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ULTRAMICROANALYSIS

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Dear Paul:

It was a pleasure seeing you again and very nice to have the opportunity to examine the Max Frei tapes. He and I were the only two people with a forensic background working directly on the Shroud. This is confirmed to some extent by the fact that we both elected to use sticky tapes. Sticky tapes are marvelous for picking and preserving any loose particles or fibers from any surface. They form a permanent record of what was on that surface and all of it is preserved spacially with respect to the original surface. I was pleased that "your" tapes (with one exception) were very definitely Shroud tapes.

For the record, the test used to authenticate these tapes was based on the particle types picked off by the adhesive. Since I had examined the original 30+ Shroud tapes in endless detail, I was familar with the particular key particles I should expect to find on any Shroud tape. These included, as you know, linen fibers and in varying degrees of deterioration. Most of the fibers were not deteriorated in any way. They are as good linen as they were the day they were born. Some, however, close to scorch areas were more or less yellowed due to partial degradation of the cellulose. This causes them to be quite brittle and in one tape, at least, several arrays of nearly parallel light brown linen fibers indicated that the tape had actually removed essentially the top layer of the cloth itself. We would expect to find broken lengths of scorched fibers with varying degrees of browning on almost all areas of the Shroud and I think we found them in all of the tapes except the "no label slide" which we decided did not come from the Shroud. We should expect to see other fibers from the wrapping cloths and we did find red silk (in particular) as well as considerable amounts of colorless cotton, particularly at the ends of the tapes where they undoubtedly came from the cotton gloves used by Max during his sampling. Except for sample 6Bd, we found relatively few pollen grains. We should also expect on any tapes close to or on image areas, to find some iron oxide; and this I found on three tapes: 12Bd, 4Bd and 2Bd. The absence of iron oxide on the other tapes presumably reflects efforts to prevent Max from sampling additional image areas. These three samples would, however, be very, very helpful to anyone wishing to confirm my red ochre/collagen tempera paint conclusion.

Since I did not spend too much time on each tape and probably did not cover more than 50% of the length of most of them, it is not impossible that some tape may have overlapped at least some body image areas and show additional iron oxide. It would be highly desirable to examine these tapes in more detail in that respect and I would urge that they be put in better con-

dition for such examination. My suggestion would be that all of the tapes which overlap the ends of the slide and are fastened to the bottom, be handled as follows: that portion from the top end of the slide and extending around over the bottom should be removed and placed on a second slide. This should be done in a "clean-room". Each of the new second slides should be carefully cleaned beforehand and labeled, of course, as a recognizable partner of the remaining top-tape half. At the same time, it would be possible in a clean room at least, to smooth out the surfaces of the tapes and even to unfold any overlaps and lay them back down on the slide itself. This procedure is one in which I have become adept and we do have a clean room in which this could be done.

If you wish I will be glad to volunteer to do that work and you or one of your people could bring the tapes out and watch the operation. I also volunteer to study those tapes in more detail and with a better microscopical setup that we have here in order to look for perhaps additional image areas on parts of the tapes that I didn't examine on the 23rd. We could also prepare a photomicrographic atlas (so to speak) of representative fibers and pollens and with a finder's slide we could map the locations of feature particles and fibers. This might take a week of time but again, we could do that here and you would have a good basis for proceeding with whatever else you wish to do.

I say all of this in spite of the fact that I think the pollen question is moot now that the three laboratories are about to announce medieval dates without any disagreement. I am, however, interested in these tapes for another reason, i.e., the presence of image area fibers. I really feel that the Shroud community owes me something. I did a great deal of very careful microscopy and microanalytical work on the fibers back in 1979 and came to a carefully considered conclusion concerning the authenticity of the Shroud and the manner in which it had been created. There was then, and there is now, no question in my mind that these conclusions were correct. Still, I have run into implacable opposition and during the last year or two, I have been essentially a non-person (since no one even considers the possibility that the image is anything but blood and that the Shroud is real). I would like then, too, to see someone examine the 3 Max Frei tapes and, if possible, some of the STURP tapes to check my conclusion. I think this should be done by people in the art world who are familiar with microscopy, with paint layers and with pigments and media. There are a few such people available and Larry Majewski and Marigene Butler are two not far from you. I would expect, then, to have them spend considerable time (longer than I spent on the 23rd) very carefully examining the tapes with very good microscope optics and in a quiet room where they can think quietly about each slide.

When I did my original work I assumed that the tapes were going to show that the Shroud was authentic and I looked for body fluids, myrrh, nitrates, etc., but I soon found the particles which seemed to me to be the color of the image on the Shroud and seemed also to be present in larger quantities in image areas. After several more months of careful examination of all 32

tapes, I was certain that my conclusion was correct. I also decided that they were a form of iron oxide (of which there are many forms) and that form was red ochre, an artist's pigment. I then looked for evidence of a medium and in time, found that evidence and was able to show that it was a collagen tempera. The point here is that it took a long time to make these observations and to draw the proper conclusions. A number of times I went off on tangents and wild-goose chases. It takes some very good microscopy to see exactly what is there and how it got there. I think that Larry and Marigene would be able to do that and there are others, of course, who might also be able and willing to do so.

I would not have to be a part of that project other than to caution them about drawing too rapid a conclusion but to spend all of the time necessary to really see what is there and why. I would have complete confidence in the conclusions they would draw.

There was another important point we mentioned at your Saturday meeting with respect to sample 4Bd. This was an excellent image tape across the right arm near the elbow. This, as you recall, had the patches of my iron oxide particles replicated from the fiber surfaces and quite large areas with many, many particles. It seemed to me, too, that in that particular area the film of medium was thicker than any I had observed before. This is indicated by the fact that the edges were detectable and that the pieces had torn in a manner characteristic of tearing of very thin films of collodion or other very thin polymer sheets. I would like to reiterate my offer of not only cooperation with respect to analyzing one or two of those films but my "cold cash" offer. (Actually, my $ remarks were my way of emphasizing the importance of these samples and what I would like to see done.)

It is very important to me personally to see that my conclusions are confirmed and, better yet, recognized and acknowledged; and I can't think, at the moment, of any better sample (4Bd) to use for this purpose. In our clean room with particle-handling techniques, I could remove any one of those tiny areas of apparent medium plus pigment without affecting more than a few square micrometers of the tape. We could, in fact, use our laser raman microprobe to characterize the film particles in situ and, depending on the results, that might be all we would want to do.

We could, however, also remove that particle from the adhesive, clean it off and then use the electron microprobe for the particles and the microscope/FTIR to identify the film material. If the film is even a small fraction of a micrometer thick, I think it would give us sufficient response with FTIR to identify it. However, it would be absolutely esential that the sample be examined with an FTIR equipped with a good microscope attachment so that you could focus directly onto the film itself without confusion with IR absorption by other surrounding material. It also essential that it be cleaned free of tape adhesive. This we can do. We would be glad, in fact delighted, to perform these tests and we would be delighted to have you or any one else present and to be the recipient of a complete report with all of the data and conclusions.

If you're still with me, there is one other problem we discussed and that is the sequencing of the tapes. I am convinced that this can be done but I'm also convinced that it requires the polarized light microscope and some good photomicrography. I would propose that if the tapes come here, we can take a series of pictures of the ends of each tape using crossed polars. This will eliminate the effect of adhesive which really messes up the markings on the ends of all of the tapes. These photomicrographs can then be studied later on a light box and the sequencing can, I'm sure at least to a degree, be done. I would expect that there would be gaps because in some places the tape was obviously cut with a pair of scissors or a razor, rather than pulled from the tape dispenser in such a way that the serrated ends are present. I would enjoy doing this and would expect that we would end up with perhaps three or four tapes we could put in sequence. We would know pretty well how they would all go together. This might then answer some questions concerning labeling and positioning of some of the unknown tapes. I will end by listing the tapes in the order in which I examined them on the 23rd. I think I have the sequence correctly but there may still be differences.

9/10, C/D, a/b - cotton (mostly on the ends of the tape), linen (some scorched), red silk

2Bd - cotton, linen, scorched fibers and lots of red ochre (this is an image area tape)

12Cd - This was a bad tape; there were very few fibers and I could draw no conclusion. This tape must be remounted and re-examined.

6Dc - the usual Shroud particles and fibers but no pigment (not image area)

4/3Aa - ditto

6Bc - ditto

3Cb - ditto

1Dab(?) - ditto

9Bd - ditto

6Ca - ditto

4Db - ditto

5Ca - ditto

11C/Db - ditto

12Aa - ditto

Support cloth - cotton

11Ad(a?) - Shroud fibers but no red ochre

11Aa(d?) - ditto