

## My thoughts on a recently published paper by Raymond N. Rogers

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July 9, 2014

I would like to express some thoughts about the « new » paper of Rogers that was recently published on the website Shroud.com, which is entitled “An Alternate Hypothesis for the Image Color”<sup>1</sup>. This article was written by Rogers in 2001 but was never published anywhere before.

### Here’s my principal thoughts about this article:

**1-** On the contrary to many Shroud researchers who have proposed in recent years their image formation “theories” (mostly supernatural hypotheses related to the Resurrection of Jesus that involve some form of energetic radiation), this “new” paper of Rogers clearly shows that this great scientist had no preconceived ideas about what would have been the main reactive agent (his words: “catalytic compound”) that initiated the formation of the image on the cloth. Effectively, this paper clearly shows that, when he wrote it in 2001, Rogers had not found out yet the Maillard reaction hypothesis (including the idea that some post-mortem gases were the main catalytic compounds) he would propose later on<sup>2</sup> and he was, for the moment, favoring the presence of skin perspiration (sweat) and/or skin secretions, including skin oils (which are biological substances that were tested by Samuel Pellicori of STURP<sup>3</sup>), as the most probable catalytic compounds which could have initiated, with the help of heat released by the dead body, a caramelization process of a portion of the top-most fibers on the top surface of the cloth<sup>4</sup>. This shows how science should work (i.e. always keep following *all* the pertinent data and observations in order to develop a rational hypothesis and adjust it along the way as necessary) and also how science should not work (i.e. never start with a preconceived notion of what must have been the cause of a phenomenon, in this case, the formation of the body image on the Shroud), in order to avoid the strong temptation of considering only the data and observations that can possibly “fit” with your preconceived idea, while leaving aside all the other data and observations that can be truly problematic to your hypothesis. Unfortunately, in the Shroud world, I’ve seen many researchers (including many “scientists” searching to build up a “theory” to explain the image formation, as well as many “historians” searching to build up a “theory” to explain the ancient history for the Shroud) falling right into that trap over the years and this is another reason why sindonology is seen by a good portion of the scientific community as a sick joke.

**2-** After the reading of Rogers’ “new” paper, it’s quite evident that the impurity hypothesis he proposed for the question of the image chromophore was the corner stone and also the starting point<sup>5</sup> of his whole hypothesis for

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<sup>1</sup> Here’s the link to read Rogers paper (online July 15<sup>th</sup>, 2013): <http://www.shroud.com/pdfs/rogers10.pdf>.

<sup>2</sup> The first paper in which Rogers introduced the hypothesis of a Maillard reaction that would have been initiated by post-mortem gases released by the corpse of the Shroud man before the appearance of the first liquids of putrefaction can be found in this particular article that was written by him in 2002, in collaboration with another author: Raymond N. Rogers and Anna Arnoldi, *Scientific method applied to the Shroud of Turin - A Review*, 2002 (<http://www.shroud.com/pdfs/rogers2.pdf>).

<sup>3</sup> Samuel F. Pellicori of STURP was able to prove with a coloration study that some natural substances like skin perspiration (sweat) containing skin oils or some ancient Palestinian burial products like olive oil or myrrh could gradually color a linen cloth with spectral properties that are very similar to what is seen in the body image area on the Shroud. This study was described by Pellicori in these two different papers he published at the beginning of the 1980s: Samuel F. Pellicori, *Spectral Properties of the Shroud of Turin*, Applied Optics 19, June 15 1980, and Samuel F. Pellicori and Mark S. Evans, *The Shroud of Turin Through the Microscope*, Archaeology 34, 35, January-February 1981.

<sup>4</sup> In his book “A Chemist’s Perspective on the Shroud of Turin, Rogers indicated that it is truly possible that a concentration of impurities was present on both sides of the Shroud after its manufacture.

<sup>5</sup> It’s very interesting to note that when he wrote his “new” paper in 2001, Rogers was still unable to prove the real presence of some carbohydrate impurities on the Shroud. Here’s what he wrote about this: “We (the STURP team) expected to find starch on the Shroud, so

image formation<sup>6</sup> and that was still the case when he proposed his Maillard reaction later on<sup>7</sup>, which proves the solidity of this particular hypothesis (at least, in Rogers' mind). For him, the presence of a thin and uneven layer of carbohydrate impurities<sup>8</sup> on the top surface of the cloth was the most probable explanation for two of the most

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we did not specifically look for it." And in the next paragraph, he wrote this: "The color should have suggested some polysaccharide impurities to us. We (the STURP team) should have tested for starch and other polysaccharides." (parentheses added) This clearly indicates that the detection of starch residues that could have been left on the Shroud during the manufacturing of this linen cloth was not included in the test plan used by the STURP team to analyze the Shroud. This is probably due to the fact that STURP's main objective was to verify the validity of the claim that the Shroud was a medieval painting (which was eventually rejected totally by STURP) and the presence or absence of starch deposits in the non-image area had nothing to do with this. And the fact that in the same part of his article, Rogers talked about new chemical analyses that could be done to verify the presence or absence of starch on the Shroud clearly showed that, back in 2001, Rogers had not performed any new chemical tests on his old STURP samples in order to verify his thought concerning the probable presence of carbohydrate impurities on the Shroud's surface (particularly starch but also saponaria residues that could have been left on the Shroud by the final washing of the cloth). So it was just a theoretical supposition at that moment in time, even though the presence of such impurities on the cloth (especially starch) was strongly suggested by a well-known method used to manufacture linen cloths in antiquity that certainly had the potential to leave some starch, saponaria and other impurities on the cloth's surface, supported by a claim made by Walter McCrone soon after the STURP team examination of the Shroud in 1978, who stated that he was able to detect some deposits of wheat starch on the STURP sample he analyzed through his microscope. And in fact, this was so probable in Rogers' mind that he was confident enough to write this article in 2001 in order to propose a brand new hypothesis for image formation that was totally based on the coloration of this kind of impurity layer on the top surface of the cloth. Note that the fact that there was still no confirmation of the presence of such impurities on the Shroud is possibly the reason why Rogers never published this particular paper in 2001. However, what is truly interesting to note is the fact that, one year later, after he had done some new chemical tests on his STURP samples, Rogers was able to scientifically confirm the presence of some starch residues on his old Shroud samples, which supported the validity of his impurity hypothesis (which was only theoretic until then) and became one of the most important parts of the new version of his image formation hypothesis he built that same year, which involved a Maillard reaction (instead of a caramelization) that would have colored these impurities through a release of post-mortem gases by the corpse of the Shroud man (instead of coming from perspiration and/or secretions that would have been present on his skin and hair - see note 2). Here's what he wrote in 2002 in a paper entitled "Scientific method applied to the Shroud of Turin - A Review" about his finding of starch deposits: "Microchemical spot tests with aqueous iodine indicated the presence of some starch fractions on Shroud fibers." And here's what we can read in his book concerning the same topic: "Microchemical spot tests with aqueous iodine indicated the presence of some starch fractions. A search for carbohydrate impurities on the Shroud confirmed McCrone's detection of some starch fractions. Starch and low-molecular weight carbohydrates from crude starch would color much more easily than would cellulose as a result of either thermal dehydration or chemical reactions." Finally, it should be noted that, on the contrary to the presence of starch on the Shroud, Rogers was not able to confirm the presence of saponaria residues on the Shroud, even though he truly expected it and performed some specific chemical tests to detect it. Here's what he wrote about that in the book he wrote about the Shroud (see note 7): "I could not prove the presence of pentose sugars on the Shroud, so I could not prove that the cloth had been washed with *S. Officinalis*. Only the fluorescence evidence remains to suggest the use of struthium (*S. Officinalis*)." This statement means that, even though he wasn't able to scientifically confirm the presence of saponaria impurities on the Shroud, Rogers was still thinking that such impurities could really be present on the cloth and could possibly be found in the future through other kind of tests. And in the end, it's important to understand that even if the possible presence of saponaria should be completely discarded one day, this could not be used alone to completely discredit Rogers' hypothesis concerning the image formation on the Shroud, mainly because of the starch deposits that he found in his Shroud samples and also because of the presence of pectin deposits found in 1998 by Alan D. Adler on his Shroud samples, which are two different carbohydrate impurities that could very well have been concentrated on the top surface of the cloth and colored during the image formation process in order to form the body image we can see on the Shroud.

<sup>6</sup> For a good summary of the hypothesis developed by Rogers concerning the most probable chromophore for the Shroud image, see: Yannick Clément, *Raymond N. Rogers' Observations and Conclusions Concerning the Body Image that is Visible on the Shroud of Turin*, 2013 (<http://shroudnm.com/docs/2013-01-10-Yannick-Clément-Reflections-on-Ray-Rogers-Shroud-Work.pdf>).

<sup>7</sup> For a good summary of the Maillard reaction hypothesis of Rogers, see: Raymond N. Rogers, *A Chemist's Perspective on the Shroud of Turin*, Barrie Schwartz Editor and Publisher, July 2008 (<http://www.lulu.com/shop/raymond-n-rogers/a-chemists-perspective-on-the-shroud-of-turin/ebook/product-17416203.html>).

<sup>8</sup> In Rogers' thinking, this impurity layer was made primarily of starch and possibly also of saponaria residues, along with maybe some substances that were extracted from the primary cell wall of the fibers during the retting process of the flax plant, which was already used in ancient times to loosen the fibers from the stalk in order to produce threads for weaving.

“mysterious” characteristics of the image, i.e. the discontinuous distribution of the yellowed fibers in the image area<sup>9</sup> and the very superficial aspect of the image<sup>10</sup>, which affected only the top-most fibers on the surface of the cloth. So far, I can say that I’ve never read a better, simpler and more rational hypothesis for the image chromophore than this hypothesis proposed by Rogers and defended by himself until his death in 2005. In fact, I can honestly say that I’ve never read another hypothesis for the image chromophore (not even the primary cell wall hypothesis proposed by Fanti and al. in 2010<sup>11</sup>) that convinced me that it could really offer the same kind of simple and rational explanation for the discontinuous and very superficial aspect of the image at fiber level.

**3-** In this paper, we can find a very important description of an evaporation-concentration experiment made by Rogers, which clearly shows that such a natural process, when it happens inside a cloth, normally produces an uneven layer of impurities on the top-most fibers of the cloth, which is the main reason why Rogers thought that this kind of impurity layer was the best explanation for the discontinuous distribution of colored fibers in the image area, as well as for the extremely superficial aspect of the image at fiber level. This particular evaporation-concentration experiment was made by Rogers with a cotton nap and a dye solution and here’s how he described the result in page 4 of his “new” paper:

“The photomicrograph shows that the main concentration of dye on the top surface appears on the fibrils of the nap that are pointing straight up and on the top-most surfaces of the threads.”<sup>12</sup>

On the basis of this result obtained by Rogers, we can presume that, after the active phase of the image formation process that happened on the Shroud (which was most probably very mild<sup>13</sup>), only a portion of the coated fibers located on the top surface of the cloth (i.e. the ones that were coated by a thicker layer of impurities) were able to get colored enough to help producing the body image that we see on the Shroud, because the amount of impurities, in their case, would have been sufficient to produce such a result. This kind of uneven result obtained by Rogers after his evaporation-concentration experiment is so important, in my mind, that it can be used to completely discredit one of the main “anti-impurity” argument that we can find in the 2010 paper entitled “Microscopic and Macroscopic Characteristics of the Shroud of Turin Image Superficiality” that was written by Fanti, Di Lazzaro, Heimbürger and some others<sup>14</sup>. Effectively, in this paper, the authors, who tried to push their primary cell wall hypothesis as the most probable image chromophore, clearly wrote that Rogers’ hypothesis versus the impurities was unable to explain the

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<sup>9</sup> This discontinuous aspect of the body image can be described like this: For a particular thread located in the image area on the Shroud, there are some colored fibers that are immediately adjacent to non-colored fibers. That means that in every part of the body image (whether it be a very dark area like the nose or a much lighter area), there are some fibers (more in the lighter area) that have not been colored by the image formation process (this means the color of those fibers stayed the same as those located in the non-image area), while some adjacent fibers were affected enough by the image formation process to become colored (yellowed). This particularity of the Shroud body image strongly suggests that its formation was caused by a very mild and natural process instead of a phenomenon involving energetic radiation.

<sup>10</sup> In his book about the Shroud, Rogers said this about the very high superficiality of the body image: “The thickness of the image color must be less than a sodium-D wavelength (589 nanometers).” See note 7 for the reference of this book.

<sup>11</sup> Giulio Fanti, José A. Botela, Paolo Di Lazzaro, Thibault Heimbürger, Ray Schneider and Neils Svensson, *Microscopic and Macroscopic Characteristics of the Shroud of Turin Image Superficiality*, Journal of Imaging Science and Technology, 54, 2010.

<sup>12</sup> In his book “A Chemist’s Perspective on the Shroud of Turin”, Rogers discusses the uneven results he obtained after some more evaporation-concentration experiments in these terms: “Different types of cloth will show different degrees of concentration of the dye on the evaporating surfaces, even on different adjoining fibers.” Such uneven results can be seen as a strong indicator that if there really is an impurity layer on the surface of the Shroud, it should be uneven, thus offering a very good, simple and rational explanation for the discontinuous distribution of colored fibers in the image area.

<sup>13</sup> On this subject, see quotes 20, 74 and 95 in my paper entitled “Raymond N. Rogers’ Observations and Conclusions Concerning the Body Image that is Visible on the Shroud of Turin” (<http://shroudnm.com/docs/2013-01-10-Yannick-Clément-Reflections-on-Ray-Rogers-Shroud-Work.pdf>).

<sup>14</sup> See note 11.

discontinuous distribution of the body image on the Shroud<sup>15</sup>. Now, I think that this “new” paper of Rogers can offer them a pretty good reason to completely rethink their conclusion versus his “impurity” hypothesis, which really seems to offer the most rational explanation for the chromophore of the body image. One thing’s for sure: In the light of what we found in this recently released paper of Rogers, it’s fair to say that such an “anti-impurity” argument, which involves the discontinuous aspect of the image fibers, is completely false. And, to be honest, I found it quite funny that they dared to use this kind of argument in an attempt to discredit Rogers’ hypothesis, while, at first sight, this discontinuity of the colored fibers really seems much more problematic for their own chromophore hypothesis<sup>16</sup>. Effectively, it is a well-known fact that the primary cell wall is always found in every normal linen fiber and always in the same degree of thickness<sup>17</sup>, no matter its location inside the cloth, whether it be on its top surface or deeper inside of it. It should be noted that, for the same reason, such a hypothesis for the image chromophore also seem to be, at first sight, unable to rationally explain the extremely superficial aspect of the Shroud’s body image at fiber level, except when some supernatural concepts are introduced, which are, by definition, totally unscientific.

**4-** It’s also important to note that because it is a proven fact that a dehydration of ONLY a thin layer of carbohydrate impurities located around a linen fiber is almost impossible to achieve with any sort of energetic radiation<sup>18</sup>, and because all the data coming from the Shroud (especially the fact that the bloodstains were not affected at all during the image formation) strongly suggests that the image formation was very mild, I’m almost sure that this is why Rogers became convinced that a totally natural process (which he was still searching to fully determine at the time of his death) was really what have caused the formation of a very faint image on the cloth. In sum, the strong conviction of Rogers that the body image color must only reside in a thin and uneven layer of carbohydrate impurities, which would be completely independent from the entire structure of the linen fiber (including the primary cell wall of the fiber) is the most important thing that led him to conclude that the image formation process was most certainly totally natural. I think it’s fair to say that, in Rogers’ thinking, the most probable nature of the image chromophore (i.e. an impurity layer) was truly most convincing to him that the particular nature of the image formation process was most probably completely natural and very mild, instead of being pretty strong because it would have involved the emission

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<sup>15</sup> Here’s what we can read on page 6 of Fanti, et al. paper: “For example Rogers proposed an image formation mechanism involving diffusion... In fact if a reactive gas were able to penetrate among the fibers of a thread to color all the circumference of a fiber, it would also color the adjacent fibers.” It should be noted that the real uneven results obtained by Rogers with his evaporation-concentration tests are in total contradiction with such a conclusion (see note 12).

<sup>16</sup> This is particularly true in the case of a coloration that would have been produced by the energetic radiations they proposed (i.e. a burst of UV light or a corona discharge). Effectively, two Italian researchers, Fazio and Mandaglio, after having analyzed the most important characteristics of the Shroud image and particularly the discontinuous distribution of the colored fibers in the image area, have concluded that if the coloration had really affected the structure of the linen fiber itself (which they think), the only phenomenon that can produce such an image are natural processes that are much milder than any sort of energetic radiation that exists, such as a low-temperature chemical process like the Maillard reaction proposed by Rogers and/or a thermal radiation released by the dead body of the Shroud man. Here’s the two most important papers they published on the subject: Giovanni Fazio and Giuseppe Mandaglio, *Stochastic distribution of the fibrils that yielded the Shroud of Turin body image*, Radiation Effects and Defects in Solids, Vol. 166, No. 7, July 2011 (<http://www.tandfonline.com/doi/abs/10.1080/10420150.2011.566877>). Giovanni Fazio and Giuseppe Mandaglio, *Can a latent image explain the characteristics of the Shroud body image?*, Radiation Effects and Defects in Solids, Vol. 167, No. 3, March 2012 (<http://www.tandfonline.com/doi/full/10.1080/10420150.2011.595413#.UjYuQRS1apo>). Finally, you can also read another paper written by Fazio alone on the same topic: Giovanni Fazio, *A Stochastic Process to Explain the Turin Shroud Body Image Formation*, Journal of Modern Mathematics Frontier, Volume 2 Issue 3, September 2013 (<http://www.simmf.org/Download.aspx?ID=7362>).

<sup>17</sup> In their 2010 paper, Fanti et al. report that the average depth of the primary cell wall is about 200 nanometers and there is no indication that this degree of thickness (which is very thin) should be normally different for a linen fiber, whether it is located on the top surface of a cloth or deeper into it.

<sup>18</sup> Here’s the most relevant statement made by Rogers on this subject: “I studied the chemical kinetics of the impurity materials and concluded that it was improbable that the impurities had been scorched by heat or any radiation source: the crystal structure of the flax image fibers was no more defective than non-image fibers. It would take very good temperature control specifically to scorch impurities without producing some defects in the cellulose.” We can find this particular quote in this paper, pg. 30: Emmanuel M. Carreira, *The Shroud of Turin from the viewpoint of the physical science*, 2010 (<http://www.shroud.com/pdfs/carreira.pdf>).

of some form of energetic radiation at the time of Jesus's Resurrection or some time before the happening of this supernatural event<sup>19</sup>.

5- Rogers' paper really shows that, in order to find a viable hypothesis for the body image, he first tried hard to find a rational explanation for the discontinuous and the very superficial aspect of the body image at fiber level, which he finally found in the probable presence of a thin and uneven layer of carbohydrate impurities located mostly over the top-most fibers on the surface of the cloth. Then (**and only then**), he tried hard to find, in the context of the Shroud man's burial, what would have been the most logical catalytic compound(s) that could have interacted with this probable layer of impurities in order to dehydrate them enough to produce a visible coloration, while, at the same time, he also tried hard to find what would have been the most logical transfer mode(s) between these catalytic compounds and the thin layer of impurities, especially in the light of the three dimensional characteristics that are imbedded in the body image<sup>20</sup>. It's very interesting to note that this paper proves that Rogers changed his mind about the question of the most probable catalytic compounds along the way (but without changing his mind about the most probable image chromophore and the fact that the transfer mode should have included a diffusion process), most probably because he ended up finding some irreconcilable problems between his first hypothesis (skin perspiration and/or skin secretions, first proposed by Pellicori of STURP) and some data and observations coming from his intensive study<sup>21</sup>, along with the fact that he eventually found out that a fresh tortured corpse could release some post-mortem gases (ammonia gas and some heavy amines) before the appearance of the first liquid of putrefaction<sup>22</sup>, thus offering him a viable alternative hypothesis for the catalytic compounds issue. It's crucial to note that these steps followed by Rogers in that precise order during his research were the **right steps** any good scientist should follow in the case of the Shroud image, which can be summarized like this: First try to explain and define the image chromophore in the light of all the data and observations available (especially the discontinuous and very superficial aspect of the image at fiber level) and then (and only then) try to find, in the context of an enshrouded corpse that recently died from various tortures and a Roman crucifixion, what could have been the most logical reactive agent(s) that could have interacted with it in order to produce an image with the same chemical and physical characteristics as

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<sup>19</sup> In a paper written in 2010, the Italian researcher Giovanna de Liso proposed a hypothesis to explain the image formation on the Shroud involving an electrostatic discharge that would have been emitted by a hypothetical earthquake that would have occurred during the time in which the dead body of Jesus would have been present inside the Shroud. De Liso proposed that such a natural electrostatic discharge would have passed through the corpse of Jesus to produce the body images (ventral and dorsal) that we see on the cloth. Here's the reference for this paper: Giovanna de Liso, *Shroud-like experimental image formation during seismic activity*, Proceedings of the International Workshop on the Scientific approach to the Acheiropietos Images, ENEA Frascati, Italy, 4-6 May 2010 (<http://www.acheiropietos.info/proceedings/DeLisoWeb.pdf>).

<sup>20</sup> This particular aspect of the Shroud image has been analyzed in depth by the STURP team and the results of this study can be found in these two papers: John P. Jackson, Eric J. Jumper and William R. Ercoline, *Three Dimensional Characteristic of the Shroud Image*, IEEE 1982 Proceedings of the International Conference on Cybernetics and Society, Washington D.C., USA, October 1982, and John P. Jackson, Eric J. Jumper and William R. Ercoline, *Examination of the Turin Shroud for Image Distortions*, IEEE 1982 Proceedings of the International Conference on Cybernetics and Society, Washington D.C., USA, October 1982.

<sup>21</sup> The most relevant data that could have forced Rogers to change his mind on the question of the catalytic compound can probably be found in quotes 8 and 9 of my paper entitled "Raymond N. Rogers' Observations and Conclusions Concerning the Body Image that is Visible on the Shroud of Turin" (<http://shroudnm.com/docs/2013-01-10-Yannick-Clément-Reflections-on-Ray-Rogers-Shroud-Work.pdf>).

<sup>22</sup> It remains to be seen if the highly tortured state of the Shroud man's body just before his death could have produced a faster and/or heavier release of these post-mortem gases, including heavy amines like putrescine and cadaverine. This is a possibility that, to my knowledge, has not been properly investigated so far. For more information about this hypothesis of Rogers concerning a release of post-mortem gases by the corpse that would have been the principal catalytic compounds that eventually caused a coloring chemical reaction on the top surface of the cloth, see: Raymond N. Rogers, *A Chemist's Perspective on the Shroud of Turin*, Barrie Schwartz Editor and Publisher, July 2008 (<http://www.lulu.com/shop/raymond-n-rogers/a-chemists-perspective-on-the-shroud-of-turin/ebook/product-17416203.html>). Note: in his book, Rogers cites a study by Arpad A. Vass et al., indicating that the appearance of the first liquids of putrefaction usually comes between 36 to 72 hours after death, depending on many factors. It should be noted that on the Shroud, there is absolutely no signs that such liquids ever stained the cloth, which indicates quite clearly that the dead body of the Shroud must have left the cloth before this phase of the putrefaction process.

the one on the Shroud, while also trying to find the most probable interaction mechanism(s) that can produce a body image with some three dimensional characteristics and a very precise image resolution.

Unfortunately for the credibility of Shroud science, this is not what often happened in the Shroud world, where many “scientists” often proposed image formation hypotheses (mostly supernatural in essence and related to the resurrection of Jesus) without trying first to define the image chromophore by taking into account, among other things, the discontinuous and very superficial aspect of the image at the fiber level. To me, it’s like a magical thinking that can be summarized like this:

“We don’t know how the burst of energetic radiation we proposed (whether it be a corona discharge, a burst of UV light, a burst of protons and/or neutrons, etc.) could have produced an image with these very particular characteristics but that’s not a problem, because our hypothesis is related directly to the resurrection, which is, in essence, a supernatural event that we can’t define and test in a lab. Because of that, it is totally conceivable (at least for those who believe in the resurrection of Jesus) that such a supernatural event could have caused that kind of “mysterious” image on the cloth, which shows a discontinuous and extremely superficial aspect at fiber level. At first sight, it is totally illogical that the burst of energetic radiation that we proposed could have caused the very same kind of discontinuous and highly superficial image everywhere on the cloth (no matter if the Shroud was in direct contact or if it was located at a few centimeters away from the corpse and no matter if the cloth was located over or under it), but since the formation of this “mysterious” image is directly related to the resurrection of Jesus... Anything is possible!”

This is exactly the kind of magical thinking that lies quietly under most of the supernatural hypotheses that have been proposed over the years. Of course, those who proposed them will never say it publicly as clearly as I have done, but nevertheless, this is the kind of thinking on which the supernatural hypotheses they proposed are resting and that’s precisely why those supernatural scenarios should be considered unscientific. Note: Even if he didn’t specifically say the same thing as I just wrote concerning the magical thinking that pollutes the Shroud world (including Shroud science) these days, we can still find a glimpse of that kind of magical thinking in a public statement made in 2010 by Paolo Di Lazzaro concerning his supernatural hypothesis for image formation involving a burst of UV light from the body at the time of Jesus’ resurrection<sup>23</sup>, when he said this in an interview:

“Though significant, our results allow the recognition of a photo-chemical process capable of generating a Shroud-like coloration, but still do not make it possible to formulate a certain and practicable hypothesis on how the Shroud image was formed: for example, if we consider the density of radiation that we used to color a single square centimeter of linen, to reproduce the entire image of the Shroud with a single flash of light would require fourteen thousand lasers firing simultaneously each on a different area of linen. In other words, it would take a laser light source the size of an entire building.”<sup>24</sup>

Here, it should be noted that in this statement, Di Lazzaro doesn’t even address the question of how in the world a single burst of UV light as he proposed could succeed to reproduce the discontinuous and highly superficial aspect of the Shroud image at fiber level (which is the same for the ventral and dorsal image) no matter if the source of energy (i.e. the dead body of Jesus at the moment of his resurrection) was located in direct contact with the cloth or at some

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<sup>23</sup> You can find a good summary of Di Lazzaro’s hypothesis in these two papers: Paolo Di Lazzaro, Giuseppe Baldacchini, Giulio Fanti, Daniele Murra, Enrico Nichelatti and Antonino Santoni, *A Physical Hypothesis on the Origin of the Body Image Embedded into the Turin Shroud*, Proceedings of the International Conference “The Shroud of Turin: Perspectives on a Multifaceted Enigma”, Columbus, Ohio, 14-17 August 2008 (<http://www.ohioshroudconference.com/papers/p01.pdf>). Paolo Di Lazzaro, Daniele Murra, Antonino Santoni and Giuseppe Baldacchini, *Sub-micrometer coloration depth of linens by vacuum ultraviolet radiation*, Proceedings of the International Workshop on the Scientific approach to the Acheiropietos Images, ENEA Frascati, Italy, 4-6 May 2010 (<http://www.acheiropietos.info/proceedings/DiLazzaroWeb.pdf>).

<sup>24</sup> You can find the complete article in which we find this statement of Di Lazzaro here: [http://www.30giorni.it/articoli\\_id\\_22597\\_I3.htm](http://www.30giorni.it/articoli_id_22597_I3.htm).

distance from it (up to maybe 3.7 centimeters<sup>25</sup>), while at the same time, avoiding to produce a visible coloration in areas located at more than 3.7 centimeters from the same source of energy? This is an excellent example of the “magical thinking” I described earlier. Effectively, in the case of Di Lazzaro’s hypothesis (as well as in the case of most if not all the other supernatural hypotheses), it’s only by thinking that the resurrection of Jesus could have produced such a feat that his whole proposal can still stand-up because this kind of image formation hypothesis is scientifically impossible! On the contrary to such magical thinking, Rogers’ hypothesis versus the catalytic compounds and the way it was transferred to the cloth is totally compatible, theoretically speaking, with his hypothesis concerning the image chromophore, without ever having to rest on any supernatural event or process. Because of this, his whole hypothesis concerning the image formation on the Shroud can truly be considered scientific, on the contrary to most (if not all) of the hypotheses involving a supernatural burst of energy at the time of the resurrection of Jesus. After having said this, it is important to note that this doesn’t mean that Rogers was right on anything regarding the image on the Shroud, but that he followed the scientific method in order to propose a rational explanation (which still needs to be fully explored and tested) that took into account *all* the pertinent data and observations that were available to him. That’s why Rogers’ hypothesis truly deserves the right to be fully considered as a scientific hypothesis. Concerning this, it should be noted that, on the contrary to most researchers who have proposed an image formation hypothesis over the years, Rogers had the opportunity to spend five days and nights with the Shroud in Turin (during the STURP examination in 1978) and, consequently, he was certainly better placed than others to know all the pertinent facts regarding the image that we see on this cloth, starting with the exact microscopic characteristics of the colored threads and fibers that composed the body image.

**6-** After having outlined the main steps followed by Rogers to build his image formation hypothesis, it’s very interesting to note that these kind of steps followed by Rogers during his research are exactly the same as the ones followed by two Italian researchers named Fazio and Mandaglio in their own study of the Shroud image<sup>26</sup>, proving without doubt their professionalism as scientists and the potential value of their scientific conclusions. Effectively, it’s only after they analyzed with great care the characteristics of the image (especially the discontinuous distribution of colored fibers in the image area) that they were confident enough to propose two possible natural mechanisms (a low-temperature chemical process like the Maillard reaction proposed by Rogers and/or a thermal radiation released by the dead body of the Shroud man) that can account for such an image. It’s important to note that, for these two scientists, as well as for Rogers, a natural image formation was really what was fitting the best with the kind of very particular characteristics of the body image on the Shroud<sup>27</sup>. The fact that they performed their research in total independence versus the one made by Rogers, while using a more theoretical approach, and, nevertheless, they came up with conclusions very similar regarding the nature of the image formation<sup>28</sup>, strongly supporting the idea that the

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<sup>25</sup> Concerning this maximum effective distance for the image formation process of 3.7 centimeters from the body that has been calculated by the STURP team for the frontal image only, see the annex at the end of this article.

<sup>26</sup> Concerning the most important papers they published about the Shroud image, see the end of note 13.

<sup>27</sup> In fact, Fazio and Mandaglio’s conclusion about the nature of the Shroud image was even more categorical as they clearly mentioned that, in their mind, the discontinuous distribution of the colored fibers in the image area could not have been caused by anything else than a stochastic process, which is a kind of natural mechanism that can be triggered by a small quantity of energy (which can be released theoretically by a fresh human corpse) and can produce, in theory, an image on linen that possesses the same properties as the one on the Shroud (including the discontinuous and very superficial aspect of the image at fiber level). Here’s what we can read about that in a paper they wrote with another Italian researcher: “The Shroud body image, produced over many years (e.g. a few decades), is natural. Therefore, to explain the image formation we do not need to say that it was a miracle and we can rule out the medieval forgery hypothesis. Nowadays, we know that a slight transfer of energy triggered a stochastic process.” Here’s the reference for this particular article: Giovanni Fazio, Giuseppe Mandaglio and Antonella Roberto, *What is the Shroud of Turin? – A Suggestive Hypothesis Awaiting a New Radiocarbon Dating*, British Society for the Turin Shroud Newsletter 75, June 2012 (<https://www.shroud.com/pdfs/n75part10.pdf>).

<sup>28</sup> However, it should be noted that Fazio and Mandaglio differ with Rogers on one important aspect of the Shroud image, which is the most probable image chromophore. Effectively, for Rogers, the chromophore of the Shroud image is most probably located only in a very thin and uneven layer of carbohydrate impurities, while Fazio and Mandaglio seem to closely follow STURP’s conclusion, which estimates that the coloration is located inside the linen fibers themselves. Here’s what those two Italian researchers have written about this question in their paper: “The stochastic mechanism (that produced the image on the Shroud) is a phenomenon that yields a latent image

Shroud image is most probably the result of a natural interaction between the dead body of the Shroud man and the surface of his burial cloth. That's why I consider that Fazio and Mandaglio's work should have been considered by those who study the Shroud image with much more care and interest than what I have noticed since the publication of their conclusions about the Shroud. My guess is that their "natural" conclusions, just like the ones of Rogers, are not as fantastic and fabulous as most people want!

7- This "new" paper of Rogers also indicates that, when he wrote it in 2001, he was already thinking, to the contrary of Pellicori's conclusion<sup>29</sup>, that a diffusion process must have been active inside the cloth in order to produce the kind of 3-D information that are encoded in the body image of the Shroud. For Rogers, the kind of natural and biological process he was favoring back then (i.e. which would have been initiated by the presence of perspiration (sweat) and/or secretions on the skin of the Shroud man's corpse) could not have happened in the way it was described by Pellicori, but could only have happened with a combination of transfer modes including both direct-contact and diffusion. Important note: After he did more studies and reflections on the subject, it seems that Rogers became totally convinced that the catalytic compounds that were responsible for the dehydration of the colored fibers were not the ones tested by Pellicori<sup>30</sup> but post-mortem gases instead (like ammonia gas, along with some heavy amines) that would have been gradually released by the enshrouded corpse. One of the main reasons for Rogers' change of mind concerning the most probable catalytic compounds that initiated the image formation process on the Shroud can be found in these two statements he made in his book about the Shroud<sup>31</sup>:

"No fibers in a pure image area were cemented together by any foreign material and there were no liquid meniscus marks. ... These facts seemed to eliminate any image-formation hypothesis that was based solely on the flow of a liquid into the cloth. This also suggests that, if a body was involved in image formation, it was dry at the time the color formed."

"Body fluids (other than blood) did not percolate into the cloth."

In light of these two statements, it really seems that Rogers, after 2001, became totally convinced that no sweat and/or secretions could have come in contact with the cloth after the Shroud man's body had been placed inside the Shroud for the reason that the data coming from the Shroud were strongly suggesting that his corpse was dry at the

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as a result of a chemical modifications (oxidation and dehydration of the cellulose) of any fibrils of linen." (first parentheses added). Giovanni Fazio and Giuseppe Mandaglio, *Can a latent image explain the characteristics of the Shroud body image?*, Radiation Effects and Defects in Solids, Vol. 167, No. 3, March 2012 (<http://www.tandfonline.com/doi/full/10.1080/10420150.2011.595413#.UjYuQRS1apo>). However, it's important to understand that even if they would be wrong about the real chromophore of the Shroud image and Rogers would be right, this would not change at all the potential validity of their conclusions about the natural and very mild aspect of the image formation that occurred on the Shroud, because the stochastic mechanism they described can be applied in both cases, whether it would concern the structure of the linen fiber itself or only a thin layer of carbohydrate impurities resting on the top-most fibers of the cloth. On this question, it's interesting to note that in a paper published this year, Fazio confirmed this understanding, as he made for the first time a clear mention of the impurity hypothesis of Rogers (without denying the other possibility that the chromophore can also be located in the structure of the linen fiber itself) in the section in which he talks about the most probable mechanisms (all of them being natural stochastic phenomenon) that can produce an image on linen with the same characteristics as the one on the Shroud. Here's the reference for this particular paper: Giovanni Fazio, *A Stochastic Process to Explain the Turin Shroud Body Image Formation*, Journal of Modern Mathematics Frontier, Volume 2 Issue 3, September 2013 (<http://www.sjmmf.org/Download.aspx?ID=7362>).

<sup>29</sup> Samuel F. Pellicori of STURP estimated that the Shroud image was the result of a natural image formation process involving only direct-contacts between the cloth and the corpse. On this subject, see: Samuel F. Pellicori, *Spectral Properties of the Shroud of Turin*, Applied Optics 19, June 15, 1980, and Samuel F. Pellicori and Mark S. Evans, *The Shroud of Turin Through the Microscope*, Archaeology 34, 35, January-February 1981.

<sup>30</sup> See note 3.

<sup>31</sup> Raymond N. Rogers, *A Chemist's Perspective on the Shroud of Turin*, Barrie Schwartz Editor and Publisher, July 2008 (<http://www.lulu.com/shop/raymond-n-rogers/a-chemists-perspective-on-the-shroud-of-turin/ebook/product-17416203.html>), pgs. 15 and 78, respectively.



time of his entombment. That's most probably why he started to look for some other catalytic compounds and found out that post-mortem gases could offer a very good alternative.

8- Finally, this "new" paper of Rogers can truly be helpful to understand how complex the formation of the Shroud image probably was. Effectively, this paper shows clearly that, in Rogers' thinking, there were probably three major conditions that must have been fulfilled in order for a particular fiber to become colored<sup>32</sup>:

A) It must have been located in the immediate vicinity of the body surface, at no more than a few centimeters. The measurements made by the STURP team for the frontal body image of the Shroud showed that, for a fiber to be colored in this region, it must have been located at no more than 3.7 centimeters from the body.<sup>33</sup> (Mario Latendresse, a Shroud researcher, estimated for the same frontal image that in each place where there was over 2 centimeters of distance between the corpse and the cloth, the image formation process had probably lost more than 80% of its coloring capacity<sup>34</sup>. Concerning the dorsal image, Fazio and Mandaglio concluded that the maximum distance in which the image formation process was able to color a fiber on that side of the cloth is certainly less than the maximum distance of 3.7 centimeters that was calculated for the frontal part of the Shroud, even though, for the moment, the precise and definitive maximum distance for the dorsal region still wait to be determined<sup>35</sup>.)

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<sup>32</sup> Here, it's important to understand that all the colored fibers that composed the body image on the Shroud possessed more or less the same color (i.e. the same optical density value), regardless of the cloth-body distance at the time of image formation. In other words, that means that there are only two types of fibers on the Shroud: 1- Those that were colored (yellowed) by the image formation process (these ones are only located in the image area and are showing pretty much the same kind of yellow-brown color). 2- Those that kept their original color (these ones are located in both the non-image and the image areas). It's also important to note that, if the conclusion of Fazio and Mandaglio is correct about the fact that the image on the Shroud is due to a natural stochastic process, a portion of the fibers that would have met the three major conditions that will be described would still have remained uncolored. In other words, because the image formation process was most probably very mild and did not imply a release of energy, the color of those exposed fibers in the image area would have remained the same as the non-exposed fibers located in the non-image area of the cloth, even though they would have been theoretically suitable to get colored by the image formation process. It should be noted that this is not what Rogers thought when he described his image formation hypothesis. For him, every fiber that would have been coated with carbohydrate impurities would have been colored if some post-mortem gases would have come in contact with them. Here's an important quote of Rogers about this: "When amines and reducing sugars come together, they will react. They will produce a color. This is not a hypothesis: this is a fact." That means that, for Rogers, the discontinuous distribution of fibers in the image area on the Shroud is solely due to the presence of a thin and uneven layer of impurities on the cloth's surface that have coated only a portion of the most superficial fibers of the cloth; and the portion of these coated fibers that were exposed to post-mortem gases eventually became the colored ones that are responsible for the image. Starting from this conclusion of Rogers, it is not clear if he ever considered the possibility that the Shroud image could be due to a stochastic process that would have not implied enough energy to color all the exposed fibers, as it has been proposed by Fazio and Mandaglio. Note that in Fazio and Mandaglio's mind, such a natural stochastic process could really have implied a Maillard reaction caused by the post-mortem gases proposed by Rogers. The only difference is that, for them, it's not every coated and exposed fiber that would have become colored, but only an uneven and unpredictable portion of these. The quote of Rogers that you just read can be found in his book about the Shroud, which is referenced in note 7. And for more information about the stochastic hypothesis of Fazio and Mandaglio, see note 16 for the references concerning the two articles they wrote together, along with the one that has been written by Fazio alone.

<sup>33</sup> See the annex.

<sup>34</sup> In a study he presented in 2005 at the Third Dallas International Conference on the Shroud of Turin, the scientist Mario Latendresse estimated that "beyond two centimeters the projection (image formation) has lost more than 80% of its efficacy." (parentheses added) Here's the reference for this paper: Mario Latendresse, *The Turin Shroud Was Not Flattened Before the Images Formed and no Image Distortions Necessarily Occur from a Real Body*, Proceedings of the Third Dallas International Conference on the Shroud of Turin, September 8-11, 2005 (<http://www.sindonology.org/papers/latendresse2005a.pdf>), pg. 3.

<sup>35</sup> See the annex.

B) It must have been subjected to a minimum amount (still undetermined) of catalytic compounds<sup>36</sup> (in Rogers' thinking, this means that a minimum amount of post-mortem gases must have come in direct contact with such a fiber for probably a minimum period of time that is also undetermined).

C) It must have been coated with a minimum amount (still undetermined<sup>37</sup>) of carbohydrate impurities. In Rogers' thinking, this layer of carbohydrate impurities would have been primarily composed of starch, along with maybe some residues of saponaria, pectin, hemicellulose, etc., and all these substances would have been left on the top surface of the linen cloth by the different "manufacturing" steps that were necessary to produce it<sup>38</sup>. For Rogers, it is this particular layer of impurities that would have been colored instead of the linen fiber itself (which include the primary cell wall).

These three conditions described by Rogers in his writings are very important to understand because it shows how complex the image formation process would have been if his image formation hypothesis is at least partially correct<sup>39</sup>. And along with these three major conditions, which were all crucial, in Rogers' mind, for the production of a color on top of the fibers that composed the Shroud image, it is also possible to think that other particular conditions could have been important for the production of a coloration (dehydration) around some fibers located on the surface of the cloth. Here's a non-exhaustive list of those additional factors, which are all still undetermined<sup>40</sup>:

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<sup>36</sup> When we put this condition 2 in relation with condition 1, we can therefore conclude that in places where the cloth's surface was located at more than 4 cm of distance away from the frontal part of the body and probably much less than 4 cm of distance away from the dorsal part of the body at the time of the image formation, the catalytic compounds were not able to travel that far with the minimum amount necessary to produce a visible coloration of at least some coated fibers, which is probably the most important factor that can explain the absence of a body image of the back of the knees on the Shroud. Note that this total absence of a body image has been confirmed by Miller and Pellicori of STURP when they analyzed the UV fluorescence photos of the Shroud. Here's the reference for this study: Vernon D. Miller et Samuel F. Pellicori, *Ultraviolet fluorescence photography of the Shroud of Turin*, Journal of Biological Photography, July 1981.

<sup>37</sup> Here's an important statement made by Rogers concerning this particular issue: "The layer (*of image color*) is approximately one wavelength of visible light thick (200-600 nanometers), and it is amorphous." (pg. 30, italicized added) This quote can be found in this paper: Emmanuel M. Carreira, *The Shroud of Turin from the viewpoint of the physical science*, 2010 (<http://www.shroud.com/pdfs/carreira.pdf>). Starting from this estimation from Rogers, we can think that the minimum amount of impurities necessary for a particular fiber to become colored was located in that very tiny range and therefore was very small. However, since the coloring process described by Rogers involves a dehydration of those carbohydrate impurities that could have produced a certain shrinkage of the impurity layer, it is possible to think that the minimum amount of impurity was originally a bit thicker before the start of the image formation process, but even if this is true, that doesn't change the fact that this minimum amount was certainly very small. Also, based on the results obtained by Rogers during his evaporation-concentration experiments, we can deduce that it is truly possible that some fibers located deeper inside the Shroud could have also been coated with some carbohydrate impurities but the amount of these impurities would have been so small that even if enough catalytic compounds would have come in contact with these fibers, no noticeable coloration (to the naked eye) would have been produced. Note that the same is possibly also true for a portion of the fibers located on the cloth's surface in the image area.

<sup>38</sup> These different steps include the retting of the flax plant to produce the threads, covering of the threads with starch to protect them during the weaving, bleaching of separate hank of yarns, washing of the final cloth with saponaria and final drying in open air, etc.

<sup>39</sup> For a good summary of Rogers' point of view concerning the very probable high complexity of the image formation process, see quote 42 in my paper entitled "Raymond N. Rogers' Observations and Conclusions Concerning the Body Image that is Visible on the Shroud of Turin" (<http://shroudnm.com/docs/2013-01-10-Yannick-Clément-Reflections-on-Ray-Rogers-Shroud-Work.pdf>).

<sup>40</sup> It's important to emphasize the fact that these are just some possible factors that could have had an impact on the production of a coloration (dehydration) on the surface of the cloth. In the present state of our knowledge about the Shroud, it's impossible to be sure if all of them really had some tangible impact on the image formation. Also, it is important to say that other factors that could have had an impact on the image formation and can still be proposed. There is no doubt that more research on the subject would be helpful to determine a complete list of all the most probable factors that could have had some impact on the formation of the Shroud image.

- A) The amount of heat (thermal radiation) that was released by the dead body after it was placed inside the Shroud<sup>41</sup>.
- B) The environmental condition(s) that prevailed during and after the execution of the Shroud man, up through the time his body reached the tomb.
- C) The kind of environmental condition(s) that prevailed inside the tomb and inside the Shroud during the short time that the corpse was present inside of it.
- D) The amount of time the body stayed inside the cloth<sup>42</sup>.
- E) The potential presence of one or more burial product(s) on the Shroud man's body and/or on the Shroud itself<sup>43</sup>.

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<sup>41</sup> Rogers really thought that this could have been another important factor in the color production. On this subject, see quotes 123, 133 and 134 in my paper entitled "Raymond N. Rogers' Observations and Conclusions Concerning the Body Image that is Visible on the Shroud of Turin" (<http://shroudnm.com/docs/2013-01-10-Yannick-Clément-Reflections-on-Ray-Rogers-Shroud-Work.pdf>). You can also read these three papers written by Fazio and Mandaglio, who also thought that a release of heat by the dead body of the Shroud man could have been crucial in the image formation: Giovanni Fazio and Giuseppe Mandaglio, *Stochastic distribution of the fibrils that yielded the Shroud of Turin body image*, Radiation Effects and Defects in Solids, Vol. 166, No. 7, July 2011 (<http://www.tandfonline.com/doi/abs/10.1080/10420150.2011.566877>). Giovanni Fazio and Giuseppe Mandaglio, *Can a latent image explain the characteristics of the Shroud body image?*, Radiation Effects and Defects in Solids, Vol. 167, No. 3, March 2012 (<http://www.tandfonline.com/doi/full/10.1080/10420150.2011.595413.UjYuQRS1apo>). Giovanni Fazio, *A Stochastic Process to Explain the Turin Shroud Body Image Formation*, Journal of Modern Mathematics Frontier, Volume 2 Issue 3, September 2013 (<http://www.sjmmf.org/Download.aspx?ID=7362>).

<sup>42</sup> We are certain of one thing: The contact between the corpse and the Shroud could not have remained for more than 72 hours (see note 22).

<sup>43</sup> This question is still unsettled because there are conflicting piece of evidences. On one hand, Raymond N. Rogers, after he analyzed all the pertinent data, concluded that the Shroud man's body and the Shroud were probably dry at the time of the entombment and he never was able to find any traces of myrrh or aloes, even after he performed specific chemical tests and a reflectance spectrometry analysis on his old STURP samples to detect such substances (see pages 43 and 44 of Rogers' book "A Chemist's Perspective on the Shroud of Turin), while Pierluigi Baima Bollone, an Italian forensic expert who also analyzed some linen samples that he took himself on the Shroud during the 1978 examination of the cloth, claimed that he was able to find traces of both burial products, while using an antibody-antigen testing. Baima Bollone also claimed that indirect confirmations of the presence of such products can be found in the results of two Italian independent researchers named Alberto Brandone (who did a neutronic activation analysis on some linen samples taken from the Shroud) and Gaetano Intrigillo (who did some research on a linen cloth that he impregnated with aloes and myrrh in aqueous solution). It should also be noted that Rogers' negative results for the presence of aloes and/or myrrh on the Shroud were done after the publication (not in a peer-reviewed scientific journal) of Baima Bollone's conclusion on that issue, while he was trying to confirm or not the validity of his positive results and in the end, he was not able to do so, which seem to give credit to an earlier negative result obtained by Samuel F. Pellicori of STURP after he did some microscopic and spectral analyses on the Shroud to detect the presence of ancient burial products such as aloes, myrrh and olive oil. Here's what Pellicori said about this: "There is no confirming evidence from visual microscopic or SEM (Scanning Electron Microscopy) examination of fibrils and particles removed from the Shroud that any of these substances exist as such today." Here's the references in which you can find the description of the tests performed by Rogers, Baima Bollone and Pellicori to detect traces of aloes and/or myrrh on the Shroud: Raymond N. Rogers, *A Chemist's Perspective on the Shroud of Turin*, Barrie Schwartz Editor and Publisher, July 2008 (<http://www.lulu.com/shop/raymond-n-rogers/a-chemists-perspective-on-the-shroud-of-turin/ebook/product-17416203.html>). Pierluigi Baima Bollone, *Sindone 101 domande e risposte* (101 Questions on the Holy Shroud), Edizioni San Paolo s.r.l., Milano, Italy, 2000. Samuel F. Pellicori, *Spectral Properties of the Shroud of Turin*, Applied Optics, Vol. 19, June 15, 1980. Final note: Even in the case Baima Bollone's tests would have given him a false positive result and that no traces of aloes and/or myrrh could really be detected on the Shroud, there is still a possibility that such burial products were really used for the burial of the Shroud man but in a dry and solid form (powder) instead of a liquid form and it is also possible that such a powder would have been put in smaller linen cloths (like bags) before being placed all around the Shroud man's body inside the Shroud, which could possibly explain why there are no images of the sides of the body and of the top of the head on the cloth. If this really happened that way, it would be nearly impossible to detect any traces of aloes and myrrh on the Shroud. It is also possible, as Pellicori noted, that such burial products (if they really were used in a liquid state) could simply have totally evaporated or even been totally washed away from the cloth over the centuries, which could also explain the negative results he and Rogers obtained. We can find this particular hypothesis of Pellicori in this paper: Samuel F. Pellicori and Mark S. Evans, *The Shroud of Turin Through the Microscope*, Archaeology 34, 35, January-February 1981. As

D) The environmental condition(s) in which the cloth had been kept and preserved before the body image appeared completely on the surface of the cloth<sup>44</sup>.

## Conclusion

There is no doubt in my mind that this “new” paper of Rogers constitutes a real historical finding, which can help us to understand all the different steps that were taken by Rogers in his study of the Shroud image. These steps indicate the high level of scientific professionalism with which he did his work in order to discover the best rational hypothesis to explain this image without underestimating or leaving out any important data and observations. In consequence, this paper can also help us to realize the poor scientific value of the work done by some other “scientists” on the Shroud image, especially when we consider the fact that those researchers have not at all followed the same scientific “path” of Rogers. In the end, I think we can really see in this particular paper, which was the first attempt of Rogers at describing his impurity hypothesis for the image chromophore, as being the genesis of the Maillard reaction hypothesis he proposed the year later (in 2002)<sup>45</sup> and which he never stopped refining until his death, two years later.

In the end, I hope this long sharing of thoughts will help some readers to understand better the professionalism of Rogers regarding his scientific study of the Shroud, as well as the great potential value of his personal hypotheses concerning the image chromophore and the image formation.

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we can see, the question of whether or not aloes and/or myrrh (or other burial products such as olive oil) were used during the entombment of the Shroud man remains open and it’s not sure at all if a new series of direct testing on the Shroud will be able to settle this issue.

<sup>44</sup> Many researchers, including Raymond N. Rogers, Alan A. Mills, John A. DeSalvo, Giovanni Fazio and Giuseppe Mandaglio, etc. have concluded that the Shroud image is most probably a latent image that could have taken many months, years or even decades in order to become fully visible on the cloth’s surface. If this is correct, there’s no doubt that, in such a context, the Shroud could have been kept in more than one environmental condition.

<sup>45</sup> See note 2.

## Annex

### The question of the maximum effective distance of the image formation process

The STURP team has concluded that the image formation process was only able to cause a visible coloration in areas of the frontal part of the cloth that were located no more than 3.7 centimeters from the corpse. Beyond this distance, the image formation process was unable to cause any visible coloration on that side of the cloth. The measurements and calculations that lead to such a conclusion can be found in these two papers: John P. Jackson, Eric J. Jumper and William R. Ercoline, *Three Dimensional Characteristic of the Shroud Image*, IEEE 1982 Proceedings of the International Conference on Cybernetics and Society, October 1982. John P. Jackson, Eric J. Jumper and William R. Ercoline, *Correlation of Image Intensity on the Turin Shroud with the 3-D Structure of a Human Body Shape*, Applied Optics, Vol. 23, No. 14, 1984.

It should be noted that no such analysis was made by the STURP team for the dorsal region of the Shroud in order to determine the maximum effective distance for the image formation process that occurred in that region. Consequently, it is truly possible that such distance could be slightly different than what was calculated for the frontal side of the cloth (i.e. 3.7 centimeters). In fact, if we believe the conclusion reached by the Italian physicists Fazio and Mandaglio, who have studied this question in depth using scientific analysis of the different intensities that are present in the dorsal image, this maximum distance for the dorsal side of the Shroud is certainly lower than 3.7 centimeters, which means that the factor of attenuation concerning the image formation process was most probably more important below the body than above it, despite of the fact that the image formation process was the same for both the frontal and the dorsal image. Effectively, since both images show the same physical, chemical and spectral properties, most Shroud researchers (including Rogers, Fazio and Mandaglio) have recognized the fact that they were formed by the same mechanism. In sum, that means that an identical form of energy (which is still undetermined) have produced the same kind of coloration on fibers located above and below the Shroud man's body, but it seems that this unknown form of energy was able to travel over a longer distance above the body than under it in order to color those fibers. However, we must note that no definitive and precise maximum distance for the dorsal part of the Shroud was given by these two scientists, who used an arbitrary maximum distance for their theoretical calculations.

But in the end, no matter what could have been the real maximum distance in which the image formation process was able to color a fiber on the dorsal part of the Shroud, the simple fact that it was probably lower than the maximum distance of 3.7 centimeters that was determined for the frontal part should be seen as another important piece of data that also suggest a natural formation of the body image, especially if it involved one or more low-temperature chemical process(es) that were initiated by a release from the dead body of molecules that were lighter than the surrounding air, like for example post-mortem ammonia gas and/or water vapor and/or other light molecules that could have been released by the fresh corpse of the Shroud man and/or heat radiation that could have come out of this fresh corpse, especially if the ambient air below the body was kept colder than the air above it for some reasons (like the possibility that the enshrouded body was resting horizontally on a cold stone bench inside a rock tomb). Effectively, the scenario of a natural image formation involving one or more of these light molecules is consistent with the conclusion of Fazio and Mandaglio that the image formation process which caused the body image on the Shroud had a maximum effective distance that was greater above the body than under it. In other words, the fact that the image formation process was probably able to travel farther above the body than under it suggests that its nature was probably chemical and that it involved one or more molecule(s) that were lighter than air, which would have acted as the main catalytic compound(s) for such a process. Beside this, it's important to mention that such a difference in the maximum distance can also have been caused by a greater presence of burial products on the back part of the Shroud at the time of the image formation, which would have produced an attenuation effect more important below the body (this is Fazio and Mandaglio's hypothesis). Nevertheless, since the presence of such burial products on the Shroud has never been scientifically confirmed properly (the STURP team, as well as Rogers in his personal analyses, were never able to detect any traces of such products on their Shroud samples), the first hypothesis involving light molecules that would have acted as catalytic compounds for a low-temperature chemical process (or processes) must be considered as the most probable one in the light of all the confirmed data and observations coming from the Shroud. At the same time, such a difference of distance is highly problematic for any hypothesis of image formation

involving some burst of energetic radiation that would have come from the Shroud man's body, because there is no good reason to think that such a burst of intense radiation would travel for a shorter distance below the body than above it.

Finally, it's also important to note that this conclusion of Fazio and Mandaglio can be seen as another good confirmation of the fact that the dorsal body image on the Shroud possess the same three dimensional properties as the frontal image, even though they are more subtle because the attenuation factor of the image formation process was stronger on that side of the cloth, and also because the backside of the Shroud man's body was certainly much closer in general to his burial cloth than the frontal side, thus creating zones of direct-contact or very close proximity between the corpse and the cloth that were more numerous and larger. In the paper "Correlation of Image Intensity on the Turin Shroud with the 3-D Structure of a Human Body Shape" written by Jackson, Jumper and Ercoline from STURP in 1984, we can find confirmation of this when they estimated that the areas of direct-contact between the cloth and the back of the body were covering a total surface of  $\approx 2800 \text{ cm}^2$  at the time of the image formation, while on the front side, they were only covering a total surface of  $\approx 1100 \text{ cm}^2$ . In all logic, this stronger attenuation factor for the image formation on the dorsal part of the Shroud combined with the fact that the body was much closer to this part of the cloth is certainly responsible for the more drastic change in the color intensity of the dorsal body that has been noted by the experts who compared the dorsal and the frontal images on the Shroud. It is this more drastic change of the color intensity that makes it more difficult to clearly see the three dimensional properties of the dorsal image, even though they really exist.

Here's the reference for the study done by Fazio and Mandaglio concerning the three dimensional properties of the dorsal body image on the Shroud: Giovanni Fazio and Giuseppe Mandaglio, *Does an I(z) correlation exist for the back-part of the Shroud body image?*, Accademia Peloritana dei Pericolanti. LXXXVI, CIA0802005-1-5, 2008 (<http://cab.unime.it/journals/index.php/AAPP/article/download/C1A0802005/272>). And here's the reference for the paper in which Fazio and Mandaglio described their hypothesis of a greater attenuation effect of the image formation process on the back part of the Shroud that would have been caused by the possible presence of aromas (such as aloes and/or myrrh) and/or burial ointments: F. Curciarello, V. De Leo, Giovanni Fazio and Giuseppe Mandaglio, *The abrupt changes in the yellowed fibril density in the Linen of Turin, Radiation Effects and Defects in Solids*, Vol. 167, No. 3, March 2012 (<http://www.tandfonline.com/doi/abs/10.1080/10420150.2011.629320#.UI08s7q1ZoI>).

### **Acknowledgements:**

I would like to thank Mr. Andy Weiss, webmaster of [shroudnm.com](http://shroudnm.com), for his help in the correction and also in the layout of this article. Since English is not my first language, his help was really appreciated. I would like also to thank Mr. Joseph G. Marino for having the wise idea to propose this unpublished paper of Rogers to Barrie M. Schwartz and STERA for an eventual publication on [Shroud.com](http://Shroud.com). Finally, I would like to thank Mr. Schwartz and STERA for having accepted to publish it on [Shroud.com](http://Shroud.com).