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Medico-Legal.

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BLOOD AND MURDER.

BY E. S. M'KEE, M. D.,
CINCINNATI.

"In science, as well as feuds, blood doth for blood atone."

"Blood hath strange organs to discourse with all;
It is a clam'rous orator, and then
Ev'n nature will exceed herself to tell
A crime, so thwarting nature."
—Gomersall.

Shakespeare has Lady Macbeth, after the murder of Duncan, washing her hands, night after night, and crying:

"Out, damned spot! out, I say!—
What, will these hands ne'er be clean?
Here's the smell of blood still; all the per-
fumes of Arabia will not sweeten this little
hand."

"If the law has made you a witness, remain a man of science; you have no victim to avenge, no guilty or innocent person to ruin or save. You must bear testimony within the limits of science."—Brouardel.

"He who hath to do with the courts of law will rightly appreciate this. Understand how great a moral and legal responsibility the expert takes upon himself when he answers the question as to the presence of blood in the affirmative; on his answer may depend the honor and freedom, even the life of the accused person."—Minovich.

Differentiation of Blood Stains.

To Major W. D. Sutherland, of His Majesty's Indian Service, the writer is indebted for much valuable information on this subject.

In murder trials the medical expert is often called upon to differentiate whether certain stains found on knives, clubs, daggers and clothing of persons under suspicion, or upon the floor, walls or earth where a homicide was committed, were caused by blood or some other coloring matter. Of even greater importance is it to determine whether stains acknowledged to be blood are human blood, or that of another animal. Some very fine work has been done in this line, sometimes resulting in convicting the guilty and at other times acquitting the innocent.

It is not the purpose of this paper to go into the whole subject, which is a very elaborate one, but to give some of the main points, especially those of recent discovery which have so far been but little published.

The examination of blood stains calls for the consideration of physical characteristics, chemical reaction, crystalline properties, optical prop-

erties, microscopical appearances of blood corpuscles.

In the treatment of blood stains the fluids used will in some instances cause a reduction in the size of the blood corpuscles unless maceration is continued for some time, old stains requiring several weeks' maceration before they are in a condition to be measured. There is no fluid used or likely to be used for softening the blood stains which will cause an increase in the size of the blood corpuscles. If the corpuscles obtained from a stain do not recover their normal dimensions, it is almost absolutely certain that their average measurement will be less, but never greater, than normal. Thus we see that while human blood might from treatment become less than normal in diameter, and thus be confounded with that of some animal having a less-sized corpuscle, the reverse could never occur.

From the studies and experiments of investigators and authorities in this line, we are come to the following opinion:

In favorable cases blood stains can be so treated that reliable measurements and creditable diagnoses of their origin can be given.

Error occurring on account of the imperfect restoration of the form and diameter of the corpuscles obtained from the stain, will make human blood appear like that of one of the inferior animals, and never the reverse.

In general it can be positively proven whether a stain is mammalian blood. The stain of an ox, pig, sheep, horse or goat may be distinguished from human blood, thus confirming the claim of an accused person in many cases that his clothes are not stained with human blood. This negative testimony is certainly as important as inculpatory testimony.

The expert can say, when the average of a suitable number of corpuscles from a blood stain corresponds with the average of fresh human corpuscles, that the stain is not from the blood of the ox, sheep or goat.

Expert Testimony.

The testimony of the expert might take the following form: This stain is not composed of the blood of such an animal (ox, sheep, goat) as the defense claims; it is like the blood of a man or some animal having corpuscles of very nearly the same size as those of a man, as the dog or rabbit.

The declaration may take the following form: "This stain is not composed of human blood; it might be the blood of a horse, ox, pig, sheep or goat, as claimed by the accused." Only when the examinations have been conducted with great care and the measurements taken with reliable instruments are such declarations justifiable.

From a forensic point of view the important constituents of the blood are the erythrocytes—the red cells—whose form may enable us to distinguish mammalian from other blood, and whose pigment, hemoglobin, by its chemical and physical characters enables us to affirm that blood is present or absent, and the serum, the watery portion of the blood, which by its chemico-biological reactions, dependent on the albuminous substances which it contains, enables us to fix the source of the blood as to whether it has been shed by man or other animal. The leucocytes have not been found of service in forensic medicine.

Blood stains may be found on the clothing of innocent persons, as for instance from flea bites, from occupation, accidental circumstances, or without explanation. Too much importance should not, therefore, be attached to them, even if the accused does not satisfactorily explain them, if he does not attempt to do so in a suspicious manner. Taylor, in his "Medical Jurisprudence," cites a case where blood was found on an innocent person under very suspicious circumstances. It was a case of suicide, where the son first found the father dead from having cut his throat, and supposing it to be a hemorrhage, lifted him up and tried to resuscitate him before discovering the true state of affairs. Much blood was thus left on his clothing and hands, but the case was proven to be one of suicide.

Sunlight and heat have been found, especially by workers in the tropics, to render blood stains insoluble. If the heat is below the temperature of boiling water, it has but little effect. Blood stains on clothing which have been ironed since the crime was committed, have been found to be insoluble.

The differentiation of mammalian from non-mammalian erythrocytes in a stain might seem easy, but a few trials will suffice to convince one that much practice is necessary to attain that certainty which the distinction in a forensic case demands. Much depends upon skill in microscopic work, but a great deal more on the treatment of the stain.

Precipitins—Serological Tests for Blood Stains.

Krause, in 1897, showed that by immunizing an animal by injections of a culture of microbe, we obtain from the animal a serum, which, when added to the filtered culture of the microbe, causes a precipitate in it. Bordet, in 1899, showed that by immunizing a rabbit with intraperitoneal injections of milk which has been partially sterilized by being heated to 67 degrees C., we obtain from the rabbit a serum which will cause the formation of a precipitate in this milk. It

was later found that lactosera are specific for the milks which have caused their production, since it is found that human lactosera reacts only with human milk, cow lactosera only with cow's milk, goat lactosera with goat's milk. Meyers, in 1900, reported that by injections of egg and serum albumin he had obtained a specific antisera, which caused the formation of a precipitate—a precipitum, as he preferred to call it—in solutions of these substances. Nuttall made 16,000 tests with 900 specimens of blood, which represented 586 different species. Dubois discovered the remains of *Pithecanthropus erectus*, the missing link between man and the extant anthropoid apes; then Selenka discovered that, like man, the anthropoid apes have a capsulated discoidal placenta, and thus differ from the other apes of the old world, and now we have a discovery that by means of a precipitating antisera, the albuminous substances of the blood serum of man are very closely related to the blood sera of the apes.

Anti-human serum reacted with human blood, but not with the blood of the ox, horse, rabbit or guinea pig, cat, pig, sheep, fowl, pigeon, turkey, goose, duck, or fish. Biondi failed to obtain any anti-human serum by immunizing a monkey. Ewing found that immunizing the solutions of the blood of four kinds of monkeys failed to give the reaction, while equivalent dilutions of human blood still continued to give it. Biondi found that the blood stains produced by the crushing of fleas, bugs and mosquitos gave the reaction, which is a point of great importance in the tropics, where these and other blood-sucking insects abound. While the reactive power of human blood stains is remarkably stable, it is important to note whether the extract which we have obtained is acid or alkaline, and to neutralize it if it be acid, to reduce it if it be alkaline. The similarity between human and simian albumin is great enough to be a source of error. The responsibility is very great for him who undertakes to make a forensic blood examination by the sero-diagnostic method, and can only be undertaken by those who are thoroughly conversant with the method, and have at their command all the conditions necessary for trustworthy work. All sera which are to be used for forensic blood work should have been previously tested as to their potency under State control. That serum tests are necessary, no one will now doubt, and all will agree that such a weapon in the hands of justice should be entrusted only in the hands of a trained observer, who should have at his command a well-equipped laboratory.

Mummy material has been tested with the precipitin test, and a reaction obtained in mummies four and five thousand years old; and the rela-

tionship has been established between the mammoth and the Indian elephant of to-day.

The Precipitin Test; Its Value in Forensic Practice Shown by Numerous Cases.

Uhlenhuth ("Das biologische Verfahren zur Erkennung und Unterscheidung von Menschen und Thier Blut," Jena, 1905) reports a number of remarkable cases, of which the following are of special interest:

1. A man was accused of having stolen some fowls. Some blood stains on his clothes were, he alleged, due to rabbit's blood. Microscopic examination showed that the stains were due to the blood of a bird, and when their extract was treated with anti-fowl rabbit serum a distinct precipitate was at once obtained, while this antiserum produced only a slight turbidity after some time in solutions of the blood of birds other than the domestic fowl.

2. A man was accused of having shot and killed a wagoner. He alleged that the blood on his clothing was due to the drippings from some meat. The precipitin test gave a positive result for human blood alone.

3. A woman was accused of having cut the umbilical cord of her child with the scissors and then having drowned the child. She claimed that the birth had occurred at stool, the cord was rent asunder, and that the stains on the scissors were due, first, to her having cut some plums, and then cut off the head of a pigeon. Autopsy demonstrated that the infant's cord had been cut, and the stain on the scissors was found to give, on extraction, a precipitate with anti-human blood.

4. A man had entered a claim for sick benefit, having been found lying in bed, his clothes soaked in blood. He claimed to have had an attack of hemorrhage during the night, but the precipitin test showed that the blood on the bedclothes was bovine, and he confessed that he had emptied a bottleful of ox blood on the bedclothes.

5. Sachs (Royal Institute for Experimental Therapeutics, Frankfort on the Main). A man was found lying in a pool of blood with twenty stab wounds in the chest, which he said were inflicted by a butcher. The butcher, on being questioned, said that some stains on his coat and trousers and one of his boots, were due to the blood of a cow and a pig which he had recently slaughtered. The extracts of the stains gave a positive reaction for pig's blood and a negative reaction for human and bovine blood. The scrapings from under the man's finger-nails, which were sent for examination, were found to give a negative reaction for all three bloods.

6. Kochel (Institute of Legal Medicine, University of Leipsic). A man claimed as the re-

sult of an accident to be suffering from a hemorrhage from the urinary tract. The precipitin test gave a positive reaction for pig's blood, and it was found that he was pouring pig's blood into his urine from a ph'al.

7. Beumer (*Zeitschrift f. Meditz. Beampte*, 1902, p. 829) reports the case where a house was burned and a small piece of charred bone was found. A solution was made, filtered, and the clear filtrate tested with anti-human, anti-pig and anti-ox sera, the reaction being positive for the last-named antiserum only.

Blood Stains Caused by Insects.

It is easy to see how great confusion might occur in the case of a suspected murder where the person under suspicion had blood stains on his clothing, which had occurred through the mashing of some blood-sucking insect, as a flea or a bedbug. It is self-evident that these stains would simulate very much human blood stains.

Chevalier, in 1830, was consulted in a case where a man suspected of committing a murder had some blood spots on his shirt sleeves, which he alleged were due to bugs. Chevalier, after careful examination of the stains left by crushed bugs, stated that he could find no difference between these and blood stains, save that the blood stains gave a solution which became turbid when chlorine was fused into it, and which when treated with sulphuric acid gave an aromatic odor.

Vibert states that flea stains are 0.5 to 3 mm. in diameter, and oval or round, but never with a pear stalk point, such as is found in a blood-spurt, and that they often yield the spectrum of blood and crystals of hematin chloride.

Schmidt finds that when viewed against a candle light, the blood stain is cochineal-red, while the flea and bug stains are brownish red. In form the blood stain is rounded, while the flea stain has points all round it, and the bug stain is circular, 1-3 mm. in diameter. The color of the blood stain is reddish brown, while the other is brownish red. The surface of the blood stain is rough, rarely with elevations in the middle; flea stain with thick elevations in the middle, which glisten; bug stain smooth, no elevations in the middle, often several stains arranged garland-wise.

Brouardel and Tulpian, in cases in which they were consulted, found some flea stains on a man's shirt, which were, when viewed by a magnifying glass, very similar to the stains which were produced when they experimentally sprinkled the shirt with blood. Biondi obtained the precipitin reaction from stains produced by the crushing of blood-laden fleas, bugs and mosquitos. If only a few droplets of blood be present on the clothing of an accused person, such

sprinkling of blood as for instance might occur on the breaking of blood bubbles made by a man whose throat is cut, defense would probably allege that these droplets were due to insect stains.

Schoefer maintained that the crystals whose presence in blood stains were first noted by Robin, are of uric acid, and that mistakes might occur if a stain that is due to some other substance than blood has been fouled by insect excreta.

Hofman has observed that in insect stains portions of the insects as well as their stains are often to be found. He crushed a blood-ladened bug on a cloth, and then wiped the mass off; he found the preparations contained portions of the trachea and bristles of the insects. A bug's bristles are characteristic, being yellow and serrated at their free end with the shaft, like the deplumated end of a feather. In a case of a shirt much stained he obtained crystals of hematin chloride and uric acid, and found the singly-pointed bristles which are characteristic of *pediculus corporis*, and a maxilla of this insect.

Sutherland carried out a number of experiments of crushing blood-ladened bugs on underclothing, and found that in about ten per cent. of the cases he was unable to find the presence of the trachea or bristles.

The Age of Blood Stain.

Soon after the medico-legal importance of blood stains had come to be realized, it was noticed that while some stains were easy of extraction, others were extracted with difficulty, and the older the stain the greater the difficulty. So marked, indeed, is this factor of age, that Pfaff constructed a scale by which the age of a blood stain might be determined by its solubility in a 1:120 solution of arsenious acid. The scale was this: Fresh blood dissolves at once, blood one or two days old within fifteen minutes, blood from three to eight days old within fifteen to thirty minutes, blood two to four weeks old within one or two hours, blood four to six weeks old within three or four hours, and blood a year old or more within from four to eight hours.

The heat to which a stain has been exposed is a matter of very great importance. Liman, in 1886, found that he could not get a solution of a blood stain which was on a coat which had been ironed after it was stained, and he was of the opinion that the heat of the iron was the cause of the insolubility of the stains.

Sunlight will render a blood stain insoluble. This is of special interest in the tropics where the sun's rays are so intense. Stains on hard surfaces are but little affected by heat or sunlight.