

# The question of pollen grains on the Shroud of Turin and the Sudarium of Oviedo

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## ***Abstract***

*El botánico suizo Max Frei Sulzer trabajó, en los años 70, sobre algunas muestras de polvo de la Síndone de Turín y del Sudario de Oviedo, para investigar sobre el origen de los polenes presentes en las dos telas. Llegó a la conclusión de que ambas las reliquias procedieron de Oriente Medio y llegaron a Europa con caminos diferentes. Su trabajo, llevado a cabo sin presentar suficientes indicaciones metodológicas y interrumpido por su muerte antes de ser completado, ha sido algo criticado. Sin embargo, las conclusiones generales de las investigaciones de Frei siguen siendo válidas. Esperamos, de todas formas, ulteriores investigaciones.*

In the 70s the Swiss botanist Max Frei Sulzer took some dust samples from the Shroud of Turin and the Sudarium of Oviedo to investigate the origin of the pollen which was on the two fabrics. He concluded that both the relics came from the Middle East and arrived in Europe through different paths. His work, which was carried out without providing sufficient methodological information and was interrupted by his death before being completed, laid itself open to some criticism. Nevertheless, the general conclusions of Frei's research remain valid. However, we hope for further investigation.

***Keywords:*** Shroud of Turin, Sudarium of Oviedo, pollen.

## ***Introduction***

There was much discussion on the value to be attributed to the research performed by Max Frei-Sulzer on the Shroud of Turin and on the Sudarium of Oviedo. Retracing the steps of this research, concerning the pollen on the two relics, it is possible to have a better idea about the findings of the Swiss scientist.

Max Frei-Sulzer graduated in Natural Sciences<sup>1</sup> with specialization in Botany<sup>2</sup>. Besides being the founder and director of the Criminal Police of Zurich Scientific Service, he was Professor in the Zurich University and in the Institute of Police of Neuchatel (Switzerland) and Hiltrup (Germany); he was

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<sup>1</sup> M. FREI, *Note a seguito dei primi studi sui prelievi di polvere aderente al lenzuolo della S. Sindone*, in *Sindon* 23 (1976), pp. 5-9, on p. 5.

<sup>2</sup> [http://www.herbarien.uzh.ch/static/database/sammlerdetails\\_de.php?id=5015](http://www.herbarien.uzh.ch/static/database/sammlerdetails_de.php?id=5015)

also science editor of the German periodical *Kriminalistik* and UN expert witness in the investigation on the death of the General Secretary Dag Hammarskjöld<sup>3</sup>.

### ***The first sampling on the Shroud***

On November 23, 1973, with the consent of the competent authorities, Frei took some dust samples from the Shroud's margins using adhesive tapes. The area of origin was shown on sample containers<sup>4</sup>. The Swiss botanist explained: "These tapes are put in contact with the surface with a light pressure and, due to their stickiness, when they are detached, they remove all the microtraces without damaging or altering the support in any way. The advantage of this method, widely used in criminology, is that - once the tape is folded on itself - loss of material or secondary contamination are completely excluded"<sup>5</sup>.

Three years after he announced: "In subsequent analyses of dust samples it was possible to find and classify a large number of pollen grains which, properly treated, have allowed the precise determination of the family, genus and species of the plant itself. Each identification result was verified and checked on herbarium material and in botanical gardens worldwide renowned for their collections, as well as documented in photomicrographic surveys. The *first conclusion* (italics in the original text) that the performed studies allow to suggest refers to the presence on the Shroud of pollen grains that come from desert plants that grow in Palestine. The most frequent pollen on the Shroud is identical to the most frequent pollen in sediments of the lake of Gennesaret sedimentary layers of two thousand years ago. Another sample comes from Asia Minor and more specifically from the area surrounding Constantinople, while a large number of granules are of French and Italian origin. It is therefore logical the deduction that the geographical and historical life of the Shroud corresponds to the migration that it suffered in time as a function of the evidence acquired"<sup>6</sup>.

In the twelve dust samples, Frei found, in addition to the pollen of flowering plants, fiber fragments, mineral particles, fragments of plant tissues and fungal spores<sup>7</sup>. With regard to pollen, he reminded: "Every species of plant produces a unique pollen that can be distinguished from the pollen of all other varieties, both under the light microscope and under the scanning electron microscope. (...) It is then possible to determine on the basis of a single grain of pollen from which plant it comes"<sup>8</sup>.

He also stated: "90% of the pollen production of a given plant is deposited within 100 meters. A propagation to a distance of tens of kilometers is still considered normal, while exceptionally strong winds in times of drought (sirocco) are responsible for rare extremely far transports of hundreds or thousands of kilometers. (...) In the case of the Shroud the represented plants bloom in different seasons and live in well-defined, and different from each other, ecological conditions. Their pollen is

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<sup>3</sup> M. FREI, *Note a seguito dei primi studi sui prelievi di polvere aderente al lenzuolo della S. Sindone*, op. cit., p. 5.

<sup>4</sup> *Ibid.*, p. 7.

<sup>5</sup> M. FREI, *Il passato della Sindone alla luce della palinologia*, in *La Sindone e la Scienza, Atti del II Congresso Internazionale di Sindonologia*, Turin, October 7-8, 1978, Ed. Paoline, Turin 1979, pp. 191-200 and 370-378, on p. 191.

<sup>6</sup> M. FREI, *Note a seguito dei primi studi sui prelievi di polvere aderente al lenzuolo della S. Sindone*, op. cit., p. 8.

<sup>7</sup> M. FREI, *Il passato della Sindone alla luce della palinologia*, op. cit., p. 191.

<sup>8</sup> *Ibid.*, p. 192.

not especially suited to very far transports. Therefore the heterogeneity and the amount of pollen cannot be explained on the basis of random contamination”<sup>9</sup>.

On his working method, Frei wrote: “It was a very difficult task to identify the different pollen-grains in the dust collected. First I had to extract them from the sticking-tape and after cleansing they were embedded in glycerine jelly as permanent mountings, so that they could be studied from all sides under the light microscope. The only true scientific method for identification of pollen grains is the direct comparison with a mounting in the same medium of ripe pollen collected from a species to which the unknown pollen might belong”<sup>10</sup>.

With regard to the selection and removal of pollen grains from the tapes, the expert Aurelio Ghio, who collaborated with Frei, stressed that the Swiss botanist followed “a method of his own, of which he was jealous custodian”<sup>11</sup>. In a manuscript of his, Frei explained how he removed the pollen grains from his sticky tape samples to put them on slides: he cut a T shaped incision into the tape, dissolved the adhesive in toluol and very carefully lifted the grain of pollen out with a small wire loop or dipped into the incision the point of a triangle of sticky tape with which he took the grain to lay it down on a microscopic slide. Then he put a drop of mounting medium, placed control pollen grains and finish off the mount with a cover slip<sup>12</sup>.

In five years of work, Frei was able to identify 49 species of plants, the pollen of which is represented in the dust of the Shroud<sup>13</sup>. From the list of these plants it can be deduced that half of them do not grow in Europe, while it is present in the Middle East; in the other half, there are many Mediterranean plants<sup>14</sup>.

He stressed: “The botanical geography does not know any place where a direct contamination with such heterogeneous floristic elements have been possible; the linen cloth then travelled and was contaminated in different places. I leave the possibility open that a part of the pollen comes from the manufacture of the cloth and perhaps also from aromatic substances such as aloe used for the burial processes or from the wet skin of the body which was wrapped in the cloth. But surely the later pollen is from wind origin during the exhibitions”<sup>15</sup>.

The conclusions of the Swiss botanist are interesting: “The presence on the Shroud of pollen of 29 plants of the Near East, and especially of 21 plants that grow in the desert or the steppes, directly leads to the hypothesis that the Shroud, now preserved in Turin, in the past was exposed to open air in countries where these plants are part of the normal vegetation. (...) Three-quarters of the species found on the Shroud grow in Palestine, of which 13 species are very characteristic or unique of the Negev and the Dead Sea area (halophyte plants). The palynology thus allows us to say that during its history (including manufacturing) the Shroud resided in Palestine. This result does not explain the presence of pollen of steppe plants that are missing in Palestine or are extremely rare there. According to

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<sup>9</sup> *Ibid.*, p. 193.

<sup>10</sup> M. FREI, *Nine years of palynological studies on the Shroud*, in *Shroud Spectrum International* 3 (1982), pp. 2-7, on p. 3.

<sup>11</sup> A. GHIO, *I pollini della Sindone dalle ricerche di Max Frei*, in *La Sindone, la Storia, la Scienza*, Ed. CentroStampa, Leinì (TO) 1986, pp. 115-118 and plates XXXII-XXXV, on p. 116; S. SCANNERINI, *Tracce botaniche sulla Sindone*, in *Sindone, cento anni di ricerca*, Istituto Poligrafico e Zecca dello Stato, Libreria dello Stato, Roma 1998, pp. 209-230, on p. 218.

<sup>12</sup> C. MALONEY, *The current status of pollen research and prospects for the future*, in *The ASSIST Newsletter* 2, 1 (1990), pp. 1-7, on p. 3.

<sup>13</sup> M. FREI, *Il passato della Sindone alla luce della palinologia*, op. cit., p. 193.

<sup>14</sup> *Ibid.*, pp. 194-197.

<sup>15</sup> *Ibid.*, p. 197.

palynology, the Shroud must have been exposed to open air in Turkey because 20 of the found species are abundant in Anatolia (Urfa, etc..) and four around Constantinople, and are completely lacking in the Central and Western Europe”<sup>16</sup>.

Frei added important clarifications: “Because the geographic side of the Shroud’s past speaks in favor of authenticity, it would be very important the possibility of expressing ourselves on the age of the traces I found. But the current state of our knowledge does not allow an exact dating, as the plants, represented by their pollen, grow also today in the mentioned areas and we know from the «Flora of the Bible» that in the last two millennia the vegetation in Israel - apart from a forest decrease and an increase in cultivated area - has not undergone fundamental changes. (...) A more precise dating could be in the future if we encounter the pollen of a plant extinct in the last two millennia. Contrary to some sensational but baseless print news, until now I have not been so lucky in my research. Further analysis of Shroud dust possibly will allow to study statistically the frequency of species and to synchronize it with the frequency spectrum of the pollen in the various horizons of sedimentation of the Dead Sea”<sup>17</sup>.

### ***The new sampling on the Shroud***

After another three-year investigation, also conducted on material removed from the Shroud on October 8, 1978, of which sampling points are identified<sup>18</sup>, Frei announced that he had identified “epidermal cells of *Aloe socotrina*” and “nine varieties of pollen not yet found in previous research”, of which eight are of Mediterranean plants and one plant (*Bassia muricata*) of salty places of North Africa<sup>19</sup>. Instead, it is accidental the presence of pollen of *Ambrosia coronopifolia*, an American plant, which probably adhered to the cotton gloves worn by Frei at the request of American Scientists<sup>20</sup>.

Frei said: “Only the scanning microscope allows us to distinguish, with absolute certainty, two species of the same genus, although the relationship is very close”<sup>21</sup>. He noted: “Some of the lists, published by the University of Tel Aviv, of pollen extracted from the bottom of the Dead Sea or the Lake of Gennesaret contain many identical names to the lists of the Shroud pollen published by me in 1978”<sup>22</sup>.

The botanist Avinoam Danin of the Hebrew University of Jerusalem (Israel) said: “As far as establishing the Shroud’s provenance, *Zygophyllum dumosum* is the most significant plant on the list. Max Frei identified pollen grains of this species on the adhesive tapes he examined. The northernmost extent of the distribution of this plant in the world coincides with the line between Jericho and the sea level marker on the road leading from Jerusalem to Jericho. As *Zygophyllum dumosum* grows only in Israel, Jordan and Sinai, its appearance helps to definitively limit the Shroud’s place of origin”<sup>23</sup>.

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<sup>16</sup> *Ibid.*, p. 198.

<sup>17</sup> *Ibid.*, p. 199.

<sup>18</sup> P.C. MALONEY, *A contribution toward a history of botanical research on the Shroud of Turin*, in *Proceedings of the 1999 Shroud of Turin International Research Conference*, Richmond, June 18-20, 1999, Magisterium Press, Glen Allen, Virginia, USA 2000, pp. 241-266, on pp. 244-246.

<sup>19</sup> M. FREI, *Identificazione e classificazione dei nuovi pollini della Sindone*, in *La Sindone, Scienza e Fede, Atti del II Convegno Nazionale di Sindonologia*, Bologna, November 27-29, 1981, CLUEB, Bologna 1983, pp. 277-284, on p. 281.

<sup>20</sup> *Ibid.*

<sup>21</sup> *Ibid.*, p. 277.

<sup>22</sup> *Ibid.*, p. 279.

<sup>23</sup> A. DANIN, *Pressed flowers*, in *Eretz Magazine* 55 (1997), pp. 35-37 and 69, on p. 69.

In the plates attached to his articles, Frei did not indicate whether the photographs were related to pollen grains found on the Shroud or pollen grains of reference, but Ghio, in republishing two of those images<sup>24</sup>, specified that they were reference pollen grains<sup>25</sup>. Frei died in January 1983 without having been able to identify some pollen grains on the Shroud<sup>26</sup> and thus having no chance to publish a comprehensive final paper<sup>27</sup>. Shortly before his death, Frei was working on the identification of other 19 types of pollen present in the Shroud samples and he had noted that one of them is of *Hypocoum aegyptiacum*, a Mediterranean plant that grows also in the Middle East and North Africa<sup>28</sup>.

### ***The pollen of the Sudario of Oviedo***

The Swiss botanist had also studied the pollen present on the Sudarium of Oviedo using dust samples not taken by him in 1978 and by him in 1979<sup>29</sup>. As on the Shroud, also on the Sudarium he found cells of the epidermis of *Aloe socotrina*<sup>30</sup>. He also identified the pollen of 13 plants, four of which do not grow in Europe while are frequently encountered in Palestine, in the deserts, in salt places or on rocks<sup>31</sup>, and five others are Mediterranean plants that grow also in Palestine<sup>32</sup>. Frei stressed: “The *Acacia albida* is typical for the Dead Sea area and the *Hyoscyamus aureus* still grows on the walls of the Old Citadel of Jerusalem. These two plants are represented also on the Shroud”<sup>33</sup>. On the Sudarium the pollen of plants that instead indicate a presence of the Shroud in Anatolia and Constantinople are not present; this can be explained by a different route of the two relics to get in Europe<sup>34</sup>. The presence on the Sudarium of pollen of *Phoenix dactylifera*, *Ceratonia siliqua*, *Tamarix africana* and *Acacia albida* could mean a trip of the Sudarium through the North Africa<sup>35</sup>.

The research of pollen on the Sudarium of Oviedo was subsequently carried out by the biologist Carmen Gómez Ferreras, of the *Universidad Complutense* of Madrid, which has identified 25 types of pollen that confirm the stay of the Sudarium in a Mediterranean environment<sup>36</sup>.

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<sup>24</sup> M. FREI, *Il passato della Sindone alla luce della palinologia*, op. cit., p. 370, fig. 25; M. FREI, *Identificazione e classificazione dei nuovi pollini della Sindone*, op. cit., plate before p. 281, fig. 2.

<sup>25</sup> A. GHIO, *I pollini della Sindone in relazione alle ricerche palinologiche del prof. Max Frei in Sicilia*, in *La Sindone, indagini scientifiche, Atti del IV Congresso Nazionale di Studi sulla Sindone*, Siracusa, October 17-18, 1987, Ed. Paoline, Cinisello Balsamo (MI) 1988, pp. 127-131, on p. 130.

<sup>26</sup> A. GHIO, *I pollini della Sindone dalle ricerche di Max Frei*, op. cit., p. 116.

<sup>27</sup> P.C. MALONEY, *A contribution toward a history of botanical research on the Shroud of Turin*, op. cit., p. 254.

<sup>28</sup> P.C. MALONEY, *The current status of pollen research and prospects for the future*, op. cit., p. 2.

<sup>29</sup> A. GHIO, *I pollini della Sindone dalle ricerche di Max Frei*, op. cit., p. 117.

<sup>30</sup> G. RICCI, *L'Uomo della Sindone è Gesù*, Ed. Cammino, Milano 1985, p. 234.

<sup>31</sup> *Ibid.*, p. 235.

<sup>32</sup> *Ibid.*, p. 236.

<sup>33</sup> *Ibid.*, p. 237.

<sup>34</sup> *Ibid.*

<sup>35</sup> *Ibid.*, p. 238.

<sup>36</sup> C. GÓMEZ FERRERAS, *El Sudario de Oviedo y la palinología*, in *El Sudario del Señor, Actas del I Congreso Internacional sobre El Sudario de Oviedo*, Oviedo, October 29-31, 1994, Servicio de Publicaciones, Universidad de Oviedo, España 1996, pp. 83-90.

## *The investigation performed in the U.S.*

The archaeologist Paul C. Maloney contacted Frei in 1982 to ask him why, in his opinion, he had found so many pollen grains while STURP (Shroud of Turin Research Project) scientists had found only a pollen grain in their samples, also them taken by sticky tapes<sup>37</sup>. It should be noted that later someone in the U.S. has come even to accuse Frei of fraud<sup>38</sup> with arguments that have proven unfounded<sup>39</sup>. Accusations that were reiterated and expanded also in Italy<sup>40</sup>. The Swiss scientist answered Maloney that the difference was due to the different pressure carried in applying the sticky tape on the Shroud, lower in the case of the applicator used by STURP<sup>41</sup>. With the method of Frei, who manually pressed the tape, also the dust present in the depressions between the threads was captured<sup>42</sup>. Most of the material is found at the lead of the tape, where the higher pressure was applied<sup>43</sup>.

After Frei's death, Maloney continued to stay in touch with the widow, Gertrud Frei-Sulzer, who in January 1986 sent him five samples taken from the Shroud in 1978. In July 1987 the widow of Frei offered to Maloney the opportunity to acquire them permanently. The contacts continued and on July 15, 1988 the acquisition of the entire collection of Frei's samples by the ASSIST (Association of Scientists and Scholars International for the Shroud of Turin), of which Maloney was vice-president<sup>44</sup>, took place. They were the samples taken by Frei in 1978<sup>45</sup>; Maloney thought that those carried out in 1973 were lost in Vercelli<sup>46</sup>, where Ettore Morano, head physician of the Saint Andrew hospital of Vercelli, had subjected Frei's samples to the scanning electron microscope<sup>47</sup>. In reality, the 1973 samples were used by Frei to create 41 slides containing pollen<sup>48</sup>. Morano had examined also a piece of thread of the Shroud, of the length of a millimeter, entrusted to him by the International Center for Sindonology of Turin<sup>49</sup>. He had found in it rounded corpuscles in large numbers, which could be categorized as spores or pollen<sup>50</sup>. Frei said that he didn't find coated pollen in his samples<sup>51</sup>; they are

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<sup>37</sup> P.C. MALONEY, *ASSIST announces the acquiring of the Max Frei Collection for Shroud research*, in *The ASSIST Newsletter* 1, 1 (1989), pp. 1-3, on p. 2.

<sup>38</sup> J. NICKELL, *Pollens on the "Shroud": a study in deception*, in *Skeptical Inquirer* 18 (1994), pp. 379-385, on p. 379; S.D. SCHAFERSMAN, *Unraveling the Shroud of Turin*, in *Approfondimento Sindone* II, 2 (1998), pp. 31-48, on pp. 31-38.

<sup>39</sup> A. WHANGER, *Pollens on the Shroud: a study in deception*, in *Shroud News* 97 (1996), pp. 11-18; P.E. DAYVAULT, *The Frei collection digitization project*, in *The Shroud of Turin. Unraveling the Mystery, Proceedings of the 1998 Dallas Symposium*, Alexander Books, Alexander, North Carolina, USA 2001, pp. 215-217, on p. 216, and in *Sindone e Scienza. Bilanci e programmi alle soglie del terzo millennio, Atti del III Congresso Internazionale di Studi sulla Sindone*, Torino, June 5-7, 1998, pp. 1-3, on p. 1.

<sup>40</sup> G. CICCONE, *Sindone, pollini e bugie*, in *Micromega* 4 (2010), pp. 80-87; G. CICCONE, *La truffa dei pollini. Il dossier completo*, June 22, 2011, <http://sindone.weebly.com/pollini1.html>

<sup>41</sup> P.C. MALONEY, *ASSIST announces the acquiring of the Max Frei Collection for Shroud research*, op. cit., p. 2.

<sup>42</sup> P.C. MALONEY, *The current status of pollen research and prospects for the future*, op. cit., p. 4.

<sup>43</sup> *Ibid.*

<sup>44</sup> P.C. MALONEY, *ASSIST announces the acquiring of the Max Frei Collection for Shroud research*, op. cit., pp. 2-3.

<sup>45</sup> P.C. MALONEY, *The current status of pollen research and prospects for the future*, op. cit., p. 3.

<sup>46</sup> *Ibid.*, p. 7.

<sup>47</sup> M. FREI, *Il passato della Sindone alla luce della palinologia*, op. cit., p. 192.

<sup>48</sup> P.E. DAYVAULT, *The Frei collection digitization project*, op. cit., p. 215.

<sup>49</sup> E. MORANO, *Aspetti ultrastrutturali al microscopio elettronico a scansione di fibre della Sindone di Torino*, in *La Sindone, Scienza e Fede*, op. cit., pp. 201-204 and 379-384, on p. 201.

<sup>50</sup> *Ibid.*, p. 202.

<sup>51</sup> P.C. MALONEY, *The current status of pollen research and prospects for the future*, op. cit., p. 6.

no fossil grains<sup>52</sup>, but Maloney has observed, on some of the pollen from Frei samples, the association with an extraneous matter, opaque to light, adhering to them<sup>53</sup>.

At the first examination of Frei's samples, which occurred on July 23, 1988, about twenty people attended, among whom there were also the botanist Benjamin Stone, director of the Department of Botany of the Philadelphia Academy of Natural Sciences in Philadelphia (PA, USA), the chemist Walter C. McCrone, director of the McCrone Research Institute in Chicago (IL, USA) and the chemist Alan Adler of the Western Connecticut State University in Danbury (CT, USA). The pollen was more abundant in the first half of each tape and their number varied greatly from one area to another of the Shroud from which they were taken. Not only pollen, but also plant parts and floral debris, such as filaments and anthers, were observed. This supports the hypothesis, suggested by the palynologist A. Orville Dahl of the Pennsylvania University in Philadelphia (PA, USA), that flowers had been laid down on the Shroud at some time during its history<sup>54</sup>.

Frei was persuaded that the mechanism of deposition of the pollen on the Shroud was the wind<sup>55</sup>. Normally Frei in his samples found one to two pollen grains per square centimeter<sup>56</sup> and could not confirm the identity Mandylion-Shroud by a greater presence of pollen of Turkey near the face. He noted: "Given the fact that the sheet was rolled and unrolled and folded many times, on the occasion of his veneration throughout the centuries, more or less equal distribution of all the dust over the whole surface is not ruled out"<sup>57</sup>. Maloney, however, in some samples found a much greater quantity of pollen: on a sample from the side strip more than 80 pollen were present, on one from the trickle of blood on the left arm 160 and on one from an area close to the face more than 275 in two square centimeters. Dahl noted that half of the plants identified by Frei are insect pollinated and also for this reason he suggested that flowers were laid on the Shroud in a liturgical context<sup>58</sup>.

### ***The opinion of other botanists***

Examining Frei's work, the palynologist Aharon Horowitz of Tel Aviv University in Tel Aviv (Israel) said that the Shroud's pollen spectrum matches that of Israel, not that of North Africa. Danin said that he agreed and added that according to pollen it is possible to demonstrate an itinerary of the Shroud through the Negev and the highlands of Lebanon<sup>59</sup>.

The botanist Uri Baruch, of the Hebrew University of Jerusalem (Israel), expressed surprise for the absence of olive pollen on the Shroud<sup>60</sup>. A surprising absence also for the cytologist Silvano Scannerini, director of the Department of Plant Biology, University of Turin, and the palinologist Rosanna Caramiello of the same University. In fact, the olive is a plant with wind pollination<sup>61</sup>, and it should be

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<sup>52</sup> S. SCANNERINI - R. CARAMIELLO, *Il problema dei pollini*, in *Sindon Nuova Serie* 1 (1989), pp. 107-111, on p. 108.

<sup>53</sup> P.C. MALONEY, *The current status of pollen research and prospects for the future*, op. cit., pp. 6-7.

<sup>54</sup> T. FLAHERTY, *Verification of the Max Frei collection*, in *The ASSIST Newsletter* 1, 1 (1989), pp. 4-5.

<sup>55</sup> P.C. MALONEY, *The current status of pollen research and prospects for the future*, op. cit., p. 2.

<sup>56</sup> *Ibid.*, p. 4.

<sup>57</sup> M. FREI, *Identificazione e classificazione dei nuovi pollini della Sindone*, p. 280.

<sup>58</sup> C. MALONEY, *The current status of pollen research and prospects for the future*, op. cit., p. 5.

<sup>59</sup> *Ibid.*, p. 3

<sup>60</sup> *Ibid.*

<sup>61</sup> S. SCANNERINI - R. CARAMIELLO, *Il problema dei pollini*, in *Sindon Nuova Serie* 1 (1989), pp. 107-111, on p. 109.

noted that “the plants whose pollen are carried by insects (entomophilous pollination) produce a much smaller quantity of grains than those produced by plants whose pollen are carried by wind (anemophilous pollination). It is obvious, therefore, that finding an anemophilous pollen rather than an entomophilous pollen on a textile item will be more likely and this for the simple calculation of the probability of grains capture of different types on an inert support”<sup>62</sup>.

Daria Bertolani Marchetti, director of the Institute and Botanical Garden of Modena University, and Marta Mariotti Lippi, professor of Archaeobotany and Palaeobotany in the Department of Plant Biology, University of Florence, reminded that the olive flowering in the Mediterranean area occurs between late May and June for a short period of time. The olive pollen, which is not very light, has no points or hooks or other processes that facilitate adhesion<sup>63</sup>.

An experiment was performed by Mariotti Lippi in an olive yard of Malmantile, near Florence. An herringbone cloth, very similar to that of the Shroud, was exposed to air after being divided. One part was been treated with an aqueous solution of aloe and myrrh. It was found that the herringbone cloth has a remarkable ability to trap the pollen, especially after the treatment with aloe and myrrh<sup>64</sup>. The observations at the scanning electron microscope showed that the pollen grains are largely deposited on the surface of the weaving threads, but some of them are also penetrated deeply between the fibers of the threads themselves<sup>65</sup>.

With the passing of time, the samples subsequently hung in a closed room with no air currents were losing much of the pollen collected<sup>66</sup>. It is not said, however, that in the long run all pollen is lost: in a square centimeter of an Egyptian linen, taken from the second wrapping of a 1000 BC mummy, ten pollen grains have been identified<sup>67</sup>.

With regard to the sampling operated by Frei, the botanists Scannerini and Caramiello say: “The procedure seems to have been correct or in any case not such that it could greatly alter the characteristics of the pollen component of the dust taken”<sup>68</sup>. Rather it is “the attribution of a denomination to the species level of the detected grains that poses some questions”<sup>69</sup>. In fact, they ask themselves: “Except in the case of monospecific genera, how is it possible to be sure of giving a pollen to species having so scarce material (a few grains? About ten?) available?”<sup>70</sup>

In the study of pollen it must be kept in mind that “in some cases species from species are easily distinguished, in many cases only different genera (i.e. groupings of similar species) are distinguished

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<sup>62</sup> S. SCANNERINI, *Mirra, aloe, pollini e altre tracce. Ricerca botanica sulla Sindone*, Editrice Elle Di Ci, Leumann (Turin) 1997, p. 47.

<sup>63</sup> D. BERTOLANI MARCHETTI - M. MARIOTTI LIPPI, *Pollini e ricerche sindoniche: nuove linee di indagine*, in *L'identification scientifique de l'Homme du Linceul: Jésus de Nazareth, Actes du Symposium Scientifique International*, Rome, June 10-12, 1993, OEIL-F.-X. de Guibert, Paris, France 1995, pp. 337-340 and plate 10, on p. 38.

<sup>64</sup> M. MARIOTTI LIPPI, *Fabrics as pollen traps: some observations*, in *Acheiropoietos - “Non fait de main d'homme”, Actes du III Symposium Scientifique International du CIELT*, Nice, May 12-13, 1997, Éditions du CIELT, Parigi 1998, pp. 237-240, on p. 239.

<sup>65</sup> M. MARIOTTI LIPPI, *Analisi palinologiche su tessuti nel quadro delle ricerche sindoniche*, in *Studi in ricordo di Daria Bertolani Marchetti. Atti della Giornata di Studi*, Formigine, May 18, 1996, Aedes Muratoriana, Modena 1998, pp.113-121, on p. 120.

<sup>66</sup> M. MARIOTTI LIPPI, *Fabrics as pollen traps: some observations*, op. cit., p. 238.

<sup>67</sup> D. BERTOLANI MARCHETTI - M. MARIOTTI LIPPI, *Pollini e ricerche sindoniche: nuove linee di indagine*, op. cit., p. 339.

<sup>68</sup> S. SCANNERINI - R. CARAMIELLO, *Il problema dei pollini*, op. cit., p. 107.

<sup>69</sup> *Ibid.*, p. 108.

<sup>70</sup> *Ibid.*

from each other, not rarely you come to discriminate only families (i.e. groups of similar genera)”<sup>71</sup>. Furthermore, “to be sure the diagnosis should be done on a large number of grains from the same source”<sup>72</sup>.

### ***The question of Gundelia tournefortii***

Danin and Baruch have published some papers<sup>73</sup> in which Danin exposes his research on plants images he believes to be present on the Shroud and Baruch examines part of Frei’s samples kept at the CSST (The Council for Study of the Shroud of Turin) since 1993 and acquired in 1996<sup>74</sup>. The samples taken by Frei in 1973 and 14 of the 27 samples taken by him in 1978 are studied<sup>75</sup>. According to Baruch, “in some cases, because of the sticky tape covering and of heavy deterioration of the grains, Frei’s determinations could be only partially confirmed”<sup>76</sup>. A third of the observed grains remains unidentified<sup>77</sup>. He refers that “of the 34 pollen reported at the specific level by Frei, only 3 are recognized as such: *Gundelia tournefortii*, *Ricinus communis* e *Lomelosia (Scabiosa) prolifera*. All Frei’s determinations are correct at the higher taxonomical level”<sup>78</sup>. Moreover, the most frequent type of pollen is that of *Gundelia tournefortii*, which accounts for one third of the grain identified<sup>79</sup>.

Baruch specifies: “It should be noted that poor optical quality of most samples (caused by the covering sticky tapes) and pollen grain deterioration prevented in many cases positive identification of the grains and in many other cases did not permit determination beyond the most basic level (usually the family level). Due to a very restrictive protocol in treating Frei’s samples, acetolysis and destructive examination of them are impossible. Throughout most of the study, the 100x oil objective was not used because of the fear that the immersion oil might damage the sticky tapes. Immersion oil and examination at 1000x were only used for one, late sample (tape 6Bd)”<sup>80</sup>. In this sticky tape an opened anther with a few pollen grains inside is seen. Pollen morphology was obscured by the sticky tape as well as by the anther wall<sup>81</sup>.

On the identification of *Gundelia tournefortii* by Baruch, and in general on his review work on Frei’s samples, the palynologist Vaughn Bryant of Texas A&M University in College Station (TX, USA) expressed considerable concerns. He points out that when pollen remains on sticky tape for a long time, begins to sink into the tape’s glue. It can arrive to obscure grain’s essential morphological

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<sup>71</sup> S. SCANNERINI, *La questione dei pollini*, in *Sindon Nuova Serie* 9-10 (1996), pp. 74-90, on p. 82.

<sup>72</sup> S. SCANNERINI, *Mirra, aloe, pollini e altre tracce. Ricerca botanica sulla Sindone*, op. cit., p. 47.

<sup>73</sup> A. DANIN - U. BARUCH, *Floristic indicators for the origin of the Shroud of Turin*, in *The Shroud of Turin. Unraveling the Mystery*, op. cit., pp. 200-214 and in *Sindone e Scienza. Bilanci e programmi alle soglie del terzo millennio*, op. cit., pp. 1-13; A. DANIN - A.D. WHANGER - U. BARUCH - M. WHANGER, *Flora of the Shroud of Turin*, Missouri Botanical Garden Press, St. Louis, Missouri, USA 1999.

<sup>74</sup> A.D. WHANGER, *Botanical study of the Shroud of Turin*, in *Sindone 2000, Atti del Congresso Mondiale*, Orvieto, August 27-29, 2000, Gerni Ed., San Severo (FG) 2002, pp. 241-249 and 73, on p. 245; P.E. DAYVAULT, *The Frei collection digitization project*, op. cit., p. 217.

<sup>75</sup> A. DANIN - U. BARUCH, *Floristic indicators for the origin of the Shroud of Turin*, op. cit., p. 203.

<sup>76</sup> A. DANIN - A.D. WHANGER - U. BARUCH - M. WHANGER, *Flora of the Shroud of Turin*, op. cit., p. 13.

<sup>77</sup> *Ibid.*

<sup>78</sup> A. DANIN - U. BARUCH, *Floristic indicators for the origin of the Shroud of Turin*, op. cit., p. 204.

<sup>79</sup> *Ibid.*

<sup>80</sup> A. DANIN - A.D. WHANGER - U. BARUCH - M. WHANGER, *Flora of the Shroud of Turin*, op. cit., pp. 10-11.

<sup>81</sup> *Ibid.*, p. 13.

features<sup>82</sup>. At first Danin continued to support the abundance of *Gundelia tournefortii* grains in Frei's samples<sup>83</sup>, then submitted the slides of Frei's tapes to the palynologist Thomas Litt of the Institute of Paleontology, University of Bonn (Germany), who answered him: "The images produced by light microscopy (interference contrast) and by confocal laser-scanning microscopy show clearly that waxes are preserved and cover the structure and sculpture of the pollen grains. This is the reason why I cannot make a precise identification of the pollen at the genus level, even less at the species level. However, with a high probability, I can exclude that the pollen I have seen on the sticky tapes belong to *Gundelia*"<sup>84</sup>.

The supposed *Gundelia* is now considered by Danin as belonging to the most general classification of the type *Carduus*, a group that includes many species of thistle<sup>85</sup>. He adds: "A general statement of a high frequency of thorny plants (of the type *Carduus*) does not help. If there are pollen grains determined to the species level, then you can say something about the way in which the group of plants found on the Shroud can be arrived there"<sup>86</sup>. So his interest in the pollen of the Shroud has definitively waned: "I regret that, from what I have learned from our research, we cannot currently use the pollen to define any geographical indication"<sup>87</sup>. Danin prefers to continue his investigation of what he considers plant images on the Shroud<sup>88</sup>.

### ***The problem of the species identification***

Looking at the list provided by Frei, the botanists Scannerini and Caramiello noted that "the monospecific entities are only three or four for those of Palestinian territory, two among the very diffuse ones and one among the elements of tropical origin cultivated in Europe"<sup>89</sup>. They specify: "This observation does not intend to invalidate the work, of which in the beginning was already stressed the care: if Frei had limited himself to the genus identification, an operation already problematic in itself, in many cases, with little material, his conclusions on the path of the Shroud, its exhibitions in different places and the consequent contacts with environments where pollen amount is very different, would be equally significant and perhaps even more probatory"<sup>90</sup>. Scannerini notes that this is "presumptive evidence, because the number of grains on which Frei has worked is small (...), but the circumstantial proofs are not negligible"<sup>91</sup>. He adds: "So Frei's results document that the Shroud really stayed in

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<sup>82</sup> V.M. BRYANT, *Does pollen prove the Shroud authentic?* in *Biblical Archaeological Review* 26, 6 (2000), pp. 36-44 and 75, on p. 42.

<sup>83</sup> A. DANIN, *Micro-traces of plants on the Shroud of Turin as geographical markers*, in *The Turin Shroud, past, present and future, International Scientific Symposium*, Turin, March 2-5, 2000, Effatà Editrice, Turin 2000, pp. 495-500, on p. 496.

<sup>84</sup> A. DANIN - H. GUERRA, *L'uomo della Sindone. Un botanico ebreo identifica immagini di piante della Terra Santa sulla Sacra Sindone*, Edizioni Art, Rome 2008, pp. 51-52.

<sup>85</sup> *Ibid.*, p. 46.

<sup>86</sup> *Ibid.*, p. 54.

<sup>87</sup> *Ibid.*

<sup>88</sup> A. DANIN, *Botany of the Shroud. The story of floral images on the Shroud of Turin*, Danin Publishing, Jerusalem, Israel 2010.

<sup>89</sup> S. SCANNERINI - R. CARAMIELLO, *Il problema dei pollini*, op. cit., p. 109.

<sup>90</sup> *Ibid.*

<sup>91</sup> S. SCANNERINI, *Mirra, aloe, pollini e altre tracce. Ricerca botanica sulla Sindone*, op. cit., p. 48.

Palestine, Anatolia and, as documented without a shadow of doubt, in recent times and today, in Savoy and Piedmont”<sup>92</sup>.

Bertolani Marchetti said: “The pollen *florula* of the Shroud gives clear evidence of steppe, desert, trampled places environments etc., which could be disseminated in a country where intense grazing must have contributed to the maintenance of those aspects of the landscape. At a cursory examination, done in light of events, a setting in a time which dates back to about 2000 years ago would seem more truthful”<sup>93</sup>.

The remarks of Scannerini and Caramiello are interesting: “In conclusion, the work on the Shroud pollen keeps all its interest and just for this it would be desirable to supplement it, thereby attempting to eliminate what would seem an excess of precision not supported by sufficient evidence, especially because of the poor methodological indications, and also, increasing the area under consideration, trying to fill those «emptiness» of floristic entities that currently have no explanation”<sup>94</sup>.

Mariotti Lippi has recently pointed out some aspects of the palynological investigation. In general, she believes that not all the pollen that has settled over time on the Shroud has been lost. As regards the characteristics to discriminate pollen, she reminds that “some of them are more visible or only visible by light microscopy, whereas others are visible under an electron microscope. (...) To give an example: the shape, size, thickness of the esina ordinarily are studied by light microscopy, while the ornaments are best demonstrated in the scanning electron microscope”<sup>95</sup>. Moreover, she emphasizes that “it is essential for the palynologist to keep in mind constantly that different physical or chemical treatments may lead to not identical results. For example, the simple hydration leads to the changement in size and shape of the grain: a small pollen grain, with elliptical profile, can become larger and spherical if hydrated”<sup>96</sup>.

With regard to the research performed by Frei on the Shroud, Mariotti Lippi writes: “Frei was an expert in palynological analyzes and knew the history of the Shroud, but in spite of having referred specifically to it, he seems to have taken into account it only in part. His experience as a criminalist was helpful for him to develop a sampling methodology, but probably he had not sufficient familiarity with the investigation of ancient materials. Probably, just because he knew he could not treat the contents of the Shroud pollen in the same way as that coming from a natural sediment, he abstained from the classic formulation of the pollen spectrum: the quantitative data is important, but it is necessary to know how to interpret it correctly and be aware that it assumes different meaning depending on the situation. In the case of the Shroud, precisely because of its history, the reading of the list of grains as a whole, as if they were deposited in a restricted period of time and in one locality, may conduct any palynologist to a result that is meaningless. Therefore, in the first instance, the addition of quantitative data can only create further confusion. The same data instead can provide clues

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<sup>92</sup> *Ibid.*, p. 50.

<sup>93</sup> D. BERTOLANI MARCHETTI, *Il contenuto pollinico della S. Sindone nel contesto dell'evoluzione climatico-vegetazionale dell'epoca*, in *La datazione della Sindone, Atti del V Congresso Nazionale di Sindonologia*, Cagliari, April 29-30, 1990, pp. 65-75, on p. 67.

<sup>94</sup> S. SCANNERINI - R. CARAMIELLO, *Il problema dei pollini*, op. cit., p. 110.

<sup>95</sup> M. MARIOTTI LIPPI, *Riflessione sulle analisi palinologiche condotte sulla Sindone di Torino*, in *Collegamento pro Sindone Internet*, September 2011, <http://www.sindone.info/MARIOTTI.PDF>, pp. 2-3.

<sup>96</sup> *Ibid.*, p. 3.

when you want to account for what was the cause that has made more or less abundant amounts or specific concentrations of grains deposit on the Shroud surface”<sup>97</sup>.

“The limit of the research carried out by Frei was - continues Mariotti Lippi - his willingness to identify at all costs, at the species level, the grains that he found. (...) When I have been dealing with the results of Frei’s investigations, since it was not possible to perform new sampling, nor have I had access to the material he collected, I decided to do the following. I looked at the list of identified and published species by Frei and I deleted all the plants that were represented, even only to genus level, in Europe, where we know the Shroud has stayed and is preserved. The list has shrunk considerably, but there are still plants in it peculiar of the Middle East areas. I considered the likelihood of errors in the identification, evaluating it on the basis of the similarity among the grains of various species within the mentioned genera, and within their families. This second operation was completely arbitrary and indicative, as I had no access to original images of the pollen grains in question. The list was further reduced, but still remained pollen grains of some Middle East plants, in my opinion very recognizable. I concluded that the Shroud, in some unspecified period of time, stayed in the Middle East. Where exactly I was not able to say, nor when”<sup>98</sup>.

“Since then - Mariotti Lippi writes more - other scholars have had direct access to the material taken by Frei. It is interesting to see how the palinologists, that is, the field’s experts, have not been interpellated except in the second or third instance and their results have been obtained by a partial or very partial revision of the material removed from the Shroud. These palinologists today cast doubt on the identifications made by Frei, thereby making even my remarks, that could only be based on library materials, waver. Even today, the scientific community has not at its disposal, among the literature of the field, the detailed results of any of these works, starting with Frei’s, never published in scientific journals. Based on available data, I do not feel myself empowered to share the negative judgment on Frei given about his good faith and moral correctness. I also think that Frei, perhaps taken by the enthusiasm, with little reference material and not being an expert in archaeo- and paleo-botanical surveys, was not able to set his research work from the scientific point of view, thus incurring a series of errors of evaluation that he was not able before first to foresee, then to correct”<sup>99</sup>.

“What today would make sense to do - Mariotti Lippi concludes - would be the review of the material already collected by a committee of palinologists: the possible presence of Middle East pollen grains would bolster the hypothesis of a staying of the sheet in the Middle East”<sup>100</sup>.

## ***Conclusions***

Nearly thirty years after the death of Frei, the work of this pioneer of palynological research, despite its limitations, however deserves appreciation and respect. As for all the other study fields of the Shroud of Turin and the Sudarium Oviedo, the result verification of this survey should be conducted by a board of free from bias referees and published in a scientific specialized journal. However, since

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<sup>97</sup> *Ibid.*, pp. 3-4.

<sup>98</sup> *Ibid.*, pp. 4-5.

<sup>99</sup> *Ibid.*, p. 5.

<sup>100</sup> *Ibid.*, p. 6.

the residual material of Frei's samples could be no more in conditions of providing useful information, it would be desirable to have a parallel new campaign of tests and sampling, to get to the end of a path that the Swiss botanist, unfortunately, could not complete.

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