



THE IMAGE OF THE TURIN SHROUD IS CODED IN THREE DIMENSIONS

A IMAGEM DO SUDÁRIO DE TURIM ESTÁ CODIFICADA EM TRÊS DIMENSÕES

Thierry Castexⁱ

ABSTRACT - This article examines the uniqueness of the image on the Turin Shroud, highlighting its physical and visual properties that defy conventional explanations. After recalling the debates on its authenticity and the contradictory dating results (radiocarbon vs. recent X-ray analyses), the study emphasizes three major features: the negativity of the image, its superficiality on linen fibrils, and above all its three-dimensional encoding.

Building on the pioneering work carried out with NASA's VP8 analyzer in 1976, and later through modern digital processing of Gian Carlo Durante's 2002 photographs, the author demonstrates that the luminous intensity of the Shroud's image is proportional to the cloth-to-body distance, enabling a relief reconstruction of the crucified body. The 3D treatments reveal previously unseen details, such as a dark halo around the face, the bent position of

the legs, and the blond-reddish hair. The study concludes that these properties exclude the hypothesis of a painting and suggest an imprinting process linked to a form of bodily radiation, still unexplained. The Shroud thus appears as a unique object at the intersection of science, history, and faith, and for many remains a witness to the Resurrection.

KEYWORDS – Turin Shroud; photographic negativity; three-dimensional image; 3D encoding; digital image processing.

RESUMO – Este artigo examina a singularidade da imagem no Sudário de Turim, destacando suas propriedades físicas e visuais que desafiam as explicações convencionais. Após relembrar os debates sobre sua autenticidade e os resultados contraditórios de datação (radiocarbono versus análises recentes de raios X), o estudo enfatiza três características



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principais: a negatividade da imagem, sua superficialidade nas fibras de linho e, sobretudo, sua codificação tridimensional.

Baseando-se no trabalho pioneiro realizado com o analisador VP8 da NASA em 1976 e, posteriormente, por meio do processamento digital moderno das fotografias de Gian Carlo Durante de 2002, o autor demonstra que a intensidade luminosa da imagem do Sudário é proporcional à distância entre o tecido e o corpo, possibilitando uma reconstrução em relevo do corpo crucificado. Os tratamentos 3D revelam detalhes antes invisíveis, como um halo escuro ao redor do rosto, a posição flexionada das

pernas e o cabelo loiro-avermelhado. O estudo conclui que essas propriedades excluem a hipótese de uma pintura e sugerem um processo de impressão ligado a uma forma de radiação corporal, ainda inexplicada. O Sudário surge, portanto, como um objeto único na intersecção entre ciência, história e fé, e para muitos permanece como testemunha da Ressurreição.

PALAVRAS-CHAVE – Sudário de Turim; negatividade fotográfica; imagem tridimensional; codificação 3D; processamento digital de imagens.

Presentation of the Turin Shroud and its mystery

The Turin Shroud is considered a mystery because of the many questions surrounding its origin, authenticity, and the way the image of a man appeared on it. This linen cloth, preserved in Turin since 1578, is believed to have wrapped the body of Christ after his crucifixion, and his image would have been imprinted on it in an unexplained manner. Several scientific analyses have attempted to determine its age and mode of formation. A carbon-14 dating carried out in 1988 suggested that it dated from the Middle Ages, between 1260 and 1390. However,

recent studies using X-rays have suggested that the shroud could be 2,000 years old, thus contradicting the results of the carbon-14 dating. The mystery of the Turin Shroud also lies in the nature of the image it bears.

Unlike a classical painting, the image seems to be a three-dimensional imprint, whose formation remains unexplained by known techniques. This debate between science, faith, and history makes the Turin Shroud one of the most studied relics in the world, but also one of the most fascinating and controversial.



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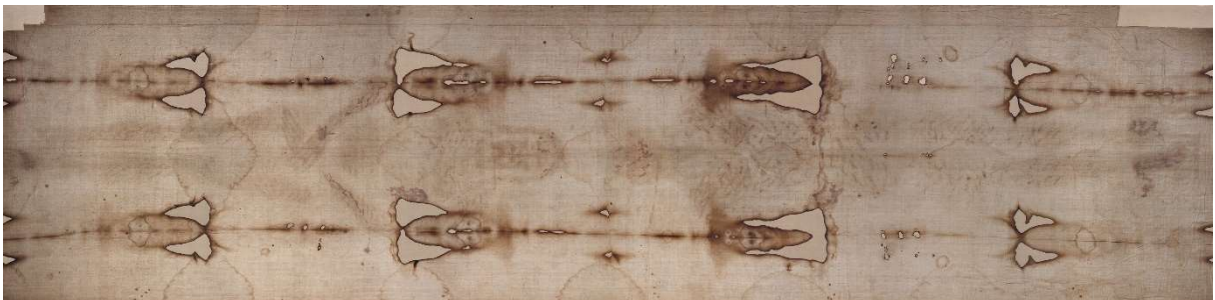
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FIGURE 1



3D Processing of the Photograph of the Holy Shroud

FIGURE 2



Turin Shroud in full dimensions : 4.42 m × 1.13 m – Photo G. Durante 2002



FIGURES 3/4



Front and Back Views of the Turin Shroud – Photo by G. Durante, 2002

First steps in studying the Turin Shroud

I really began to take an interest in the Turin Shroud thanks to a colleague and friend, Eric de Bazelaire, with whom I worked at the Jean Feger Scientific and Technical Center in Pau (France), for oil exploration.

One day in the year 2000, Eric, who was an international expert in

signal processing and professor at the University of Pau and the Adour Region, showed me an image of the Turin Shroud on his computer screen. “Do you see this image?” he said to me. “If we invert it, it becomes visible like a normal photograph; that means it has the properties of a photographic negative.” And he added: “It is not a painting, because there are no traces



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of pigments or dyes on the fabric.” “But then what is this image made of, where we see a body, front and back, that has been tortured and crucified?” I asked him. “That we do not yet know,” he replied. “But researchers from all over the world, called ‘sindonologists,’ are trying to analyze and understand where, when, and how the image was formed. It is a riddle for today.”

Since that time, I have continued to work on the imaging of the Holy Shroud, and more particularly on its 3D representation.

This extraordinary relic continues to astonish me, and it gradually reveals some of its hidden secrets. But let us be honest: we are still far from understanding its mechanism of formation.

Today, more than 30 specialties are interested in this relic, which is the most studied in the world. To name just a few: historians, theologians, doctors, surgeons, biologists, physicists, biophysicists, chemists, palynologists, papyrologists, archaeologists, numismatists, image processing specialists, photographers, specialists in textiles and ancient fabrics, etc.

We now know, thanks to the use of microscopes, that the image of the crucified man is carried by linen fibrils on a thickness of **0.2 microns**

(1 micron = one thousandth of a millimeter). This is extremely thin; we are dealing with a very superficial image.

This body image did not penetrate through the fabric; it remained on the side of the cloth that was in contact with the body. If this image had been painted, the paint would easily have penetrated the fabric, since its thickness is **0.34 mm**, and moreover it would have shown cracks over time.

Exploration of the three-dimensionality of the image

Three-dimensionality of an image refers to the ability to represent depth and relief, giving the impression that an object or scene has real volume rather than just a flat surface. In the case of the Turin Shroud, this property is particularly fascinating, because the image imprinted on it seems to contain depth information that allows the reconstruction of a body in three dimensions. The image of the Turin Shroud presents a luminous intensity that varies according to the supposed distance between the cloth and the body it wrapped.

In 1976, NASA researchers used an analyzer called VP8, designed to measure variations in brightness of certain planets and convert them into relief. Applied to the Shroud,

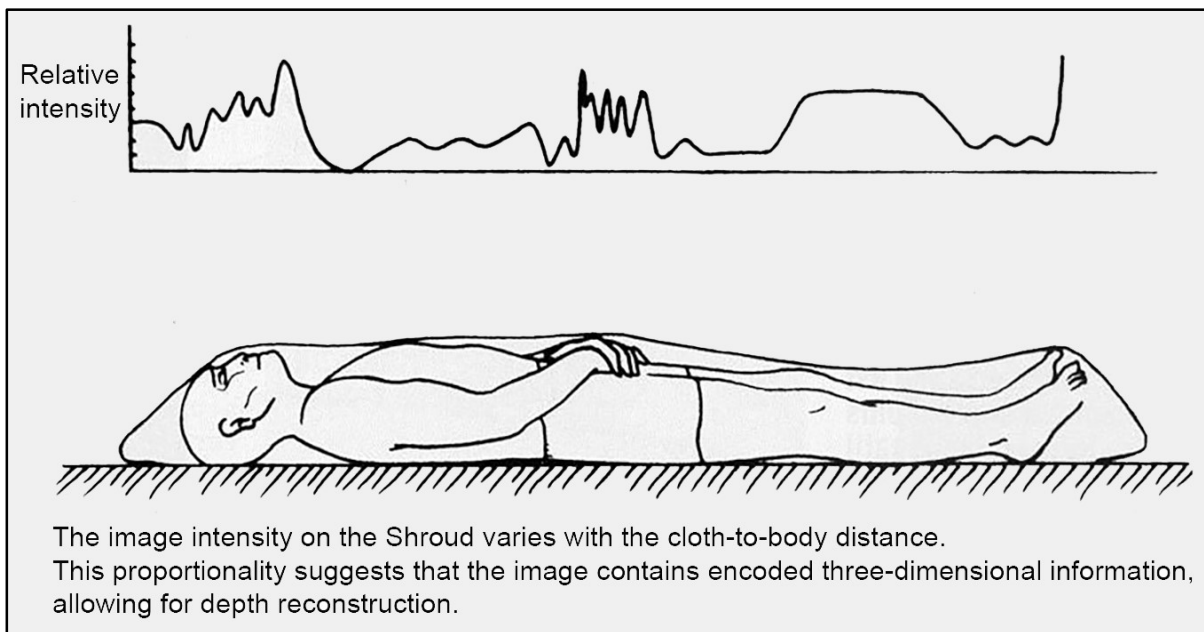


this analyzer revealed that the image was truly three-dimensional.

Unlike classical photographs or paintings, which use shadows and

contrasts to simulate depth, the image of the Shroud showed a real correspondence between luminous intensity and the body's topography.

FIGURE 5



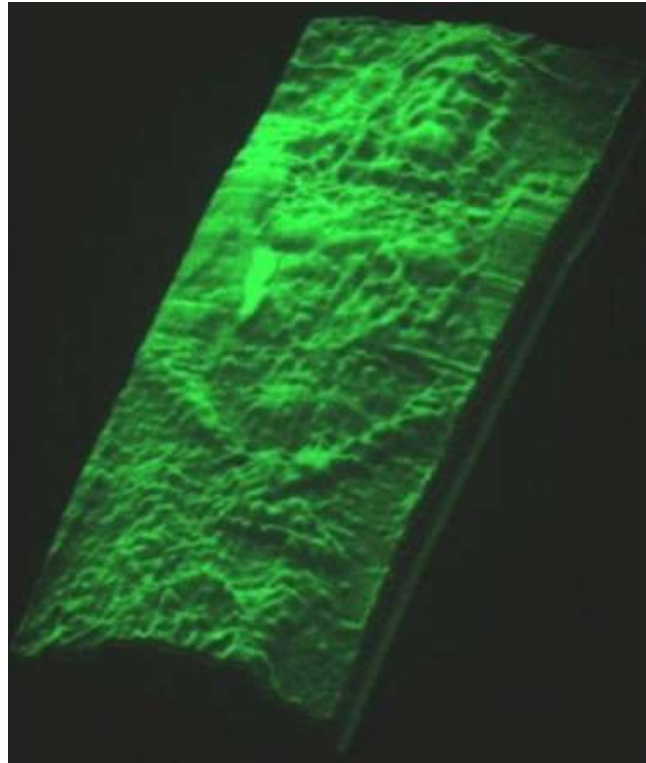
The way in which this three-dimensionality was coded in the image remains a subject of debate among researchers; it is intrinsically linked to the very process of image formation, which would result from radiation emitted by the body rather than a chemical reaction with bodily fluids. Even if the process of image formation is unknown, one can rule out the idea

of an image formed by an external light source projecting shadows all around the cloth to form relief.

When analyzed in 3D, the image reveals an anatomically perfect body shape, front and back, which is unusual for a simple impression on cloth, and even less possible with a bas-relief.



FIGURE 6



3D Image by NASA – VP8 Analyzer (1978)

From 2011 onwards, taking advantage of new color photographs by Gian Carlo Durante taken in 2002 after restoration of the Shroud, I was able to carry out image processing with 3D software from industry. But before converting the image into relief, it was necessary to apply pre-processing with filtering and equalization, to obtain a more homogeneous and less noisy image. From there, I was able to convert the pixels of the image into “heights,” and thus obtain a relief and color image.

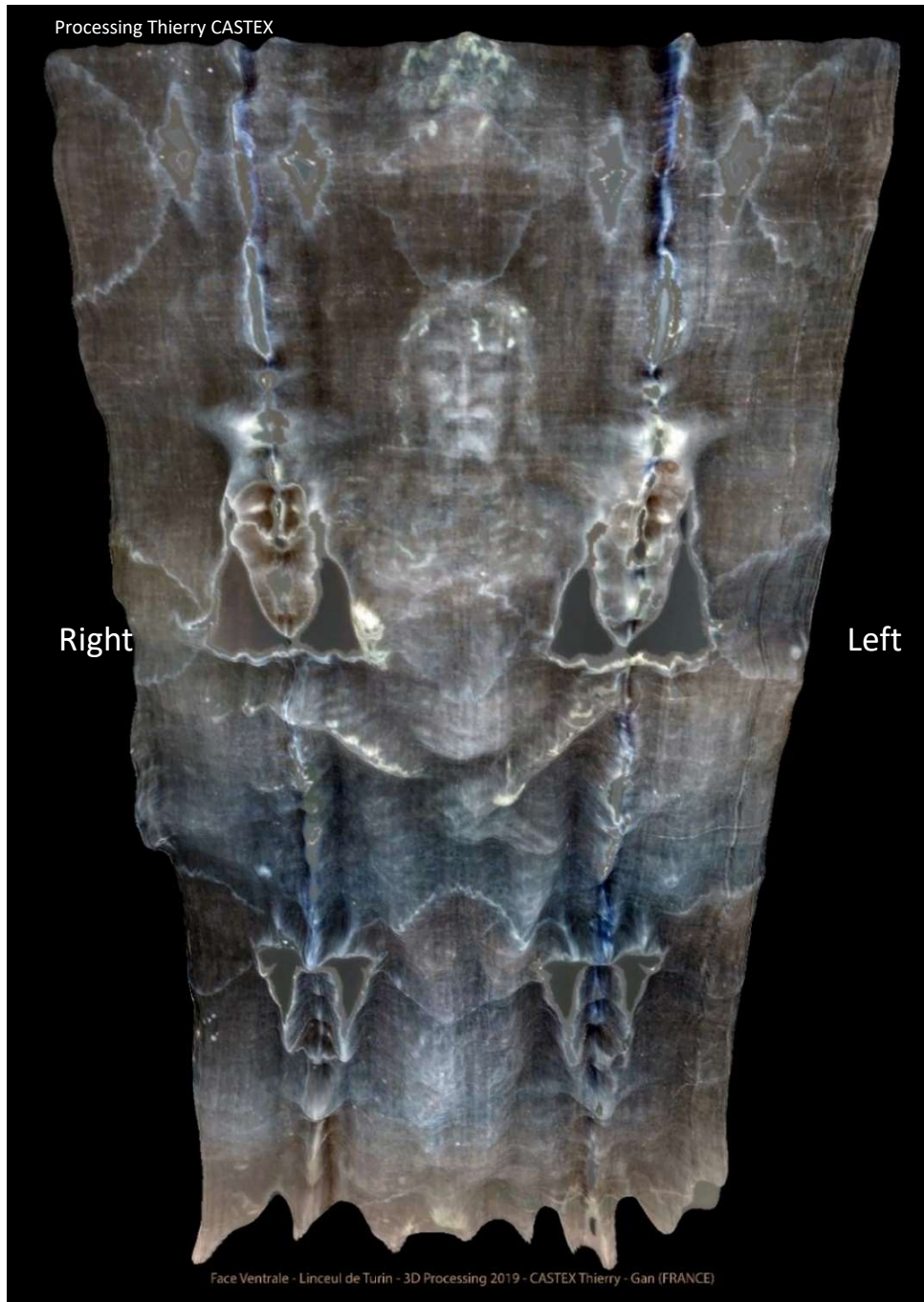
The results obtained made it possible to bring out information on the Turin Shroud that was not very visible until now. For example, the presence of a dark “halo” around the face, which was certainly created during the ostensions of the Holy Shroud in Edessa during the 5th century AD. A glass disk was placed in front of the face of the Shroud to avoid any pollution, and it left a circular trace around the face in the form of a nimbus. This dark nimbus on the negative was therefore very clear on the positive (or the original).



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FIGURE 7



Color 3D Processing of the Turin Shroud by Thierry Castex – Photo Durante 2002

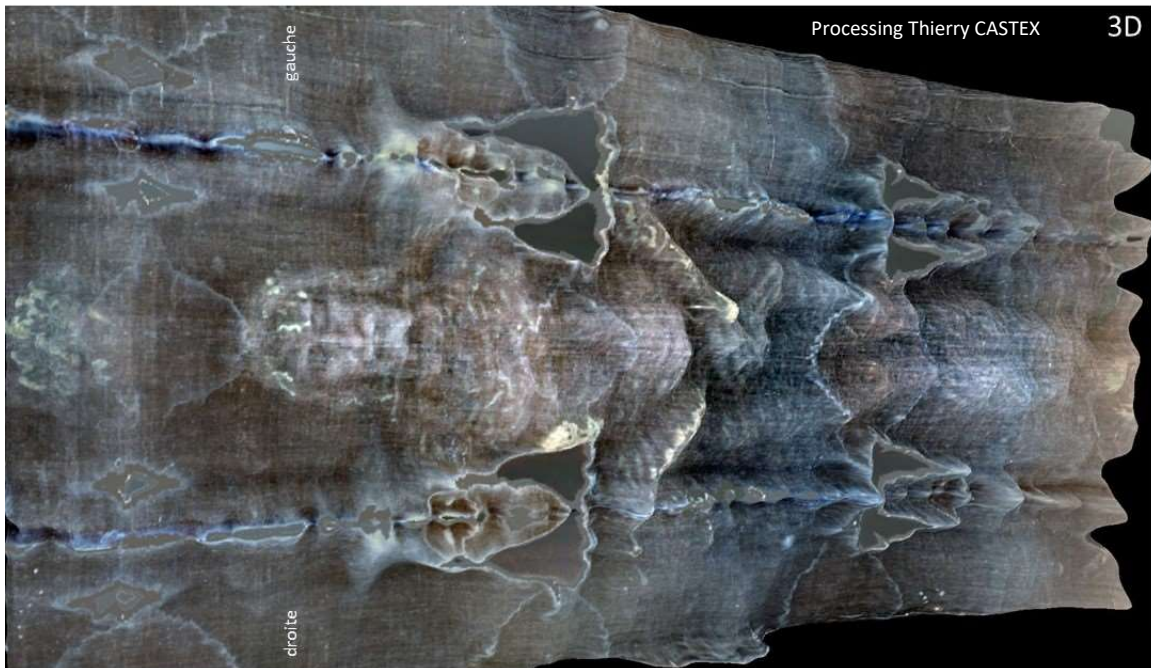


FIGURE 8



Dark Halo around the Face – 3D Processing – Photo Durante 2002

FIGURE 9



Body Position with Bent Legs – 3D Processing – Photo Durante 2002



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Another example: one can better distinguish the folding of the legs with the tips of the knees raised, as well as the belly with a rather swollen appearance.

Moreover, as suspected, these 3D images show for the first time that there is indeed three-dimensional information on the dorsal side, as on the ventral side.

We see thick braided hair of light chestnut, even blond-red color, whose colors are well separated from the rest of the image.

Are these colors perfectly reproduced? To be sure, spectrophotometric analyses would have to be carried out on the Shroud fabric in order to calibrate the colors obtained by photography. From an optical point of view, we know that to obtain a 3D or relief image, the wave surface emitted by the source must contain all the information on its amplitude and phase. This is the case with holography, but not with traditional photography, which loses the phase information contained in the emitted signal.

In the case of the VP8 camera, used by NASA for planetary topography, the technique used consists in reconstructing relief from the luminous intensity of distant stars, assimilated to objects located at infinity. Even if the phase has been lost, by using the law of conversion of distances, which tells us that the intensity of the pixels of the image is inversely proportional to the square of the distance, one can obtain a different “height” at each point of the image, and thus reconstruct relief.

While waiting to better understand the origin of this astonishing image, we can already state three main properties that characterize it:

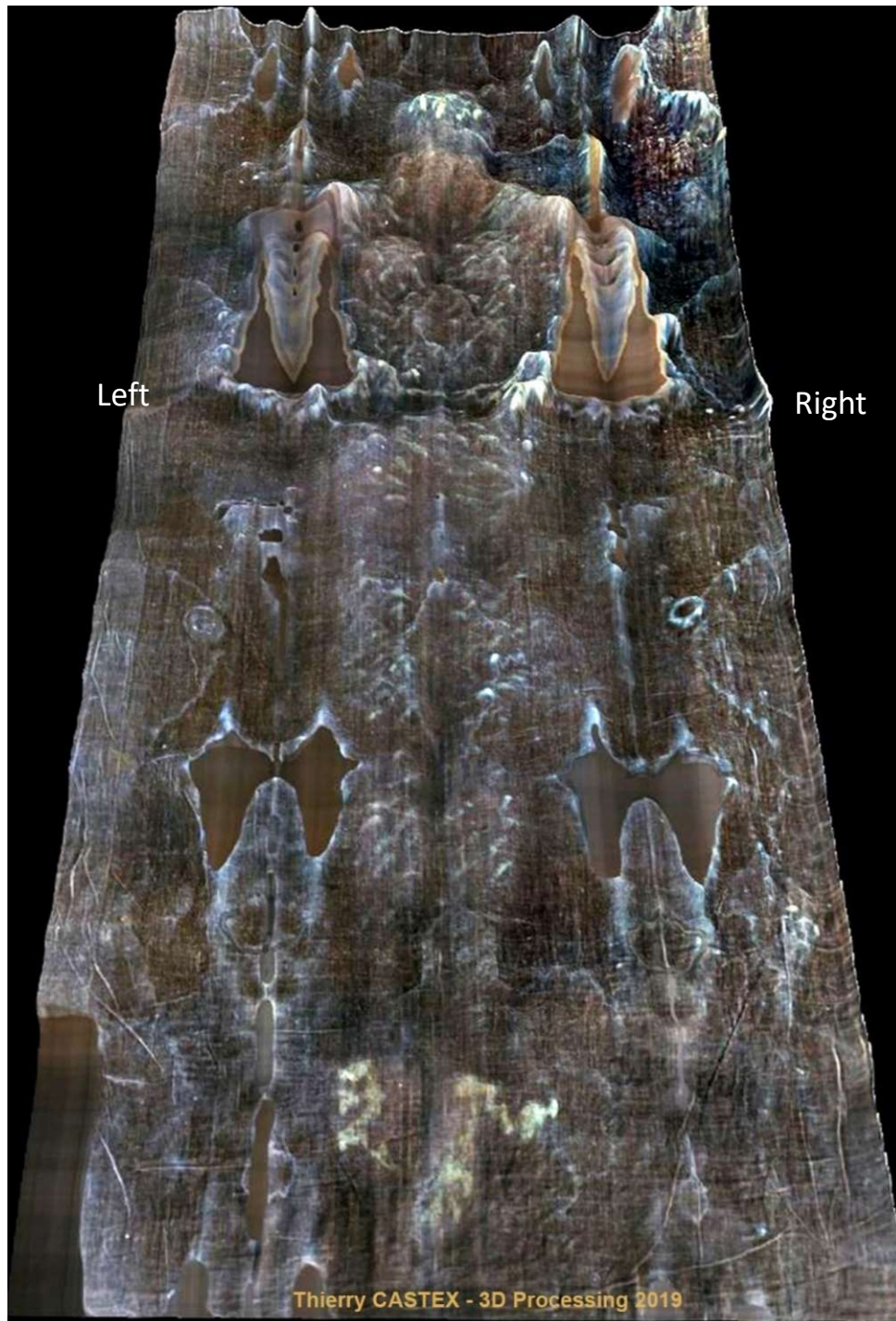
- its negativity (because it resembles a photographic negative)
- its three-dimensionality (because there is 3D coding)
- its inverted colorimetry (because colors appear when the image is inverted, going from positive to negative).



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FIGURE 10



3D Image of the Dorsal Side of the Turin Shroud – Processing by T. Castex



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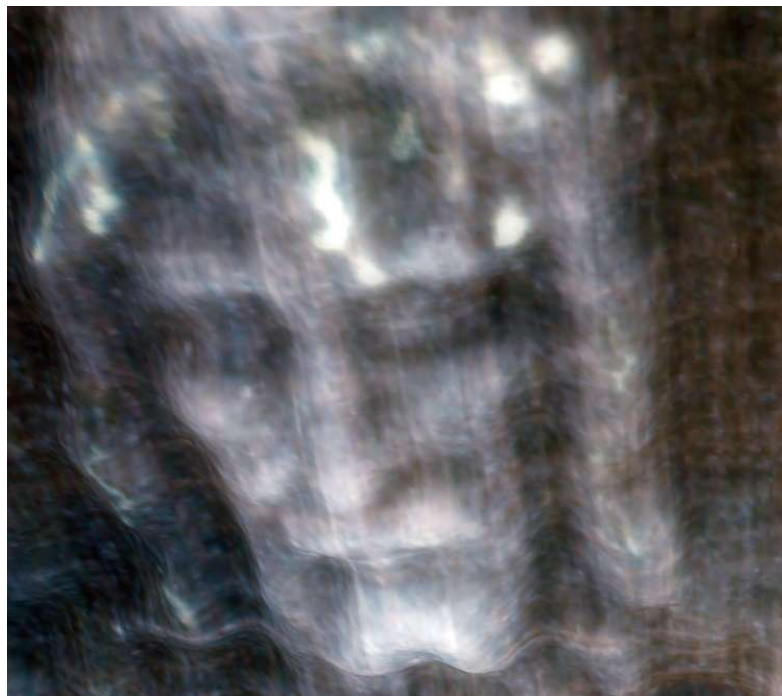
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FIGURE 11



View of the blond-red hair ending at the shoulder blades

FIGURE 12



3D Visualization of the Tilted Face – Processing by Thierry Castex



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A few words of conclusion

These three properties totally exclude the idea that this image is a painting, because it seems absolutely impossible to paint an image in negative, with such details, while inverting shades, shadows, and colors, and integrating three-dimensional coding.

Moreover, the paint would have penetrated the thin fabric (0.34 mm thick), and would have left traces of pigments, which do not exist on the cloth.

With all the technical means we have today, we would not even be able to reproduce it. This image remains a mystery.

Most scientists who study the Turin Shroud think that the image was made by radiation coming from the body, but without knowing its true nature.

As many believe, the image imprinted on the Shroud would therefore be a Witness of the Resurrection of Christ...





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