

RESEARCH ARTICLES (5)
PROBLEMS WITH POLLEN
Hugh Farey

In 1973, Max Frei took about 12* sticky-tape samples from the upper body image Shroud and identified 48 different varieties of pollen grains. In 1978 he took about 26* further samples, and was given “samples from the silver shrine in which the relic has been kept.” He also studied photographs of the dust extracted by vacuuming by Giovanni Riggi. From these four sources, Frei identified 57 different plants (56 in the form of pollen, one in the form of multicellular hairs). To study them clearly, grains were extracted from their sticky tape and “embedded in glycerine jelly” on separate slides, so that they could be examined from all sides. He claimed that every identification was confirmed both by optical and Scanning Electron Microscope. As a byproduct of the microscopical studies, he also identified hairs of *Platanus orientalis* (a plane tree) and epidermis cells of *Aloe socotrina*. This last (Aloes), and also *Ambrosia coronopifolia*, an American ragweed whose pollen on the Shroud presumably derived from the clothes of the STURP team, were omitted from his final list of 58 plants. ⁽¹⁾

Frei wrote a short article about his findings in an article in Shroud Spectrum International (Issue 3, June 1982), but sadly died before he could produce a more detailed analysis, and the book he was writing “The Pollens of the Shroud of Turin” was never published. A rather critical description of Frei’s working methods in John Heller’s “Report on the Shroud of Turin” ⁽²⁾ prompted Frei’s friend Fr Werner Bulst to publish a second article on the pollen, including a facsimile of Frei’s original table of the 58 plants and where they came from (Issue 10, March 1984). ⁽³⁾ Out of respect for both for Frei’s expertise as a pollen specialist, and for the fact that he had spent the last nine years of his life working on the Shroud, his findings have been treated as inviolable, and found their way into many

* The exact number varies from source to source.

other publications as incontrovertible proof that the Shroud must have been from Jerusalem.

However, almost from the moment they left Turin, Frei's sticky tape samples have been subject to some quite specific criticism. He had found too many grains, only about half of them were from wind-pollinated plants, the geographical and biological distribution was unconvincing, they looked far too fresh, and he had been impossibly precise about identification. Having spent four years exploring Turkey and the Middle-East for plant samples with which to compare his Shroud tapes, he was accused of deliberately doctoring them to fit the hypothesis that the Shroud had been made in Israel and travelled to Constantinople before ending up in France and Italy. Each of these points will be discussed below, with some reference to the comments of the various other scientists who have examined some of Frei's tapes, among them Walter McCrone, Orville Dahl, Uri Baruch and Thomas Litt.

1) Frei found too many grains of pollen to be credible.

Sticky-tape samples of the surface of the Shroud were taken in two ways, one by the STURP team, using a purpose-designed applicator which applied the tape with a constant, pre-determined force, and the other by Max Frei, who pushed the tape hard against the cloth by rubbing it with a fingernail. Nevertheless, Walter McCrone said he found "an average [of] less than 2 - 3 pollen grains per tape" on the STURP samples, and "an average of 2 - 3 on all but one of Max Frei's tapes." Frei himself, responding to a question by McCrone, said that he had found "one per centimetre." McCrone considered that he could not have had more than 130 pollen grains to examine - with the exception of a single tape which had "several hundred (!) pollen grains in one heavy smear." (4)

A few years later, in 1998, Uri Baruch, a palynologist with the Israel Antiquities Authority, was able to examine some of Frei's tapes in detail. In two papers by Avinoam Danin, two slightly different accounts are given. In a short article published at www.shroud.com (5), Danin wrote that Baruch "analyzed most of Frei's 1973 sticky tape pollen specimens

and ten of the twenty-five 1978 sticky tapes. He examined 165 pollen grains, of which 45 (27.3%) were *Gundelia tournefortii*. On some of the tapes, he found more than ten grains in an area less than 5x1 cm." In another 1998 paper, however, presented before the 3rd International Congress on the Shroud of Turin ⁽⁶⁾, Danin says: "Microscopic slides sampled by Dr Max Frei in 1973 and 14 of the 27 slides he sampled in 1978 were studied microscopically at 100 to 800 power magnification. [...] The most frequent type of pollen of all 168 grains studied is that of *Gundelia tournefortii* which accounts for 33.3% of the grains investigated and identified." Curiously, in Table 2 at the end of this same paper, Uri Baruch lists 203 identified grains (mistotaled as 204), and a further 109 unidentified ones, making 312 in all. 91 grains were identified as *Gundelia tournefortii*, which is about 45% of the total identified.

If about 2 grains per tape is reasonable, then a total of 70 - 90 grains would be expected from Frei's complete set of samples. It does seem that 300 or so is pushing the bounds of credibility. On the other hand, Emanuela Marinelli, ⁽⁷⁾ quoting Paul Maloney, says that some slides had much larger quantities - "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 centimetres." It is difficult to reconcile all these various observations.

2) The proportion of insect-pollinated plants is too great.

Plants whose pollen is wind-borne rather than carried by insects have about 10 times as much pollen per anther, and scatter it indiscriminately. ⁽⁸⁾ Insect borne pollen sticks quite firmly to its parent plant until captured by insects, which usually requires the plant to be brushed against. Under natural circumstances, the vast majority of any pollen assemblage would be from wind-borne pollen, and the Frei samples consist of a vast disproportion of insect-borne pollen. However, one explanation is that most of the pollen on the Shroud was indeed placed there, as part of the funeral rites. For this to make sense, then all the different insect-borne pollens from Israel found on the Shroud must have come from plants growing in the vicinity of Jerusalem.

3) The geographical distribution of the plants is unrealistic.

If the Shroud is truly that of Christ, it seems unlikely that it was exposed to the elements in Israel for very long before being hurried away in hiding, perhaps through Turkey to Constantinople, where it may have been sporadically exposed to the faithful before being looted by crusaders and taken to France. It is extraordinary, then, that so many of the plants can be found in one or other of the two principle databases of Israeli flora, Avinoam Danin's Flora of Israel Online ⁽⁹⁾ and (useful for common names) Sarah Gold and Amram Eshel's Wild Flowers of Israel ⁽¹⁰⁾, and so few can be found in Europe. Some balance can be restored if we only consider wind-borne pollen, when about the same number of plants are represented from Israel and Europe, but we are then left with the corollary that some 20 different species of flowering plant were hurriedly collected from different parts of Israel, including the shores of the Dead Sea, in a single afternoon, as part of the funerary tribute, in order to account for the insect-pollinated pollen variety.

4) The biological distribution of the plants is unrealistic.

According to Steven Schafersman, a micropaleontologist from Miami University, who contributed an Appendix to Walter McCrone's book, *Judgement Day for the Turin Shroud* ⁽⁴⁾, a typical assemblage consists "almost entirely of tree and grass pollen." Only about 38% of Frei's pollens are from trees and shrubs, and virtually none from grasses. Furthermore, over 10% flower in the second half of the year, which would of course, be too late for the crucifixion and resurrection.

5) The pollen look too fresh.

I have never seen any of Max Frei's photographs of the pollen he found on the Shroud, although a number of illustrated publications and videos in which he features are available. However they are accompanied by SEM photos of collections of pollen from type specimens, and are none of them originals. Frei himself said that "none of the pollens was glued to the cloth with tempera, or covered with tempera." Giovanni Riggi, on the other hand, said that practically all the pollen he saw was covered with 'incrustations' or a 'mineral coating.'⁽¹¹⁾ Frei attempted to explain his

results by claiming that Riggi's samples were largely taken by vacuuming from the non-image side of the Shroud (part of which would have been in contact with the limestone of the tomb), whereas his were from the image side, which was protected from it. However Riggi noted that even the STURP tape samples also contained principally unidentifiable, mineral-coated pollen.

6) Frei was too precise about identification.

Of his 58 plant types, Frei identified all but two at species level. This has been roundly condemned on theoretical grounds, as even 30 years later, with better preparation methods and better microscopes, palynologists still find it difficult to identify pollen precisely even at genus level, preferring to classify it according to "type." ⁽¹²⁾ Uri Baruch, who examined 31 of the slides onto which Frei had transferred his pollen for identification, was only able to confirm four species, and even one of those has been seriously called into question.

At the very least, the case against any credibility being able to be given to Max Frei's pollen analysis is strong, and those who still maintain that his sticky-tape samples are truly representative of the pollen assemblage on the Shroud have some serious defending to do. Their case is not helped by the considerable secrecy with which Frei worked, his untimely death, and the fact that none of the SEM photos with which he illustrated his lectures was actually from his own work. Recently, criticism has focussed on one particular 'smoking gun,' Slide 6 B/d, which, according to the grid drawn up in 1973, was taken from the part of the Shroud including the image made by the hair and beard of the left-hand side of the face.

This slide, it was claimed, had a huge assemblage of identical pollen piled at one end. McCrone claimed that it also had an unusually large number of cotton (glove) fibres, suggesting that the tape had been peeled back from the slide and pollen dabbed onto it. This was the slide he referred to in *Judgement Day for the Turin Shroud*, and also the one on which Uri Baruch identified 91 specimens of *Gundelia tournefortii*, one of

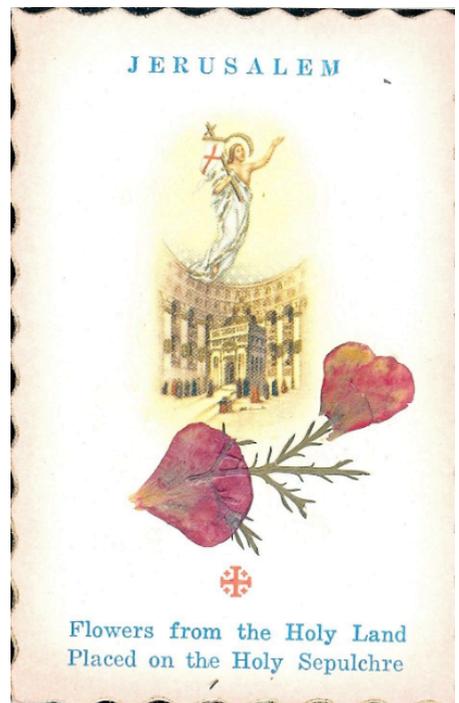
the only four species level identifications in which he concurred with Frei. As *Gundelia tournefortii* is an unattractive, insect-pollinated, extremely thorny desert plant, the pollen was at first claimed to be from the crown of thorns (adding a new twist to the story, as Christ would have wreathed in flowers). However, in 2001, Thomas Litt, another palynologist, of the University of Bonn, was given the chance to study some of the famous slides, and decided that the pollen wasn't from *Gundelia* at all, but more likely from a thistle of the genus *Carduus*. Ignoring the fact that thistles are found all over the world, pro-authenticists seized upon *Carduus argentatus*, an Israeli thistle, as the species represented on the Shroud.

Assuming that most of the pollen found on the Shroud was actually placed there, if not by fraud then out of devotion, there are a couple of possible lines of inquiry. In an article on the use of plants in ancient funerary rituals,⁽¹³⁾ Marzia Boi, a palynologist at the University of the Balearics, listed some plants that might have been typical of 1st century Jewish funerary rituals, dividing them into oils, incenses and spices. Given that she mentions some 40 possible plants, it is hardly surprising that she finds some of them on the Shroud. However, Boi makes far too much of them. After Baruch had tentatively identified 8.2% of the pollen as Cistaceae (200 species of rock roses), 4.2% as Umbelliferae (3700 species of carrots and parsley), and 0.6% as Pistacia (20 species), Boi assumes these can be narrowed down to kinds of laudanum, galbanum and mastic, which can be used in funerary rites. This is unwarranted.

However, Boi went on to compare the illustrations accompanying Frei's identifications (which are not, as we have seen, his actual observations), and declare that some of them were incorrect. In particular, she reclassified his Anemone as Pistacia, and both his *Ridolfia* and his *Gundelia* (also disputed by Litt, above) as *Helichrysum*, a plant which is used today as an 'essential oil' and which Boi claims was used for embalming in ancient times. There seems little to support this.

Another way in which insect-borne flower pollen from the Holy Land could end up on a cloth in Turin is by having flowers pressed

against the cloth, so that they could then be sold as second class relics and souvenirs of the Shroud. When I first read this in Ciccone's paper I was skeptical, until I looked at his dozen or so illustrations, and then searched for some myself on ebay. Although the Shroud is heavily protected today, dozens of cards are available of flowers pressed against the Holy Sepulchre or the Holy Manger, for only a few dollars, and I have no doubt that something similar could have happened to the Shroud in the past.



Souvenirs of flowers of the Holy Land pressed against sacred objects
found on ebay.com

To complete the picture, we should mention Alan and Mary Whanger's discovery, if so it be, of 28 different types of plant whose imprints they identify on the Shroud. As long ago as 1983 Oswald Scheuermann spotted *Chrysanthemum coronarium*, later confirmed both by

Alan Whanger and Avinoam Danin. However its pollen was not among those identified by Max Frei, Uri Baruch, or Thomas Litt. In his Flora of Israel (Plant Stories, Chapter 15), Danin identifies 15 of the Whanger's plants, but only 10 match Frei's identifications. In his own article, "Holes in the 3D-Image of the Body on the Shroud" ⁽¹⁴⁾ Danin describes how on the right side of the face and across the brow, "there is an almost continuous carpet of flowers [...] most similar in shape and size to flowering heads of *Matricaria recutita* or *Anthemis bornmuelleri*." The pollen of neither of these flowers was among those identified by Max Frei.



Gundelia tournefortii (left) or *Zygophyllum dumosum* (right)
Unlikely plants to use in funerary rites, in my opinion

The table which follows lists of Frei's identified species. Some of his names are more commonly known by alternatives, which are given here. Of the 203 pollen identified by Baruch, some 61% of Frei's species were identifiable only at Genus level, and a further 17% only at Family level. The proportions of these are given here.

Formal Name * Corrected from the original		Common Name	Type of Plant	How Pollinated	Found in Israel
<i>Faidherbia</i>	<i>albida</i> *	Winter Thorn	Tree	Wind	Yes
<i>Alnus</i>	<i>glutinosa</i>	Common Alder	Tree	Wind	
<i>Althaea</i>	<i>officinalis</i>	Marshmallow	Perennial	Insect	Yes
<i>Amaranthus</i>	<i>blitum</i> *	Purple Amaranth	Annual	Wind?	Yes
<i>Anabasis</i>	<i>syriaca</i> *		Dwarf Shrub	Wind?	Yes
<i>Anemone</i>	<i>coronaria</i>	Garden Anemone	Bulb/Tuber	Insect	Yes
<i>Artemisia</i>	<i>sieberi</i> *		Dwarf Shrub	Wind?	Yes
<i>Atraphaxis</i>	<i>spinosa</i>	Spiny Atraphaxis	Dwarf Shrub	Insect	Yes
<i>Bassia</i>	<i>muricata</i>		Annual	Wind?	Yes
<i>Capparis</i>	<i>sp.</i>	Caper bush	Dwarf Shrub	Insect?	Yes
<i>Carduus</i>	<i>personata</i>	Great Marsh Thistle		Insect	
<i>Carpinus</i>	<i>betulus</i>	Common Hornbeam	Tree	Wind	
<i>Cedrus</i>	<i>libani</i> *	Cedar of Lenanon	Tree	Wind	Yes
<i>Cistus</i>	<i>creticus</i>	Pink Rock Rose	Dwarf Shrub	Insect	Yes
<i>Corylus</i>	<i>avellana</i>	Corkscrew Hazel	Shrub	Wind	
<i>Cupressus</i>	<i>sempervirens</i>	Italian Cyprus	Tree	Wind	Yes
<i>Echinops</i>	<i>glaberrimus</i>		Low Plant	Insect	Yes
<i>Epimedium</i>	<i>pubigerum</i>	Bishop's Hat		Insect	
<i>Fagonia</i>	<i>mollis</i>	Fagonbush	Dwarf Shrub	Insect	Yes
<i>Fagus</i>	<i>silvatica</i>	Beech	Tree	Wind	
<i>Glaucium</i>	<i>grandiflorum</i>	Red-horned Poppy	Low Plant	Insect	Yes
<i>Gundelia</i>	<i>tournefortii</i>	Tumble Thistle	Low Plant	Insect?	Yes
<i>Haloxylon</i>	<i>persicum</i>	White Saxaul	Shrub	Insect	Yes
<i>Haplophyllum</i>	<i>tuberculatum</i>		Dwarf Shrub	Insect	Yes
<i>Helianthemum</i>	<i>vesicarium</i>	Pink Sun Rose	Dwarf Shrub	Insect	Yes
<i>Hyoscyamus</i>	<i>aureus</i>	Golden Henbane	Dwarf Shrub	Insect	Yes
<i>Hyoscyamus</i>	<i>reticulatus</i>	Egyptian Henbane	Low Plant	Insect?	Yes
<i>Ixiolirion</i>	<i>tataricum</i> *	Blue Desert Lily	Bulb/Tuber	Insect	Yes
<i>Juniperus</i>	<i>oxycedrus</i>	Plum Juniper	Tree	Wind?	Yes
<i>Laurus</i>	<i>nobilis</i>	Bay Laurel	Tree	Insect?	Yes
<i>Linum</i>	<i>mucronatum</i>		Dwarf Shrub	Insect	Yes
<i>Lythrum</i>	<i>salicaria</i>	Purple Loosestrife	Low Plant	Insect	Yes

Found in Turkey	Found in N. Europe	Flowering Season	% of Genus/Family found by Baruch	Comments
		Mar-Sep	0.5	Frei: <i>Acacia albida</i>
	Yes	Spr		
	Yes	Aug-Sep		
	Yes	Jun-Dec		Frei: <i>A. lividus</i>
		Aug-Sep	0.5	Frei: <i>A. aphylla</i>
	Yes	Spr		
Yes		Sep-Dec	1.5	Frei: <i>A. Herba-alba</i>
Yes		May-Jun	0.5	
		Feb-Jun		
Yes			0.5	
	Yes		0.5	
	Yes	Spr		
Yes	Yes		1.0	Frei: <i>C. libanotica</i>
		Mar-Jun	12.8 (family)	
Yes	Yes	Win-Spr	0.5	
Yes	Yes		0.5 (family)	
		Jun-Oct	2.0	
Yes		Apr-Jun		
		Feb-Apr	1.0	
	Yes			
		Mar-May	44.8	May be misidentified
		Feb-Apr		
		Mar-Apr	0.5	
		Jan-May		
		Mar-Jun	0.5	
		Feb-Apr		
		Spr		Frei: <i>I. montanum</i>
Yes	Yes	Mar-Apr		
Yes	Yes	Mar-May		
		Mar-May	0.5	
Yes	Yes	Jun-Nov		

Formal Name * Corrected from the original		Common Name	Type of Plant	How Pollinated	Found in Israel
<i>Oligomeris</i>	<i>linifolia</i> *		Annual	Wind?	Yes
<i>Podonosma</i>	<i>orientalis</i> *	Golden Drop	Dwarf Shrub	Insect?	Yes
<i>Oryza</i>	<i>sativa</i>	Rice	Grass	Wind	
<i>Paliurus</i>	<i>spina-christi</i>	Crown of Thorns	Tree	Wind	Yes
<i>Peganum</i>	<i>harmala</i>	Wild Rue	Low Plant	Insect	Yes
<i>Phyllyrea</i>	<i>angustifolia</i>	Mock Privet	Shrub	Insect	
<i>Pinus</i>	<i>halepensis</i>	Aleppo Pine	Tree	Wind	Yes
<i>Pistacia</i>	<i>lentiscus</i>	Mastic Tree	Shrub	Insect	Yes
<i>Pistacia</i>	<i>vera</i>	Pistacio Nut	Tree	Wind?	
<i>Platanus</i>	<i>orientalis</i>	Oriental Plane	Tree	Wind	Yes
<i>Sarcopoterium</i>	<i>spinusum</i> *	Prickly Burnet	Dwarf Shrub	Wind	Yes
<i>Prosopis</i>	<i>farcta</i>	Dwarf Mesquite	Shrub	Insect	Yes
<i>Prunus</i>	<i>arabica</i>		Shrub	Insect	
<i>Pteranthus</i>	<i>dichotomus</i>		Annual	Wind?	Yes
<i>Reaumuria</i>	<i>hirtella</i>	Common Reaumuria	Dwarf Shrub	Insect	Yes
<i>Ricinus</i>	<i>communis</i>	Castor Oil Plant	Shrub	Insect	Yes
<i>Ridolfia</i>	<i>segetum</i>	Bishop's Weed	Annual	Insect	Yes
<i>Roemeria</i>	<i>hybrida</i>	Purple-horned Poppy	Annual	Insect	Yes
<i>Lomelosia</i>	<i>prolifera</i>	Prolific Scabious	Annual	Insect	Yes
<i>Scirpus</i>	<i>triqueter</i> *	Club Rush		Wind	
<i>Secale</i>	<i>sp.</i>	Grass		Wind	Yes
<i>Silene</i>	<i>conoida</i>	Campion	Annual	Insect	Yes
<i>Suaeda</i>	<i>aegyptiaca</i>		Low Plant	Wind?	Yes
<i>Tamarix</i>	<i>nilotica</i>	Nile Tamarisk	Tree	Wind?	Yes
<i>Taxus</i>	<i>baccata</i>	Yew	Tree	Wind	
<i>Zygophyllum</i>	<i>dumosum</i> *	Bushy Bean Caper	Dwarf Shrub	Insect	Yes

Uri Baruch also suggested pollen from the Umbelliferae Family (13 grains, 6.4%), Tubiliflorae Family (8 grains, 3.9%), Papillionaea Family (7 grains, 3.4%), the Oak Genus (*Quercus*, 11 grains, 5.4%), the Olive Genus (*Olea*, 2 grains, 1.0%), another thistle (*Centaurea*, 3 grains, 1.5%) and a ground plantain (*Plantago*, 1 grain, 0.5%). This amounts to almost a quarter of the pollen he could identify, but which was missed by Max Frei.

Found in Turkey	Found in N. Europe	Flowering Season	% of Genus/Family found by Baruch	Comments
Yes		Mar-May		Frei: <i>O. subulata</i>
		Feb-June		Frei: <i>Onosma syriaca</i>
	Yes			
		Apr-Jun		
		Mar-Apr		
		Spr-Sum		
	Yes	Mar-Apr	0.5	
		Mar-Apr	1.0	
Yes	Yes	Apr-May		
Yes		Feb-Apr		Frei: <i>Poterium spinosum</i>
Yes		Apr-Aug		
Yes		May		
Yes		Jan-Apr	1.0	
		Mar-Jul		
Yes	Yes	Mar-Sep	1.0	
		Jun-Oct		
Yes				
		Mar-May	0.5	
Yes	Yes			Frei: <i>S. triquedrus</i>
	Yes		3.0 (family)	
		Feb-Aug	0.5 (family)	
		Mar-Sep	2.0	
Yes	Yes	Spr		
		Feb-Apr		

Interestingly, a website called tiuli.com, which includes a section on flowers (http://www.tiuli.com/flower_search.asp?lng=eng), lists 310 plants which grow around Jerusalem and flower in April, Israel's "Month of Flowers." Only 14 out of the 46 Israeli plants found in Max Frei's list (30%) appear on it.

So, what are we to make of Max Frei's pollen identification, and the conclusions he drew from it. I think the question must remain open. In spite of all the secrecy and confusion there remain a few grains of pollen from some exclusively wind-blown Middle Eastern trees that are difficult to explain except that they fell on the Shroud while it was in Israel. Perhaps, if Thomas Litt's analysis is ever published, we will discover that the entire assemblage has been over-optimistically interpreted, but if not, we must not be too hasty to dismiss it altogether.

References for 'Problems With Pollen'

- 1) *Nine Years of Palynological Studies on the Shroud*, Max Frei, Shroud Spectrum International Vol. 3, June 1982,
at <http://shroud.com/pdfs/ssi03part3.pdf>
- 2) *Report on the Shroud of Turin*, John H Heller, Houghton Mifflin, 1983
- 3) *The Pollen Grains on the Shroud of Turin*, Werner Bulst, Shroud Spectrum International Vol. 10, March 1984,
at <http://shroud.com/pdfs/ssi10part4.pdf>
- 4) *Judgement Day for the Turin Shroud*, Walter McCrone, Microscope Publications, 1996
- 5) *The Origin of the Shroud of Turin from the Near East as Evidenced by Plant Images and Pollen Grains*, Avinoam Danin, 1998,
at <http://www.shroud.com/danin2.htm>
- 6) *Floristic Indicators for the Origin of the Shroud of Turin*, Avinoam Danin and Uri Baruch, 1998, at <http://www.shroud.com/pdfs/daninx.pdf>

- 7) *The Question of Pollen Grains on the Shroud of Turin and the Sudarium of Oviedo*, Emanuela Marinelli, at <https://www.academia.edu/1536346>
- 8) *Forensic Palynology in the United States of America*, Bryant, Jones and Mildenhall, *Palynology* Vol. 14, 1990
- 9) *Flora of Israel Online*, Avinoam Danin, Hebrew University of Jerusalem, at <http://flora.huji.ac.il/browse.asp>
- 10) *Wild Flowers of Israel*, Sarah Gold and Amram Eshel, University of Tel Aviv, at <http://www.wildflowers.co.il/english/>
- 11) Quotations from Riggi found in: *La Truffa dei Pollini. Il Dossier Completo*, Gaetano Ciccone, La Sindone de Torino, 2011, at <http://sindone.weebly.com/pollini1.html>
- 12) See, for example, *Pollen Studies of Textile Material from an Iron Age Grave at Hammerum, Denmark*, Renée Enevold, *Journal of Archaeological Science*, 2012, which lists 44 pollens, 12 as species, and the rest as genera, families, or 'types.'
- 13) *The Ethnocultural Significance for the Use of Plants in Ancient Funerary Rituals and its Possible Implications with Pollens Found on the Shroud of Turin*, Marzia Boi (Universidad de las Islas Baleares), 2010, at <http://www.shroud.com/pdfs/boiveng.pdf>
- 14) *Holes in the 3D-Image of the Body on the Shroud*, Avinoam Danin, at <http://shroud3d.com/findings/prof-avinoam-danin>

