

THE ORIGIN AND NATURE OF BLOOD
ON THE TURIN SHROUD

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In 1981, John Heller and I published a paper in the *Journal of the Canadian Society for Forensic Sciences*, in which we discuss the microchemical testing of fibrils from the Shroud of Turin. The evidence for blood on fibrils taken from the "wound" areas of the image is quite strong. Contrary to what has been claimed by our detractors, the image and the bloodstains categorically are not composed of iron oxide pigment in a collagen binder. Iron is of course present in the blood areas in a slightly higher proportion than in normal blood, as would be expected in the traumatic conditions suggested by the nature of the wounds. The amount of iron is, however, really quite small.

In addition to the iron content being at the expected level, we found we could generate a porphyrin fluorescence, which is a very sensitive and very specific test. It did not fluoresce to begin with, so it is not a plant material such as chlorophyll, as some people have claimed. Chlorophyll is also a porphyrin and it does fluoresce, but its fluorescence does not have to be generated.

Furthermore the material we were testing gave the right reflection spectrum for blood, and it gave the right transmission spectrum. It gave a positive hemochromagen test, which is the standard chemical test for blood. It gave positive cyannethemoglobin, positive detection of bile pigments, positive demonstration of protein, positive indication of albumin, it did respond to the protease tests, and it did match the control prepared in the lab. We did get positive Benzidine tests by increasing sharply the peroxide content. (This is by the way a poor forensic test for blood, since iron oxide will also give a positive.) Finally we did immunochemical tests for whole human serum and for globulin. One has to be careful here, because of the problem of cross-serology. We ran controls for baboon, dog, horse, rabbit, etc., and of course baboon was within a factor of ten. We were only doing a surface precipitate test; there was no way to quantify it. So we cannot rule out the possibility that this could be some other type of primate blood. In sum, our testing showed that the substance composing the bloodstains on the Shroud is a blood-derived material; it is definitely from primate blood, and it is the exudate of a wound.

I will go into some detail on the latter point, as it relates to the question of whether an artist could have produced the image by using real blood. In the 1920s Paul Vignon pointed out that one of the peculiar characteristics about the

bloodmarks on the Shroud is that clotted blood is represented. No other artist in history had painted blood in a clotted form; they usually showed free-flowing blood. The bloodmarks on the Shroud are all depressed in the centres, raised on the edges, and in the ultra-violet photography we can see around all of these a halo of the exuded serum. In fact, those haloes tested positive for serum albumin by the standard Bromcresol Green test (used by physicians to test for albumin in the urine), and they also gave a positive immuno-chemical test with albumin serum.

Recently, Gil Lavoie has done some experiments in which he studied the clotting of blood and its transfer onto a linen cloth. He put drops of blood on plastic sheets, leather, paper and other surfaces and then applied a linen cloth to it at various intervals in the clotting process. He found that to produce imprints like those of the Shroud, one had to get the impression onto the cloth within about two hours in order for the impression not to be smeared. He also discovered something even more interesting: he did the experiment of letting the blood clots hang vertically, and found that a lot of the exuded serum dripped off. In sum, he found that to get imprints closest to what we have on the Shroud, the blood needed to clot in a vertical position, and it needed to be transferred to the cloth within two hours. This conclusion matches very closely what is indicated by other chemical and pathological evidence, i.e., that the individual whose image is on the cloth was wounded in a traumatic way, and held up with arms outstretched.

Now we should remember that we are not looking at whole blood on the cloth; we are looking at exudate from a clot. When this fact is borne in mind, it begins to make sense out of a lot of things that were previously unclear about the blood marks on the Shroud. Under SEM we see clearly that there are very few, almost no cells in the "blood". If in fact this is the exudate of a clot then there *should not* be many cells in it, as these would stay back in the clot. Furthermore, there should be no nitric acid because it should also remain in the clot. That is precisely what we find in the X-ray fluorescence studies. All of the evidence we have up to the present supports the hypothesis that the "blood" on the Shroud is the exudate from clotted blood.

When we examined the blood areas on the Shroud at 30x magnification, it certainly had all the normal characteristics of a blood stain. Blood is of course a mixture of chemicals, and what one sees on the Shroud at 30x is certainly a mixture, it shows capillarity (that is, it goes through the entire cloth) and it shows cementation. It all looks perfectly acceptable for blood except for one thing — it is too red for blood that is supposed to be some 600 to 2000 years old. Everyone knows that blood changes color when exposed to the air; it changes to a methemoglobin which gives it a brown color. So we need to explain why the centuries-old blood on the Shroud is still so red.

It has been claimed that the blood images are in fact composed of iron oxide. If that were true, it should appear as birefringent. But when examined under Polaroids, it is *not* birefringent, it is not pleochroic, it does not appear as iron oxide (nor does it test positive for iron oxide) and it is not iron oxide. On the other hand, blood from the charred region is birefringent, it is pleochroic, and it does test

positive for iron oxide. So there is nothing wrong with our experiments, since we have controls right on the cloth itself. We have of course also done controls made up artificially. Incidentally, finding iron oxide in the charred blood areas is just as one would expect. In 1669, Robert Boyle showed that when blood was combusted it left a fine red powder. Interestingly enough, he did not identify it as iron oxide. That was left to an Italian named Medini, who in 1747 established that combusted blood contained iron oxide and that, therefore, there was iron in the blood. So finding iron oxide in the charred blood areas is consistent with the hypothesis that the bloodstains on the Shroud are composed of real blood, not painted by an artist.

The next test we did was to take micro-spectrum photometry on the nonbirefringent red-coated fibrils from the Shroud. It was obvious that the spectrum it produced did not match the spectrum of methemoglobin, at least as it is given in the standard references, which is a solution spectrum of blood. But in a *film* of hemoglobin there is a confirmation change; it no longer remains in the "met" form but goes to the para-hemic form. It is known now that there is a certain species which will spontaneously go to the para-hemic form if there is not enough turn-over in the spleen and the liver to process the blood fast enough. We found a spectrum that was characteristic of only one known group of compounds — the so-called high-spin, high-iron porphyrins. So instead of being wrong, the spectrum peaks were in the right place. What we were seeing was the breakdown products of hemoglobin — bilirubin and biliverdin. And one began to make sense out of all this. There is an extraordinarily high bilirubin count, almost as high as the methemoglobin. Now how does one account for such a high bilirubin in a person? One possibility is that the person had a severe malaria, but this does not seem very likely. But a torture, scourging and crucifixion leading to shock — that would produce a tremendous hemolysis. In less than 30 seconds, the hemolyzed hemoglobin will run through the liver, building up a very high bilirubin content in the blood. If that blood then clots, the exudate forms, and all the intact cells with hemoglobin stay behind, only the hemolyzed hemoglobin goes out along with the serum albumin which binds the bilirubin. So what one ends up with on the cloth is an exudate which has an enhanced bilirubin index with respect to the hemolyzed hemoglobin. You now mix bilirubin which is yellow-orange with methemoglobin in its para-hemic form which is an orangey-brown and you get blood which has a red color.

In fact, we have been able to simulate this spectrum in the laboratory by the process described above. This very strongly suggests that the blood stains are of a man who was severely beaten. No one would have ever dreamed, when we first started doing the analysis, that the chemistry would provide corroborating evidence to what the pathologists concluded long ago about the Shroud figure. The blood has no cells, is very low in potassium, and has the right colour and composition for the blood of a man who was severely flogged and crucified. This is entirely consistent with the forensic evidence.

It has been claimed that an artist could have touched up the image by painting with real blood. We have shown by immunological tests that the blood is definitely primate blood, and that it must have been taken from the exudate of

a clot at a certain point in the clotting process. An artist would therefore have needed the exudate from the wounds of a severely tortured man, or baboon, and he would need to take the substance within a 20-minute period after the clotting had begun, and paint it on the cloth with the serum edges and all the other forensic precision that we see there. I believe most reasonable people would conclude that it is simply impossible that an artist could have produced the blood imprints on the Shroud of Turin. Rather, it is logical to conclude, from the nature and characteristics of the bloodstains on the Shroud, that the cloth once enfolded the body of a severely beaten and crucified human being.