

Botanical Study of the Shroud of Turin

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The first development indicating that botanical findings would be of value in helping to understand the place of origin and the journeys of the Shroud of Turin, the burial circumstances of the Man of the Shroud, and to provide some important information about the formation of the images occurred in 1973.

That year, the Shroud was brought out for a very limited period in order that a television production featuring it might be made. At that time, the authorities wished to have the photographs taken in 1969 by Professor Giovanni Judica-Cordiglia compared with the appearance of the fabric of the Shroud for verification of their authenticity. For this task they secured the services of Dr. Max Frei, founder and director of the scientific department of the Zurich Criminal Police in Switzerland. He was internationally recognized as a criminalist, that is, a specialist in the gathering and interpretation of evidence for forensic purposes. He also had a Ph.D. in botany.

Dr. Frei invented and developed a simple, effective method of evidence collection which he called the sticky tape technique. This involved the use of ordinary transparent adhesive or sticky tape from a dispenser roll. He would extend a length of the tape, place it on the surface to be examined, and with his forefinger massage the lead portion of it into the material being examined. Then he would draw his finger back over about two inches (five cm.) of the tape to facilitate the picking up of materials. Then he would immediately transfer this length of tape to an ordinary clean labeled glass microscope slide, securing it so that there could be no contamination. As an alternative, he would sometimes seal the exposed length of the sticky tape with the next equal length of tape on the roll folded over on itself, making a transparent sandwich of sorts with the material to be examined secured between the two layers of tape. Either way, he could later examine the sampled material by microscope directly through the transparent tape without fear of any contamination getting into the original sample.

This technique would, of course, pick up all kinds of material, such as threads, hairs, soil, plant fragments, blood, and pollen grains. The pollen grains are the male spores of the plant and are produced in the anthers and then are transported to the female parts of other plants for the purpose of fertilization. Depending on the type, pollen grains are transported either by wind currents or by direct contact with some type of insect or even a bird that moves from plant to plant. Pollen grains are tiny structures generally measuring from ten to one hundred microns in diameter. They are rather complex, and the exine or outer coating is very hard, durable, and ornate. When exposed, the pollen grains simply disintegrate in varying lengths of time, but when sealed, for example as in the mud at the bottom of a lake or in a rock, they may last for thousands or millions of years.¹

Because pollen grains have rather distinctive shapes, structures, and exines the plant of origin can often be identified. The pollen grains of different species of, for instance, the same family or genus may so closely resemble one another that the species cannot be determined. The use of the scanning electron microscope (SEM), which gives enormous magnification and reveals fine details of the exine or surface, may help in further distinguishing the species. The most commonly used method for analysis and identification of particular pollen grains is to compare under similar circumstances each grain directly with control mature pollen grains from a known plant, using a light microscope.

The specialty within botany of studying and identifying pollen grains is called palynology. While not generally recognized as a palynologist, Dr. Frei had been studying and identifying pollen grains in Europe for nearly thirty years as a regular part of his forensic studies.

While in the process of verifying the photographs of the Shroud fabric itself using a microscope, he noted the presence of dust, debris, and pollen grains. He requested permission on the spot to take sticky tape samples, and this was granted by the authorities. He took twelve samples from non-image areas on the frontal half of the Shroud.

Later, on examining these twelve tapes microscopically in his laboratory, he found a number of pollen grains. He identified the locations on the tapes of the particular pollen grains, and then cut out each small section containing a pollen grain. For each pollen grain, he dissolved the adhesive, cleaned the pollen grain, placed it in glycerin gel on another glass slide and placed a glass cover slip over it. This procedure allowed Dr. Frei to manipulate the pollen grain while observing it under high magnification in order to better see the important details. As he could not recognize most of them, he knew that they were not of European origin. He sought help in various herbarium collections of pollen grains and in references, but without much success. Soon he realized that to complete his studies he would need to collect control specimens for himself.²

Assuming that the Shroud might be authentic, over a period of time he undertook seven expeditions on his own to the areas where the Shroud might have been at some time in its history, namely, Israel; Urfa (Edessa), Turkey; Constantinople; and Cypress. He gathered botanical specimens, identified them, and harvested pollen grains from them for comparison with those he found on the Shroud. After years of this tedious work, he putatively identified forty-eight different pollen grains at least to genus level.

In 1978, as a part of the massive scientific investigation of the Shroud by the Shroud of Turin Research Project (STURP), Dr. Frei was given permission to take additional sticky tape samples from the Shroud. This time he used a localizing grid system developed by Drs. Baima Bollone and Aurelio Ghio. He chose various representative sites on the Shroud and took a new set of 27 sticky tape samples. Before his death in 1983 he only partially studied these tapes. He removed nothing from them, and did not disturb their seal in any way. He was writing up his work and preparing a manuscript when he rather suddenly died. By that time, he had tentatively identified fifty-eight different pollen grains. There was no other botanist working with the Shroud researchers, and so his work abruptly stopped.³

Unrelated to Dr. Frei's botanical work was a discovery in 1983 by Oswald Scheuermann, a physics teacher in Germany, who had been working on mechanisms of the Shroud image formation since 1981. Because his data indicated that corona or electrostatic discharge might be a mechanism of the image formation, which agreed with some of our early observations, we had contacted him in 1982 and were actively exchanging ideas and findings.⁴ In 1983, Scheuermann indicated that he thought he had detected images of flowers around the face and head area on his photographs of the Shroud. He sent me photographs, but I was not able to clearly discern what he was claiming. As we were embroiled in controversy with various other parties about the presence of coin images over the eyes, which Scheuermann agreed with, I suggested that we shelve his finding of the flower images.

In 1985 while examining one of our nearly thirty high-grade photographically enhanced photographs of the Shroud based on those taken by Enrie in 1931 which we use in our research, I suddenly spotted an image which resembled the outline of a chrysanthemum-type flower on the anatomical left side just above the level of the top of the head anteriorly and fifteen cm. lateral to the midline of the body. The image is partial, faint, shows outlines and probably high points, and is embedded in numerous other irregular images. Having once discovered what a flower image on the Shroud looks like, I looked at other areas and saw that there are large numbers of these faint, partial patterns which were almost certainly floral in origin.

Being no botanist myself, I nevertheless set about the task of trying to discern and identify these images. Following the lead of Frei's pollen grain determinations showing that many were from the Middle East, I sought help from colleague Rex Morgan who happened to be in Israel at that time as was soon returning to Australia with a planned stop by our home. I requested him to buy the best botany books in Israel and bring them to me. He arrived with a large extra suitcase full of books, the most useful of which were the six volumes of *Flora Palaestina*⁵ which had life-size drawings and detailed descriptions of some 1900 plants of the area.

Next, I requested that Scheuermann make corona images off of a variety of plants and thorns (and other objects) so that I would have the best idea of what the images on the Shroud might look like. He quickly responded with a large number of excellent photographs of various samples, along with corona images made from them. Knowing what corona images look like has been a key in helping us to discern and interpret many of the images that we see on the Shroud.

Armed with these tools, I started the tedious task of searching our various photographs to discern patterns or image which did not resemble the weave or have a more obvious explanation. Then I tried to match these with the drawings of the flowers in the books. Working in my spare time, this task took me about four years to complete.

In the meantime, another important development took place. Dr. Frei's widow, Mrs. Gertrud Frei-Sulzer, wanted something done with the large amount of material and data that Dr. Frei had gathered but had not completely studied. Archaeologist Paul Maloney, with whom we were working at that time, contacted Mrs. Frei about Dr. Frei's materials in 1986. She loaned him five of the sticky tape slides taken from the Shroud in 1978. On examining them microscopically, he noted the presence of many pollen grains, as well as a variety of other materials such as fibers

and botanical debris. Thus we knew that they are an important source of botanical information from the Shroud. In July, 1988, we completed arrangements with Mrs. Frei to transfer the available materials in Dr. Frei's Shroud-related collection to the custody of the ASSIST group. A small group went to Switzerland to document and acquire the collection for transportation back to the United States.

Mr. Maloney had arranged for the slides to be verified immediately after arrival in the United States by Dr. Walter McCrone in the Botany Department of the Philadelphia Academy of Natural Sciences in the presence of about twenty-five observers. Dr. McCrone scanned each of the twenty-seven slides under a microscope with a video attachment so that everything could be seen by the group. The entire procedure was recorded using two video cameras. By identifying the peculiar constellation of scorched linen fibers, red and blue silk fibers, and other materials on all but one of the slides (which apparently had been taken from the reliquary that the Shroud had been kept in), Dr. McCrone verified that all except that one of the slides had been taken from the Shroud as was presumed.

During the examination, when pressed, he began commenting on the numerous pollen grains visible on the tapes, although the purpose of this study was only to scan the slides for authentication. As recorded on the video tapes, McCrone identified forty-three objects as clearly being pollen grains, with another eleven as possible ones. This is at considerable variance with his later statements in which he claims to have seen only about ten pollen grains on all of the tapes together, except for a cluster on slide 6Bd which he considered to be "contamination" from the tape having been pulled back in order to introduce the pollen grains as an act of "skullduggery."⁶ Subsequent examination of the same slides by a forensic microscopist to study this issue found no evidence that any of the slides had been altered or tampered with.

The next major event affecting Shroud research, botanical and otherwise, was the release into the media in August, 1988, of the results of the radiocarbon dating by three laboratories done on a single specimen taken from the Shroud in April, 1988. The nearly universally publicized result indicated that the Shroud dated from A.D. 1260 to 1390, and hence was a fake of medieval and European origin.

Since we (my wife and co-researcher Mary and I) had previously dated the Shroud by its images, history, and artistic productions based on it to the Spring of A.D.30 in the Middle East, we knew that the radiocarbon dating could not possibly be correct. Most of the public accepted the results, however, and decided that the Shroud was simply a clever medieval artistic production of some sort, and wrote it off. Interest in and support for Shroud research plummeted.

We continued our identification of the floral images on the Shroud, however, and by 1989 had tentatively identified twenty-eight different plants. We observed that all twenty-eight of these are found in Israel, and that Dr. Frei had identified pollen grains of twenty-five of them at least to the level of family or genus or to a closely related plant. The common blooming time of twenty-seven of the twenty-eight plants is March and April.⁷ We felt that this was an important finding, but we were totally unable to get this information into either the lay or professional media

because of indifference or hostility or a wish to avoid controversy. As a result, the botanical work on the Shroud virtually ceased again.

In 1993, the custody of the Frei collection was transferred from the ASSIST group, and since 1994 the responsibility for research on it has rested with the Council for Study of the Shroud of Turin (CSST), a non-profit corporation established to facilitate and continue our research and educational efforts.

The next major step forward occurred in 1995 when we took a trip to Israel with colleagues from the Centro Espanol de Sindonologia, a Spanish Shroud research group. Before going, I telephoned Dr. Avinoam Danin, Professor of Botany at Hebrew University in Jerusalem and internationally known as the authority on the botany of the Near East. I told him generally of our findings and requested a consultation with him, which he granted. We took several of our photographs with us to Israel. When I handed the first one to him without further explanation, he looked at it for about fifteen seconds and said, "Those are the flowers of Jerusalem." Needless to say, we were pleased that Professor Danin used his remarkable skill in detecting faint images and his prodigious knowledge about the flora of the Near East to concur with the tentative impressions that we had gathered from our four years of research.

Recognizing that this is a most unusual botanical finding, he agreed to work with us on our research. Subsequently, he has visited us in North Carolina on five occasions, spending over a month with us reviewing our photographs and examining the various materials and specimens in the Frei Collection in great detail. As he is a specialist in plant taxonomy and not palynology he contacted Dr. Uri Baruch, the leading available expert in Israel on pollen analysis, recognizing the importance of the microscopic material in the Frei collection to show a fuller understanding of the botanical aspects of the Shroud. He showed photographs of some of the flower images on the Shroud to Dr. Baruch, who is a palynologist with the Israel Antiquities Authority. As soon as Baruch saw that flowers had been laid directly on the Shroud, he knew that patterns of pollen grain distribution on the Shroud would differ from the usual "pollen rain" that occurs with random air deposition. He agreed to join the research team, and has come to North Carolina on two occasions, spending two weeks with us examining the available specimens from the 1973 collection by Dr. Frei and the twenty-seven sticky tape slides from the 1978 collection. In addition, he examined the three slides available from the material that Dr. Frei had taken from the Sudarium of Oviedo in Spain in 1979.

To illustrate the findings, I will show a number of slides and then a short video segment to illustrate the polarized image overlay identification of some of the floral images.

For the 1978 sampling, Dr. Frei carefully planned ahead of time where he would take the sticky tape samples in order to get a variety of materials and locations. He was not aware of the flower images. Photographer Barrie Schwartz documented the taking of these samples. This distribution map of the sites of the samplings by tapes is based on the photodocumentation by Schwartz. Each sticky tape sample looks simply like tape attached to a slide as shown in this photograph taken by Paul Maloney of the four tapes initially loaned by Mrs. Frei.

Dr. Frei took seven extended field trips in the Middle East on his own to secure known plant pollen grains to use as controls in identifying the pollen he found on the tapes.

In his examinations, Frei used both a light microscope in his laboratory and a scanning electron microscope at facilities in Zurich, Switzerland and in Vercelli, Italy.

The pollen grains are like tiny specks of dust, often with a yellow color. They are more concentrated in the lead portion of the sticky tapes which he had massaged into the fabric. They can be seen scattered among the various fibrils on the 1978 tapes which are still intact. Pollen grains from the 1973 tapes were extracted by Frei and mounted by him individually under a cover slip in a glycerin gel for examination. Although he probably over-identified some of the pollen grains to species, and his distribution areas for some of the plants were only partially correct, he did note major and crucial distribution patterns among the fifty-eight varieties of pollen grains that he identified.

A number of the plants have a rather wide distribution area, but some are quite specific, such as those growing in desert or salty soils. Only seventeen of the varieties Frei found grow in Italy or France, while forty-five grow in Jerusalem or in its environs. Thirteen are found in the region of Constantinople, and eighteen are found in the region where Edessa existed.³ Thus Frei's observations on the pollen grains indicate that the Shroud had been in Jerusalem or its environs and that it probably followed the course to Edessa and to Constantinople and then to France, as indicated in the historical discussion by Ian Wilson.⁸

Unfortunately, some of those who are antagonistic to the possibility of the Shroud being authentic have rather maliciously attacked Frei's work and findings, as well as his competence and integrity.⁶

The Frei materials were examined by Dr. Uri Baruch, using our AX-70 Olympus computerized research light microscope which can digitally record the images of the pollen grains and locate them again on the slides. The stored images of control pollens facilitates side-by-side comparisons with the pollen grains on the tapes from the Shroud.

Professor Danin diagrammed the locations of sixteen of the images of botanical objects on the Shroud that we examined. It is easier to spot these images if one knows what corona images of flowers and plants look like. This was greatly helped by Scheuermann's production of such images. It also helps to have a drawing or photograph of the plant in question to use side by side for comparison. One photograph shows the images of four imprint plants, with the drawings from *Flora Palaestina*. The first is the *Gundelia tournefortii* thorn, which we feel was used to make the Crown of Thorns. The second is the *Zygophyllum dumosum* plant, which is limited to only the area of the Sinai desert plus a small corridor north almost to Jericho. The third is the *Hyoscyamus reticulatus* plant. The fourth is a partially opened *Capparis* flower, which shows by the degree of opening that it was picked about three to four o'clock in the afternoon. Images of a number of the fruits of the *Pistacia* plant are visible on the Shroud. They probably were used as some of the burial spices. These fruits are still available as a spice year round in the markets of Jerusalem.⁹

Danin has computerized data on the locations of about 120,000 plants by five-kilometer squares in the Near East, and thereby can quickly compute distribution patterns. He found that twenty-seven of the twenty-eight varieties of the floral images on the Shroud that I had identified occur within fifteen kilometers of Jerusalem. Combining the pollen grain findings and the floral image data, Danin states that the Shroud originated in the immediate environs of Jerusalem and nowhere else on earth. This information is detailed in the monograph *Flora of the Shroud of Turin*.¹⁰

The common blooming time of the identified flowers is March and April, narrowing the time that the Shroud images were produced to the season of Passover.

Examination of the flower images and comparing them with photographs of the progressive wilting of flowers after being picked, and also with corona images made off of flowers when they were fresh and then at twenty-four and forty-eight hours after being picked revealed a most interesting chronology. Of course different flowers wilt at different rates, but a number of the floral images on the Shroud would indicate that the images were formed between twenty-four and thirty-six hours after the flowers had been picked. This coincides with the physiologic observations on the Shroud of the blood clot separation and the lack of signs of decomposition, which would indicate that the images were formed between twenty-four and forty hours after death. In addition, this corresponds to the traditional time of Jesus' body in the tomb from Friday evening until sometime early Sunday morning (by Jewish reckoning, three days and three nights).

Many have difficulty seeing the floral (and other non-body) images on the Shroud. Our studies indicate the importance of having good quality enhanced photographs, of having a knowledge of what corona or electrostatic images look like, of knowing what the flowers or other objects look like, of being able to do comparisons with known objects, and of having a relatively open mind.¹¹

Of great interest is that a number of the floral images were included in a number of icons and other depictions which are based on the Shroud and which were made between the third and seventh centuries as well as during the early Medieval period. This indicates that the iconographers attached great importance to reproducing the original images as accurately as possible. This was facilitated by the Shroud images being much more easily seen in the early centuries. Our observations would suggest that the images, perhaps especially the floral and non-body images which may have been lighter originally than the body images, became much less apparent after the fire of 1532, which may have accelerated the yellowing process of the entire Shroud fabric which is swallowing up the images.¹²

Thus the botanical findings on the Shroud of Turin of the images of many flowers, buttressed by the evidence of the presence of the pollen grains from many of the same flowers, give us vital information about the background of the Shroud, the circumstances around the creation of its images, and its course in history.

“Consider the lilies of the field (which are the Crown Anemone or *Anemone coronaria*, whose images are on the Shroud) and how they grow: they neither toil nor spin, yet I tell you, even Solomon in all his glory was not clothed like one of these.” Matthew 6:28-29.

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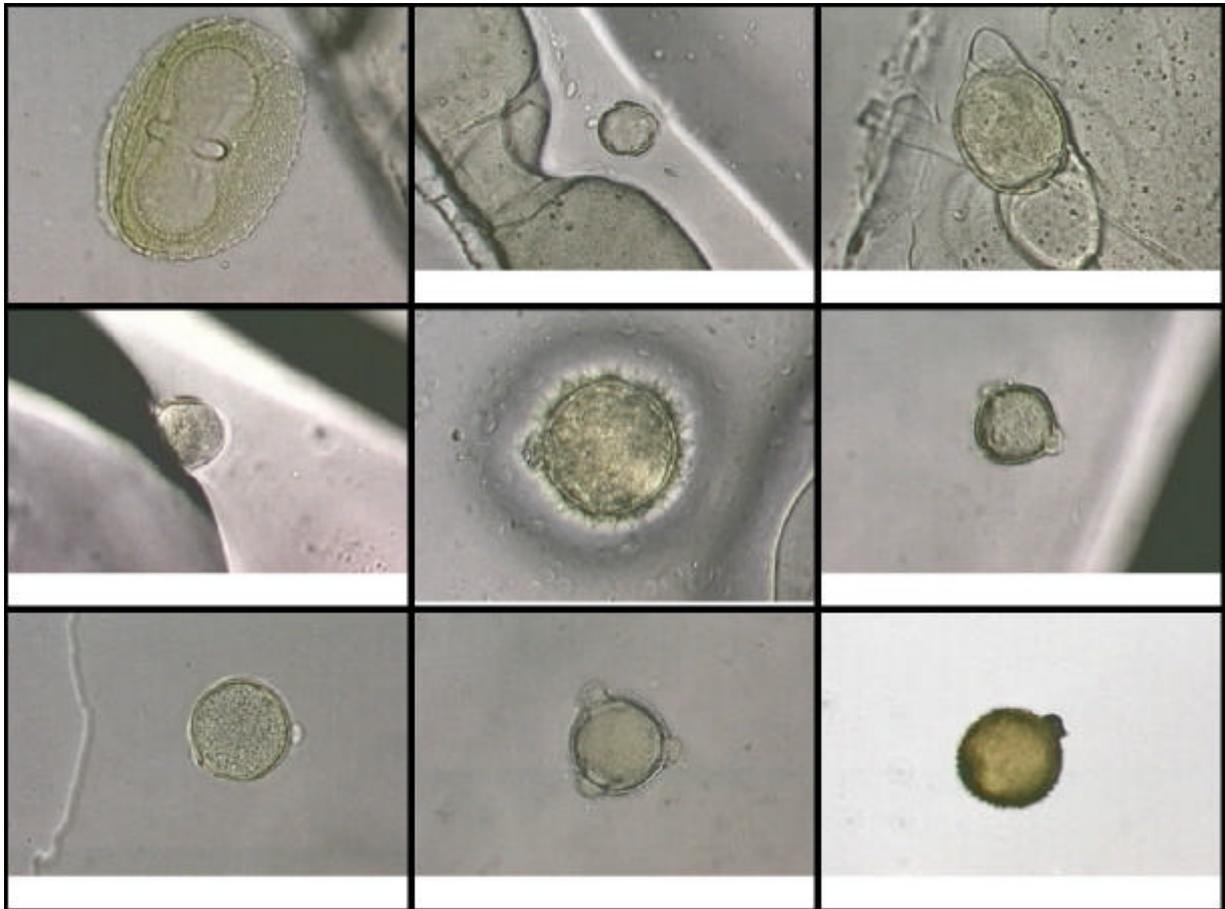


Figure 1

Pollen grains obtained from the Shroud by Dr. Max Frei in 1973 by means of sticky tape sampling. He removed these pollen grains from the tapes and remounted them individually for better study and identification.

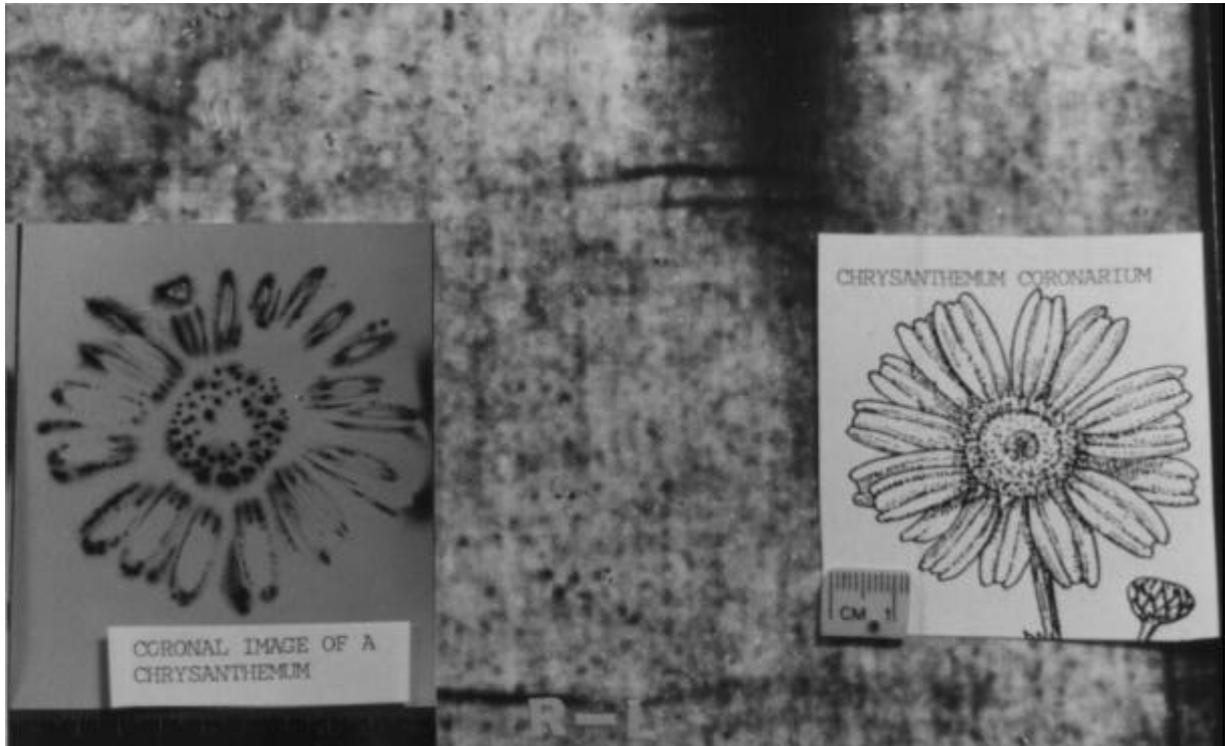


Figure 2

Image of a *Chrysanthemum coronarium* flower on the Shroud itself centered between a corona or electrostatic image made from a chrysanthemum flower by Oswald Scheuermann on the left and a life-size drawing of a *Chrysanthemum coronarium* from *Flora Palaestina* on the right. The Shroud photograph is a photographically enhanced copy made from the Enrie negatives.



Figure 3

Four floral images identified on an enhanced photograph of the Shroud made from Enrie negatives. The images are characteristic of what one would expect from a corona or electrostatic images from the plants themselves. The arrows point to the corresponding features between the Shroud images and the life-size drawings from *Flora Palaestina* and, in the case of the *Gundelia tournefortii* thorn, the plant itself.