceptional thunderstorm, which would also have been accompanied by the intense gamma radiation needed to produce the unusual characteristics of the Shroud.

It is also true that the gospel chronology places these events before the body was wrapped in the Shroud and placed in the tomb. It cannot be ruled out, however, that a similar gamma-ray generating weather phenomenon could have occurred after the burial in the

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7. Gospel of Luke, 23:44-45 (New King James Version)
8. Gospel of Matthew, 27:51 (New King James Version)
9. Alex Fox *Superbolts of lightning strike*, Science, 9 sept 2019. https://www.science.org/content/article/world-s-strongest-lightning-hits-not-summer-november-february
10. Wenyuan Fan, et al, *Stormquakes*, Geophysical Research Letters, 14 October 2019. https://doi.org/10.1029/2019GL084217
11. Wakasa, Sachi A. et al, *Does lightning destroy rocks?: Results from a laboratory lightning experiment using an impulse high-current generator*, Geomorphology, Volume 161, p. 110-114. August 2012. DOI: 10.1016/j.ge'. phpomorph.2012.04.005

tomb, perhaps echoing the event described in the Book of Exodus 19:16: *'Then it came to pass on the third day, in the morning, that there were thunderings and lightnings, and a thick cloud on the mountain;'*. [12]

Conclusion

The hypothesis of Jean-Baptiste Rinaudo explains how neutron emissions produced by disintegration of deuterium nuclei could have affected the radiocarbon dating result and caused protons to emanate from the body to produce the image seen on the Shroud. However, with the density and efficiency of deuterium alone, this would have required a huge and destructive energy input.

This paper builds upon this hypothesis by showing how neutrons could have been produced much more efficiently through the interaction of high-energy gamma radiation with the body.

It identifies a possible source of such radiation to be large, violent thunderstorms, of a type which gospel accounts suggest may have accompanied the crucifixion of Jesus.

It also explains how the protons produced by the interaction of neutrons with nitrogen atoms in the skin of the body in the tomb could have created the remarkable image observed on the Shroud.

In particular, it explains how this phenomenon could account for the image's extraordinary characteristics, such as the high-resolution, realistic image of the body with encoded 3D information, which is the result of the strong electric field that accompanies lightning causing protons emanating from the skin surface to follow a vertical path, combined with the decrease in proton intensity as the distance increase between the skin and the fabric of the Shroud.

[12.] Book of Exodus, 19:16 (New King James Version)

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