FLORISTIC INDICATORS FOR THE ORIGIN OF THE SHROUD OF TURIN

by

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INTRODUCTION

Minute plant parts and pollen grains were incidentally observed on the Shroud of Turin by Dr. M. Frei in 1973 when he was asked for an opinion by the church about accuracy of earlier photographs (Frei 1982). Applying methods he developed in his forensic investigations, Frei used transparent sticky tapes approximately 5 cm long which he pressed into the linen of the Shroud using pressure of his thumb to assure collecting of small particles for microscopic examination. The location of his sampling sites in 1978 utilized a grid devised by Prof. Baima Bollone and Dr. Aurelio Ghio and is fully documented photographically by Barrie Schwortz (Schwortz 1978 and 1998) and partially in Weaver (1980: p. 750). Comparing the pollen grains he found on the Shroud with pollen grains he obtained from living specimens in Israel, Turkey, Cyprus, France, and Italy, Frei (1982) concluded that the Shroud with its pollen must have originated in the Middle East. His untimely death in 1983 prevented him from completing the examination of his collection of 1978. Preliminary studies of his material by Maloney (1988) revealed a wealth of additional pollen grains as well as other plant parts.

Images of plants were detected on the Shroud by Scheuermann (1983) and by Whanger and Whanger in 1985 on photographically enhanced prints of negatives from photographs by Enrie in 1931. The Whangers tentatively identified the plant images by comparison to 1:1 illustrations of plants in Flora Palaestina (Feinbrun 1978; Zohary 1966, 1972). Although covering much of our findings, the Whangers' (1989) manuscript was not accepted for publication, possibly because it was submitted only a year after the radiocarbon 14C dating of a corner of the Shroud led those who did it to declare that the Shroud is a 13-14 century forgery (Damon et al., 1989). Later studies (Adler, 1996) proved that the chemical make-up of the single linen sample sent to three distinguished laboratories for carbon dating differed distinctively from that of most of the Shroud. Other ways of dating, such as by comparing the blood stains morphology on the Shroud with those on the Sudarium of Oviedo (Adler, 1996; Adler, Whanger, and Whanger 1997), prove its age to be at least from the 8th century CE Dating from earlier dates are fully reported by Whanger & Whanger (1998).

The first author became involved with the interpretation of plant images he saw on the 1:1 enhanced photos of the Shroud at the Whangers' collection at Durham, North Carolina in 1997. The second author in February 1998 checked microscopic slides derived from the

Shroud, sampled by Frei, which are in the custody of The Council for Study of the Shroud of Turin (CSST).

In the present paper we wish to report our preliminary findings and discuss their chronological and spatial significance for the study of the Shroud of Turin.

METHODS

Palynology

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. In determining the pollen grains from the Shroud U. Baruch compared grain morphology with control specimens, collected and determined by A. Danin in 1996 & 1997, and his own control collection. The samples were studied using an Olympus AX-70 computerized research light microscope.

Plant image detection

Plant images were studied at the first stage using 1:1 prints derived from third generation approved Giuseppe Enrie (1931) negatives and printed for high contrast (Whanger & Whanger 1998). The findings were later compared to the negatives of Secondo Pia (1898) displayed in Museo Della Sindone and Archivio di Stato, both in Turin. They were also compared to a 25% life size colour photograph of the Shroud (Miller, 1978) and to the fluorescence photos assembled by Miller (1978). Finally, on June 4, 1998 the first author observed a few of the images on the Shroud itself, using a pair of binoculars from a distance of ca. 4 m, at the exposition of the Shroud of Turin. Plant name nomenclature follows Feinbrun-Dothan and Danin (1991) and Danin (1998).

RESULTS

Pollen

Table 1 presents results of re-determination of microscopic slides which were determined by Frei (1982). The rest of the slides reported by Frei (l.c.) are not in the possession of CSST at present. Of the 34 pollen grains reported at the specific level by Frei (1982) only 3 are recognized as such (Gundelia tournefortii, Ricinus communis, and Lomelosia [Scabiosa] prolifera) by the present authors. All Frei's determinations are correct at the higher taxonomical level, however, the differences in our perception will be discussed later.

Table 2 presents the results of pollen determination of the 1973 tapes and 14 of the 27 sticky tapes sampled by Frei in 1978. 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. The second most frequent is the Cistaceae type (13.1%). Although Dr. A. Orville Dahl determined several clustered pollen grains which he identified as likely those of Cistus creticus from tape 6Bd (Whanger 1996), we can not

approve or disapprove this determination until pollen of the suspected Cistaceae are removed from the sticky tape and determined under a microscope with higher resolution.

Plant images

Images of opened flowers, flowering buds, inflorescences, leaves, spiny bracts, stems, and fruits have been observed on photos of the Shroud and on the Shroud itself. An example of an inflorescence of a plant from the Asteraceae (Compositae), best fitting in size and morphology to that of Chrysanthemum coronarium, is presented in Fig. 1. Hundreds of additional flowers and inflorescences were discovered on the enhanced photos of the Shroud. We shall restrict ourselves in the present paper to only three species which are the most significant.

An image of an inflorescence of Gundelia tournefortii was observed at the area of the right anatomic shoulder (Fig. 1). Discovered first on Enrie's enhanced photos it was later seen again at the same location in Enrie (1931) and Pia (1898) negatives in Turin, and in Miller (1978) colour photo.

Images of Zygophyllum dumosum leaves were observed at the man's chest area, above the boundary of the water stain (of the fire extinguishing at the church in Chamb(rcy, France, 1532). The leaf of Z. dumosum, which starts to develop in winter, is succulent. It has a sausage-like petiole and two flat thick elliptic leaflets (Figs. 2, 3,). In summer the two leaflets dry and fall. The six-months-old sausage-like leaf slowly shrinks during the summer. Following the first rain the one-year-old leaf swells and resumes its full size. By that time new leaves, each with two leaflets start to grow. The images on the Shroud are of two pairs of young but full-sized leaves and a few sausage-like older leaves (Figs. 2). The large top-left leaf in these figures was first observed on Enrie's (1931) enhanced photograph and later on his negatives, on Pia's (1898) negatives, on Miller's (1978) colour photograph, on Miller's (1978) fluorescence photo, and finally on the Shroud itself.

A peduncle carrying three fruits of Pistacia lentiscus (Fig. 1) was observed in all the five media listed above for the Zyophyllum dumosum leaf. In addition there are more than 300 spots, at same size as these three fruits, most of which have an attached line which looks like a pedicel. Many of these spots, interpreted as fruits as well, are attached to branched lines which resemble peduncles of Pistacia palaestina and P. atlantica (as illustrated by Huber, 1972).

Chronological notes

Being the most frequent pollen type on the Shroud (Table 2), Gundelia tournefortii may serve as a quasi-calendar for indicating the season when its spiny flower-carrying inflorescence was laid on the Shroud. According to Feinbrun-Dothan and Danin (1991) G. tournefortii blooms from March to May. Danin's field observations of 1998 could extend the blooming time to February in the warm parts of its area in Israel. This definite calendar dictates the origin of Pistacia fruits. All the three species do not bear fruits between February and May. Therefore these fruits were originated from a preserved source and were not picked up directly from local trees and shrubs.

The phenologic status of Zygophyllum dumosum indicated by the presence of leaves from two years and from flowers (Fig. 3) may be found in the eastern Judean Desert between January and April.

The wide temporal range of blooming in Israel is a result of high diversity of habitats in this part of the world.

Spatial notes

Gundelia tournefortii is restricted to the Middle East. Its distribution area according to Kupicha (1975), is displayed in Fig. 5. Zygophyllum dumosum is endemic to Israel, W Jordan and Sinai (Fig. 5 & 6). The three Pistacia species mentioned above have a wider distribution area, and since their fruiting time does not coincide with the flowering time of Gundelia tournefortii they have no significance as distributional or chronological indicators (cf. Discussion).

DISCUSSION

The two plant species that are part of the Shroud, evidenced by pollen grains incorporated among the linen threads and by their images, indicate that it came from the Middle East. The most likely area where flowering stems of both G. tournefortii and Z. dumosum could be laid fresh on the Shroud is the vicinity of Jerusalem. Pollen grains of G. tournefortii at a density of 11-14 grains/5 cm2 could not derive from dispersal by natural agents (e.g. wind)(Fig.4). In the rare cases where pollen grains of this species were found as part of the "pollen-rain" (Baruch 1993), they never reached a density of more than 1-2 grains/400 cm2. The inevitable conclusion is that the pollen containing inflorescence or inflorescences had been laid on the Shroud, prior to the formation of the plant images sometime in the remote past.

There can be hardly any doubt that the plant images presented here form a genuine part of the Shroud. The proof we have that they are not artifacts caused in the processes of photographic enhancement of Enrie's (1931) negatives, is that the images were discovered also on Enrie's negatives, the photos made by Pia (1898), and those of Miller (1978). The three sets of photographs are separated by up to 80 years. They were taken with different cameras, with different optical quality, using films with different emulsions and different spectral characteristics. They were developed under different darkroom conditions, and yet the same sets of images were observed in the photos of all three generations. This fact, together with other non-body images, not mentioned here, prove that the images are not artifacts, but part of the nature of the Shroud.

The images of the Zygophyllum dumosum leaf and the three Pistacia fruits were seen on the Shroud even without photographs.

The images of Zygophyllum dumosum leaves on the Shroud are of turgescent ones indicating that fresh plants were laid on the Shroud (Fig. 2). The distribution maps of G. tournefortii and Z. dumosum have area of almost common boundaries along the Jerusalem-Hebron area in Israel and the Madaba-Karak area in Jordan. On the earth map both areas are in a small locality - the Holy Land. Further investigations may enable us to use additional plant indicators for restricting the area in the Holy Land from where the Shroud started its journey.

Fruits of the three species of Pistacia are not available on plants during the season indicated by Gundelia tournefortii and Zygophyllum dumosum. Therefore, these fruits should have been brought in from a storage. The present day practice (as was told by a

spice-merchant in the market of the Old City of Jerusalem) is that the Pistacia fruits (BUTUM in Arabic) are picked up when ripe in September, dried and preserved by this way to be sold the year round. They are used as a condiment for cakes and as a component of spices (e.g., Za'atar).

The differences in determinations of pollen grains between us and M. Frei (1982) derive from the knowledge and perception of the pollen flora of the study area. It seems that M. Frei was not aware of the possibility that many of his determinations at the specific level could not be accepted by palynologists today. At present, with the great increase in our knowledge of the Middle Eastern palynology, palynologists familiar with the local flora will be highly reluctant to determine a Chenopdiaceae pollen grain as Anabasis aphylla. This is because generally Chenopodiaceae pollen grains can not be determined to a specific level. Frei was correct, however, in his determination of Gundelia tournefortii, which became one of our leading indicators.

ACKNOWLEDGMENTS

We thank Dr. A. Adler for his enlightening conversations during the preparation of the manuscript; Dr. A.D and Mrs. M.W. Whanger, Mr. P.E. Dayvault, and Bishop J. Barclay for the critical reading of the manuscript. Thanks are due to Mrs. Tamar Soffer for drawing the maps and to the Israel Academy for Science and Humanities for using of few of the drawings from Flora Palaestina.

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FIGURE CAPTIONS

1. Images of Chrysanthemum coronarium and Pistacia lentiscus on the Shroud with adjacent drawings from Flora Palaestina (Koppel, 1972 and 1978).
2. Floral images on the shroud, with a thorn of Gundelia tournefortii adjacent to a Gundelia image, and a drawing from Flora Palaestina adjacent to one of the Zygophyllum dumosum images (Koppel, 1972)
3. A stem of Zygophyllum dumosum displaying leaves from the present year (with two leaflets) and leaves from the previous year or years (without leaflets). Specimen gathered in the Judean (Sinai) desert by A. Danin.
4. Pollen grains of Gundelia tournefortii. Upper left is a pollen grain under tape taken from the Shroud in 1978 by M. Frei. Upper right is a control pollen grain under tape obtained by M. Frei. Lower left are Gundelia pollen grain controls under tape gathered by A.

Danin. Lower right are Gundelia control pollen grains under a cover slip examined by phase contrast, gathered by A. Danin.
5. Distribution map of Gundelia tournefortii and Zygophyllum dumosum (from Danin et al. 1999).
6. Distribution map of Zygophyllum dumosum (from Danin et al. 1999)

Table 1. A list of comments made by Uri Baruch on Max Frei (1973) pollen determination

Slide number	Frei's label	Baruch's comment
MS01	Anabasis aphylla	OK, but Anabasis type
MS02	Alnus glutionsa	empty
MS04	Acacia albida	OK, it is Acacia but not with species level
MS05	Artemisia sieberi	OK but for Artemisia sp.
MS06	Atraphaxis spinosa	OK for a generic level.
MS07	Capparis ovata	Capparis sp., + non Capparis
MS08	Carduus	Cedrus, + Carduus type!
MS09	Carpinus betulus	at the present status - not identifiabe
MS10	Cedrus libanoticus	OK, but Cedrus
MS11	Corylus avelana	at the present status - not identifiable
MS13	Echinops glaberrimus	OK but should be Echinops sp.
MS15	Fagonia mollis	looks like F. arabica control (Danin's)
MS16	Fagus sylvatica	inconclusive material
MS17	Glaucium grandiflorum	Echinops; the Glaucium is not found
MS18	Gundelia tournefortii	OK
MS20	Haplophyllum tuberculatum	OK, but species can not be determined
MS21	Helianthemum vesicarium	Cistaceae; the slide is not clear enough
MS23	Hyoscyamus reticulatus	Only generic level is tangible
MS26	Linum mucronatum	Only generic level is tangible
MS31	Paliurus spina-christi	either Paliurus or Ziziphus
MS32	Peganum harmala	Can not be confirmed
MS34	Sarcopoterium spinosum	Can not be confirmed
MS35	Prosopis farcta	OK
MS38	Reaumuria hirtella	species can not be differentiated
MS39	Ricinus communis	OK
MS41	Scabiosa prolifera	OK + Centaurea solstitialis type, + Tubiliflorae type
MS42	Scirpus	Cyperaceae OK
MS43	Secale	Gramineae OK
MS45	Suaeda	OK as Chenopodiaceae
MS46	Tamarix	OK as Tamarix spp.
MS47	Taxus	Uri can't confirm

Table 2. Results of examination (by U. Baruch) for pollen grains found in sticky tapes derived from the Shroud of Turin sampled by M. Frei in 1973 and 1978 (updated after Danin et al, 1999).

POLLEN DETERMINATIONS	POLLEN GRAIN NUMBER	PERCENTAGE OF TOTAL ID POLLEN
Acacia sp.	1	0.3%
Anabasis type	1	0.3%
Artemisia sp.	3	1.0%
Atraphaxis sp.	1	0.3%
Capparis sp.	1	0.3%
Carduus type	1	0.3%
Cedrus sp.	2	0.6%
Centaurea solstitialis type	3	1.0%
Centrospermae	1	0.3%
Chenopodiaceae	1	0.3%
Cistus incanus-type	1	0.3%
Cistus salviifolius-type (?)	2	0.6%
Cistaceae	23	7.3%
Corylus sp.	1	0.3%
Dryopteris (?)	1	0.3%
Cyperaceae	1	0.3%
Echinops sp.	4	1.3%
Fagonia sp.	1	0.3%
Gramineae	6	1.9%
Gundelia tournefortii	91	29.1%
Haplophyllum sp.	1	0.3%
Hyoscyamus sp.	1	0.3%
Linum sp.	1	0.3%
Olea sp.	2	0.6%
Ononis type	2	0.6%
Papilionacea	5	1.6%
Pinus sp.	1	0.3%
Pistacia sp.	2	0.6%
Plantago (?)	1	0.6%
Pteranthus (?)	2	0.6%
Quercus (deciduous) [?]	8	2.6%
Quercus (?)	3	1.0%
Ricinus (?)	2	0.6%
Lomelosia prolifera	1	0.3%
Tamarix sp.	4	1.3%
Tubiliflorae	8	2.6%
Umbelliferae	13	4.2%
Total identified	204	65.2%
Unidentified grains	109	34.80%
Total	313	

This paper was presented at the 3rd International Congress on the Shroud of Turin on 6 June 1998 in Turin, Italy.