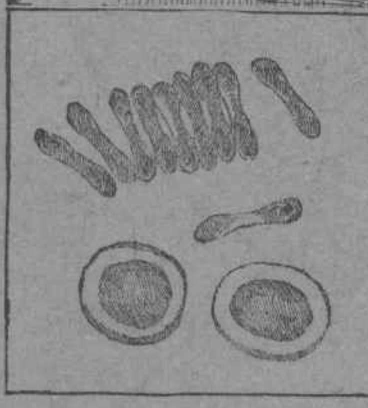
Modern Science, the Great Detective of Modern Crime.

How the Infallible Microscope Has Superseded "Old Sleuth" and His Old-Fashioned Methods.

Expert Burning Cloth in Laboratory.



HUMAN BLOOD CORPUSCLES.

"Science Is Our Greatest Aid in the Detection of Crime."

By Captain George W. McClusky, Chief of Detectives at Police Headquarters.

To the Editor of the Journal:

HAD it not been for science many a criminal who has answered for his crime would to-day be at large. More than that, it has had the effect of increasing the vigilance of the detectives themselves, as they now fully understand that the smallest clew, which would under ordinary circumstances, be beyond solution theoretically, when studied and analyzed by the scientist often leads to the discovery of the guilty party.

Twenty years ago the detective force of New York City was obliged to cover a great deal more territory than now, to fix more incidents, to establish more motives, thereby using up valuable time in reaching a proper basis to work out a case. But to-day they get at the bottom of things more rapidly, for they have been taught by modern science the important work of concentrating upon the clews which, by the aid of science, may be built up into irrefutable evidence.

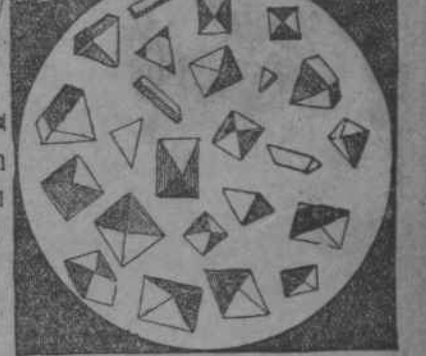
The detectives in the New York service now all make careful study of results that can be properly reached through scientific investigation. They are just as familiar with the scope of science as they are in the technical causes of crime. They know what part of the work they can trust to science, and what science demands of them in the way of clews and evidence. Armed with this knowledge they are able to think quickly, to act quickly, and especially to mass necessary material, and thus speedily close up cases that years ago would lag indefinitely, and perhaps never be solved at all.

I could fill a book about the numerous advantages that science gives us. Poisons, blood stains, bits of fabric, hair, dirt, odors, post-mortem and ante-mortem conditions, chemical analysis, microscopy, etc., are all now part of the scientific education of a modern detective.

The science of criminology is developing right here in New York the best detective force in the world. Our men are thinking more on analytical lines, reaching deductions from evidence that not so very long ago would have been entirely dismissed in criminal solutions.

Every man in this department knows that in order to keep up with the profession he must industriously apply himself to a close study of those things that will enable both the police and our scientific allies to get at the bottom of things.

Examination to Discover Presence of Arsenic.



ARSENIC CRYSTALS.

Telltale Footprints. 1. When Standing. 2. Walking. 3. Running.

THE onward march of science has been remarkable, among other things, for the powerful aid it has given to the detection of crime. So true is this that no great murder trial is ever without its expert witness to give scientific testimony. So infallible are the methods of the scientific investigator of crime, so inexhaustible his resources, and so convenient his appliances, that he has come to be even more important to the course of justice than the detective. In fact, the detective has learned that he himself must become a scientist and an expert, in a small way, if he would succeed in his profession.

Although great poisoning, shooting, stabbing, and other homicidal trials have a wonderful fascination for all newspaper readers, very few fully appreciate the medical evidence, which is usually the most important link in the chain.

The evidence is of three kinds—that of the ordinary medical man, who sees the patient dying, perhaps, and performs the post-mortem; that of the chemist, who, in his quiet laboratory, traces the poison or identifies the blood stain, and that of the expert, who gives his inference from the facts stated by the first two. It is these experts who often differ from one another.

In a large number of cases the post-mortem examination is the first step in unravelling a mystery.

The man who performs it is not to be envied, for the smallest scratch on his hand may admit a dose of deadly poison. Many medical men, indeed, wear rubber gloves, and those less careful generally cover their hands with a layer of sticky ointment. It takes from two to four hours to do the job thoroughly.

But it is not all cutting up, as most people think. The first thing done is to notice the position of the body, and whether there are any weapons, bottles, or glasses near.

Then it is examined from head to toe for scratches, cuts, bruises, moles, tattoo marks. Everything about the hair, eyes, teeth, nose, ears and other parts is written down. The height, the age, the muscular development are all noted.

Of course, this inspection alone often reveals the cause of death. Suppose, however, that no external injury is found and no organ is diseased, the suspicion of poisoning naturally arises. In that case the doctor looks for certain marks that the commonest poisons make, and then he places the stomach and other parts in glass jars, which are securely covered, sealed, labelled, and handed to the analyst.

Probably, in most cases, the ordinary medical attendant is able to tell whether a person is dying a natural death or is being carried off by some deadly drug. His position, however, is not a pleasant one. It is impossible to be certain; and, in order to make a full investigation, he must suggest either that the victim is committing suicide, or that some one else, perhaps his wife or son, is committing murder. And, after all, the signs in the living are very obscure.

Of course, if a person is foolish enough (as many are) to drink sulphuric or nitric acid, his mouth and throat are burned as if he swallowed coals of fire, the former leaving black and the latter yellow stains; but when the poison is arsenic, or opium, or strychnine, the symptoms are very like those of certain diseases.

Apoplexy, in the same way, is very like opium poisoning; and hydrophobia, lockjaw, and even some cases of hysteria closely resemble poisoning by strychnine.

Still, when a healthy man grows suddenly ill soon after a meal the doctor keeps his eyes open, and if death follows he has a pretty shrewd idea of what caused it.

At all events, he feels perfectly justified in assuming that the case is not a normal one. He therefore hands over to the analyst the jars and other receptacles containing the portions of the subject's body likely to bear traces of the poison, knowing full well that if any poison is there the analyst will positively detect it.

The analyst begins by making a series of what may be called "brews," mincing, pounding, boiling, cooling, filtering, decanting and distilling over and over again. In these operations various solvents are used in succession, plain water separating out one class of poisons, alcohol dissolving out another group, benzol taking up a third, naphtha a fourth, ammonia a fifth and so on.

This preliminary work takes, not hours, but days to perform. At an early stage in it the operator discovers such volatile poisons as prussic acid, chloroform, carbolic acid and phosphorous; if any of them be present. Later on he comes across the alkaloids, such as strychnine, digitalin, cantharidin and other terrible poisons of that class.

Finally, the residue of the animal matter with which we have supposed the medical detective to be experimenting is mixed with hydrochloric acid and distilled once again, after which it can contain no poison except one of the metals.

Thus in the course of his examination the analyst has made a number of decoctions, in one of which the poison is certain to be. In each decoction there may be any one of several groups of poisons.

In which is it, and what is it? After all this patient labor the solution is still far off. It may be a ptomaine from poisonous fish or decayed meat, a deadly berry, or leaf, or root, a small quantity of morphia, or phosphorous, or lead, or arsenic, or antimony.

Each brew is tested in turn. But, as illustrating the general procedure, take the last, which contains whatever metal may have had the fatal result. First, the chemists tests with "group re-agents." He knows that if he puts into the glass containing the last brew certain bodies in succession, some metals, if they are there, cannot be kept from rushing into the arms of one; others will as passionately embrace another, others still will unite with a third, while some will always repudiate any alliance.

There are in all cases signs of the union when it takes place, such as a blue or white or red color, or a powder falling to the bottom, or a fizzing of escaping gas.

In practice the analyst puts a little of the brew in a small glass test-tube, pours in some distilled water, and carefully drops in some hydrochloric acid. Now, if there is either silver, mercury or lead in the brew, down goes a white powder; if none of these things is there no change occurs.

Next he adds some sulphuretted hydrogen water, a sort of aerated water smelling of rotten eggs. If tin, platinum, bismuth, cadmium, arsenic, or one of several other metals is in the brew a colored powder falls to the bottom. Should nothing occur, he adds other things, until he has tested for five groups of metals.

When he finds a poison belonging to a certain group he has still to ascertain which of five or six bodies it is.

For instance, after adding the first two test liquors, if he sees a yellow coloration or precipitate he knows that he has either arsenic or tin or cadmium. He then adds some strong ammonia, after boiling the liquid till the smell of rotten eggs has disappeared. If the powder dissolves and the color goes he is quite sure he has found arsenic.

In this business-like way the murderer is convicted.

But now arises the necessity for making doubly sure, and another kind of test altogether is employed. Life and death hanging on the result, the test must be beyond all doubt. But arsenic is one of those self-assertive things about whose presence there cannot be the most infinitesimal doubt. Give a man a particle the size of a mustard seed and let him swallow it. When he dies bury him and let him lie under the earth for a quarter of a century. Then gather the few remnants, give them to a chemist, and he will return you a considerable portion of the poison in the same state as that in which it was administered.

Probably the most famous special test of arsenic is Marsh's, the invention of a Woolwich chemist, and equally famous is Reinsch's, which is performed as follows: The suspected liquid is put in a little glass test-tube with some hydrochloric acid. Then a small bit of bright copper is dropped in and the test-tube is held over the flame.

Now arsenic has the wildest love for copper, and every trace of it in the tube flies to the slip of copper and covers it with a gray coat. Another metal does the same, certainly, but they can be distinguished subsequently.

Presently the copper is removed, washed, dried, and placed in a tough glass tube, very narrow at one end. This is held over a flame and carefully heated, and then a phenomenon, not unknown, either, in the loves of mortals, occurs. The arsenic abandons the copper and clings in crystals to the sides of the glass tube, where it can be recognized by the aid of a magnifying glass or microscope; and if the crystals are heated with a bit of acetate of potash the odor drives the chemist from the room.

To this curious fact that arsenic loves copper when it is wet with warm hydrochloric acid and hates it when it is hot and dry, is due the discovery of many a crime.

Blood is so characteristic a fluid that it might be supposed a skilful analyst could never have any difficulty in recognizing it. Of course, if he were given, say, a cupful in its ordinary state he could not make a mistake. But he never gets a chance of earning his fee so easily.

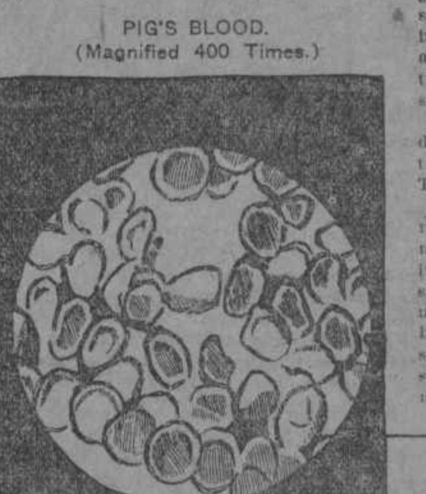
When the police seek his assistance they give him, perhaps, a suit of dirty clothes, which may be stained by two or three small dark spots that might be anything.

Or perhaps he is given a rusty knife or a perfectly clean hatchet and is asked to say if there is blood on it.

What the analyst first does when he receives such an article as a pair of trousers is to scrutinize every inch of its surface with a magnifying glass. If he finds a little lump of dark-colored stuff he scrapes it off and puts it into a watch glass. If he discovers merely a dark stain he cuts out the piece of cloth and puts it into a small quantity of distilled water.

Now he has to find out whether the suspicious-looking thing is really blood, or whether it is merely red paint, or logwood, or cochineal, or madder, or iron-mould. There are three ways of doing this and he nearly always utilises them all.

PIG'S BLOOD.
(Magnified 400 Times.)



PIGEON. PHEASANT. PIKE. TOAD.

HUMAN BLOOD.
(400 Times Magnified.)

CAMEL. HORSE. MOUSE. MAN.

Corpuscles in the Blood of Different Creatures as Shown by the Microscope.

First, there is the marvellous spectroscope test. This test will reveal the presence of the minutest trace of blood, and it is practically infallible. It depends upon the curious property, possessed by nearly all bodies, of absorbing certain parts of the light that passes through them. Sunlight passing through a prism is split up into the familiar seven colors of the rainbow. But if a little blood dissolved in water is placed in a glass tube, and if the light is made to pass through it on its way to the prism, the blood takes something out of it; for now among the seven bright colors are seen two dark bands near the middle of the yellow ray.

Nothing but blood gives these two bands in that particular place, with the exception of two or three substances that are not likely to be found on criminals' clothes. These are cochineal, mixed with certain chemicals, hot purpurin sulphuric acid, and the red dye of the banana-eater.

Blood, however, changes after it is shed. In stains a few weeks old the coloring matter changes from what is technically called haemoglobin to methaemoglobin, and, later still, to haematin. All of these give different spectra. The analyst has standard spectra already mounted, and he invariably looks at the mounted or standard specimen and the suspected fluid at the same time, placing them side by side, so that a mistake is impossible.

But though the spectroscope is a certain discoverer of blood, it can draw no distinction between human and animal blood. That duty remains to the microscope.

With the microscope can be seen those red corpuscles which, in some mysterious manner, seize on the oxygen of the air as it passes into the lungs, shoulder it, so to speak, and rush away with it, like so many ants, to the remotest part of the body. Unfortunately, they can only be seen in blood that has not been very long shed—that is to say, some weeks or months.

To see these the analyst scrapes the little clot from the piece of cloth, or wood, or iron, and places it on a slip of glass; over this he carefully lays the little film called a cover-glass; and then he gently places, at the edge of the latter, the tiniest possible drop of water. This gradually insinuates itself, and soon dissolves the blood clot; and, when the mixture is placed under a microscope magnifying from 200 to 500 diameters, he sees one of several pictures.

Individually, the blood corpuscle is just like a tiny round biscuit, and measures 1-3200 to 1-4000 of an inch across its face. It is these two factors, the shape and measurement, which enable the medical man to say whether the blood is human. The picture above shows how a corpuscle looks under the microscope. Looking at its face, it is like a thick-edged biscuit, with a dark depression in the centre. Some are turned sideways in our illustration. These exist in blood and nothing but blood, so that, when the spectroscope fails, the microscope succeeds.

But it is not always that the analyst can get sufficient blood to place under the microscope. Perhaps he gets a piece of cloth saturated with a trifle of red fluid which he cannot scrape off, or perhaps he gets a stain some months or years old in which the corpuscles are destroyed.

Our detective mixes the particle of blood-stained wood, or earth, or dust, or cloth fibres with water and caustic potash, and filters it. Then he takes a drop of the liquid and places it in the useful watch-glass. Into this he puts some glacial acetic acid and a crystal of ordinary table salt. He heats the mixture and lets it cool. And, if it is blood, he gets peculiar crystals, visible under the microscope. These, by the way, differ to some extent in different animals.

Another test is so new that it has not yet been given a fair trial. It is as follows: If a fairly large quantity of blood can be got, it is burned, and the ash is analyzed. Now, there are two salts always in blood—sodium and potassium salts. But, while the quantity of the former in human blood is usually twice that of the latter, it is six times as great in the sheep's blood, eight times as great in the cow's blood and sixteen times as great in the blood of a fowl. Very important results are expected from this principle.

Reliable as are the microscope and spectroscope, the analyst always uses the third means at his disposal—the chemical test. For instance, he gets a knife covered with dark red stains. Are they blood, or are they only the rust formed by vinegar or the juice of a lemon that has deceived so many people? Assuming that he has removed the stain, he places the matter in any kind of tiny vessel and drops in some tincture of galls. If the thing is only rust, he has some excellent blue ink; if it is blood, he finds that a reddish powder makes its appearance.

Probably the most interesting of all his duties to the analyst is that of judging from what animal the blood stains came. This can be done only in some cases; that is, when the blood is not quite so old that the red corpuscles have entirely lost their shape.

Of course this is a matter of the greatest importance when a man is on his trial; for, in the first place, every spot of blood found on his belongings is supposed to have come from his victim, although it may be nothing more than the blood of a fish; and, in the second place, the stock of explanation of blood stains on his clothing offered by a prisoner is that they came from some animal he killed. The plan is to ask him what animal. Five times out of six he will say a domestic fowl or some kind of bird—especially if he is a poacher who has killed a gamekeeper—and then he is done for.

Look at the pictures on this page and you have the whole thing in a nutshell. It will be seen that the red corpuscles of the blood of birds, reptiles and fishes (with the exception of the cyclostomata) are oval, while those of mammalian blood are round. Here is, at once, a sure way of differentiating mammalian blood from that of the other three great classes of animals. The only difficulty is that the blood corpuscles get out of shape, under certain circumstances, and are no longer either oval or round. But there is another difference:

A mammalian corpuscle is of uniform substance throughout; that of a fish, bird, or reptile has a small, dense spot near the centre, called a nucleus. Snails, slugs, worms and other low forms of animal life do not come into the question at all, for their blood is generally colorless, and, if not, it is blue-green, violet, brown, being scarcely ever red, and then not from the presence of corpuscles.

All that remains for the analyst, therefore, supposing he finds a round corpuscle, is to say to what mammalian animal it belongs. (The llama, alpaca, camel and their kin, by the way, have oval corpuscles.)

How are the corpuscles of different mammalia to be distinguished under the microscope? Merely by their size. They have all been measured with the greatest care, a specially small unity of length, called a micron, having been invented for the purpose.

Therefore, when it is a question of whether the blood is that of a dog, pig, hare, rabbit, or man, he would be a daring man that would give a decided opinion. But it is certainly possibe to come to a safe conclusion as to whether it is that of a human being or a sheep, goat, or elephant.

Owing to the influence of disease on the blood, however, it is never really safe to say absolutely "This is human blood," and in fact, all that is generally stated in evidence is whether it is mammalian.

There is one other important piece of work the medical detective can perform in his laboratory in the way of tracking criminals; that is to distinguish hairs from vegetable fibres, and human hairs from animals'. Our illustrations show how it is done. He simply places the thing to be tested under the microscope, and—as he is acquainted with every description of hair, cotton, wool, silk and other fibre—he can tell at a glance what it is.

Hair is more like wool than anything else, but wool is irregular and hair is pretty regular in breadth. The hair of an adult, also, has a streak in the middle.

We append accurate illustrations from microscopic photographs of the hairs of many animals. Obviously, there is no difficulty to the practised eye in distinguishing them. In fact, most animals' hairs can be known by the naked eye, or with a small magnifying glass; but that of skye terriers and spaniels is wonderfully like human hair.

On all these little things hinges very often the terrible issue of "guilty" or "not guilty!"

Footprints are usually left to the police to interpret. But, very probably, the result is often a miscarriage of justice.

And, moreover, the comparison of a naked foot with its supposed print on the ground, or the fitting of a boot to a boot-mark, is a process requiring not only the most exact measurements, but consideration of the kind of mark made on different kinds of soil, and in the various positions taken by the foot in standing, walking and running. In running we press mainly on the toes, and in walking the greater part of the foot comes down, and the longer the foot rests on the ground the deeper is the impress.

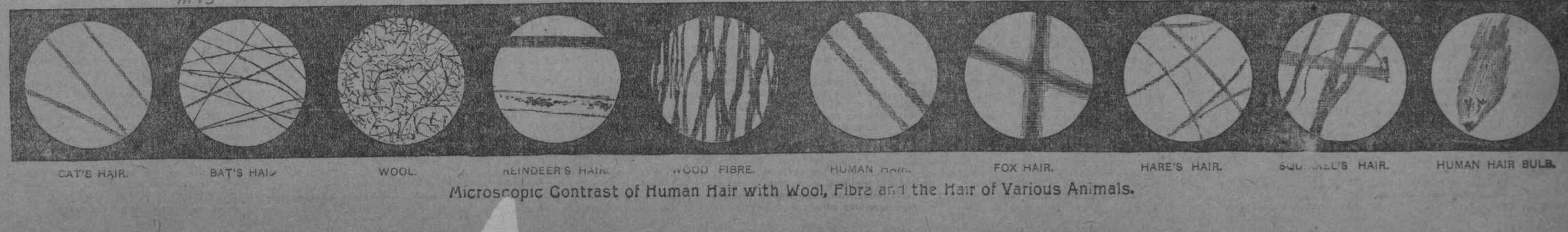
In fact, an expert can make a pretty shrewd guess as to the rate at which the owner of the foot was travelling, by considering the size and depth of the footprint.

In order to make a comparison, a cast has to be taken, if the mark is on soft ground. This is done by heating the footprint with a hot iron and filling it in with paraffin. From this a plaster cast is taken, and it can be preserved for comparison until some one is arrested.

When the footprint is found in snow, gelatine is used to take the form of it, and from this also a plaster cast is made.

Of course, these operations have to be carried out with the greatest care, for footprints are frequently the strongest pillars of an indictment. In order to compare the foot of the suspected person, he is made to walk, stand and run over a surface similar to that on which the incriminating print has been found. There is one case in which the scientific detective is certain—when the person has stood still on soft, but firm and tenacious soil.

The footprints represented in our sketch are those, of course, of naked feet, which give the clearest impression. But a corresponding variation occurs in all footprints made by persons wearing boots, so that the attitude or action of the wearer is easily told.



CAT'S HAIR. BAT'S HAIR. WOOL. REINDEER'S HAIR. WOOD FIBRE. HUMAN HAIR. FOX HAIR. HARE'S HAIR. SQUIRREL'S HAIR. HUMAN HAIR BULB.

Microscopic Contrast of Human Hair with Wool, Fibre and the Hair of Various Animals.