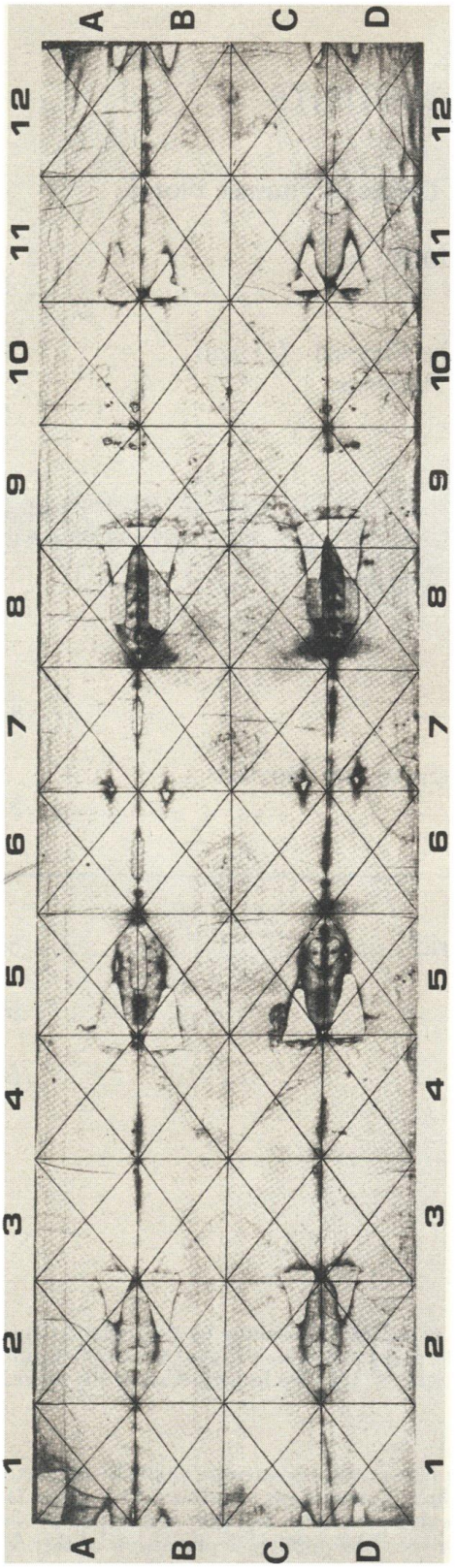

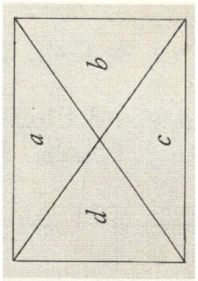

Map of the Shroud, drafted by P. Baima Bollone and Aurelio Ghio.

IDENTIFICATION OF THE GROUP OF THE TRACES OF HUMAN BLOOD ON THE SHROUD*

PIERLUIGI BAIMA BOLLONE, MARIA JORIO & ANNA LUCIA MASSARO

Sufficient reasons exist to accept as established that traces of blood are present on the Shroud. In 1980 Heller and Adler obtained the conversion of a heme to a porphirin on a specimen taken from the surface of the Shroud with "sticky tape". Forensic hematology investigations have demonstrated the factual presence of blood (Baima Bollone, 1980; Heller and Adler, 1981). Through the use of fluorescent antibodies we have demonstrated that this is human blood (Baima Bollone, Jorio and Massaro, 1981).

These acquisitions, plus the ascertained practicability of the ABO system to type historic and prehistoric material, led us to the present investigation for the purpose of identifying the blood group of the traces of human blood on the Shroud.

The present research was conducted on small samples of linen fibres, stained with human blood, obtained by mechanically disentwining warp and weft threads drawn out of the Shroud from the area of the so-called "bloody belt" (C 9d on the reference map; Baima Bollone and Ghio, 1977; Gervasio, 1978) during the night of 9 October 1978 (Baima Bollone, 1979).

For comparison we used:
— samples of "white" linen fibres, that is, fibres without stains, obtained by mechanically disentwining warp and weft threads removed from the Shroud, on the same occasion, from D 2c;
— samples of linen fibres obtained by mechanically disentwining warp and weft threads removed from a fabric extracted from an Egyptian funerary urn dated 1200 BC, unquestionably stained with traces of human blood;
— samples of fibres from a cloth experimentally daubed with human blood type A1;
— samples of fibres from a cloth experimentally daubed with human blood type B;
— samples of fibres from a cloth experimentally daubed with human blood type O;
— samples of fibres from a cloth experimentally daubed with human blood type AB.

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We employed the hematological technique which we considered the most likely to succeed, applying some modifications suggested by experience gained in the field specializing in the identification of ancient material.

First of all, by means of bi-adhesive tape, the following were made to adhere to a series of glass slides, each sample at a convenient distance from the others:
—samples of stained fibres from the Shroud; samples of "white" Shroud fibres; and a sample from each of the four experimental stains.

And in another series of glass slides:
—samples of fibres from the Egyptian funerary urn and a sample of each of the four experimental stains.

On each of these two series we performed the following:

a) search for the agglutinins, using the De Dominicis and Lattes technique, modified in this way:
—continuance of the slides in refrigerator at + 4°C for a long period of time;
—superposition on the fibres of a suspension of red blood cells (erythrocytes) A1 for one series and of B for the other;
—cold incubation for 30 minutes;
—apposition of cover slides and observation by ordinary optic microscope; and,
—successive elimination of the cover slides, mechanical removal of the fibres from the bi-adhesive tape, fixation in alcohol, coating with gold and observation under the electron scanning microscope.

b) search for the agglutinogens by means of the mixed agglutination technique, modified this way:
—incubation of the slides at + 4°C for 24 hours, with serum anti-A and serum anti-B Dade diluted 1/20;
—three prolonged washings in a solution of physiological saline; —washing in a 1% solution of bovine albumin;
—incubation of the slides respectively with red blood cells A1 and red blood cells B;
—apposition of cover slides and observation under ordinary optic microscope; and,
—successive elimination of the cover slides, mechanical removal of the fibres from the bi-adhesive tapes, fixation in alcohol, coating with gold and observation under the optic scanning microscope.

The reading of the results was based on the criteria indicated by Dunsford and Bowley (1970) and yielded the following observations:

	Agglutinins De Dominicis-Lattes method		Agglutinogens mixed agglutination	
	red blood cells A	red blood cells B	red blood cells A1	red blood cells B
Experimental stains:				
A	—	++	++++	—
B	+++	—	—	++++
O	+++	+++	—	—
AB	—	—	++++	++++
Fibres from Egyptian urn	?	?	—	—
Shroud:				
"white" fibres	—	—	—	—
stained fibres	—	—	++	+++

Control by the electron scanning microscope confirmed the data collected in the table.

The negative response in the search for the agglutinins α and β and the positive response in the identification of the agglutinogens A and B on the Shroud fibres stained with human blood, compared with the constantly negative results of the "white" fibres, and of the correct response of the control stains (A1, B, O and AB) permit the affirmation that the hematic traces under examination contain the erythrocyte antigens A and B.

There are, of course, many factors which lead to errors in the determination of blood groups, especially in ancient materials. Hart, Kvas, Soots and Badaway (1980) list a whole series of animal antigens, worms and bacteria capable of giving a false positive result, and of matter which—exactly the contrary—can intervene negatively (animal agglutinin and lecithin).

Nevertheless, the exclusion of every perturbation in the agglutination is guaranteed by the results on the test fibres and the fact that our "white" fibres, tested not only in the same conditions but even on the same slides with the positive stains, proved to be devoid of agglutinogens.

For the reasons indicated, we are therefore in a position to conclude that the traces of Shroud blood which we examined belong to the AB group.

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