WHEN LIFE OR DEATH HANGS ON A BLOOD STAIN.

HOW SCIENCE SOMETIMES SERVES THE ENDS OF JUSTICE.

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In cases of murder, stains supposed to be blood are sometimes found on the clothing or belongings of suspected persons. In doubtful cases of this kind, the fate of the defendant usually depends, not so much on judge, jury, or eloquent lawyers, as on the observations of a man who, quietly seated in his laboratory, is compelling with his microscope the invisible to become visible.

When the prisoner claims that certain dark red stains on his clothing were caused by spatters of red paint, the judge and jury and the lawyers cannot prove or deny the statement. They may say: "It looks like blood." But what do value resemblances amount to, since, in so many of the affairs of life "things are not what they seem?"

A human life hangs in the balance. It must neither be sacrificed by vague suspicions, nor saved if the suspect is guilty. The man with a microscope and a laboratory is the only person who can settle the question, and he can settle it beyond the shadow of a doubt. He dissolves a particle of the stain in a drop of liquid, then spreads a minute fraction of this drop on a little slip of glass three inches long and an inch wide. Next he examines it with the microscope. If he sees a great host of little red discs, such as appear highly magnified, he knows that the stain was made by blood.

But suppose the stain is old and has been exposed to the weather for weeks or months. It has become greatly changed. It can be dissolved only with difficulty; and the little blood discs, if present, may be shrivelled, distorted, and broken up, until it is impossible to determine whether they are real blood discs or particles of something else. When the blood has reached this state, it is impossible to use any chemical which will restore the discs to their original condition. Consequently, it is frequently impossible to identify old blood by means of its discs. In such cases the investigator takes a particle of the stain on a glass slip, and dissolves it in strong acetic acid, adds a minute portion of common salt, and heats it with extreme care. Great skill is here required in order to heat just sufficiently and not too much. The glass slip is then examined with the microscope; and if a great number of stick-like, X-shaped (and occasionally stellate) crystals appear, the stain is known to be blood. These are called "Teichmann's crystals" (from the discoverer). They are regarded by experts as yielding evidence which is absolutely conclusive. They can be produced by no known substance except blood.

Another important method for the detection of blood is that of spectrum analysis, which depends on its optical characters and requires more complicated apparatus than the other processes.

The fourth test which may be applied to blood is strictly chemical. A small portion of the suspected substance is put on clean, white paper, and is moistened with tincture of guaiacum. A drop of hydrogen peroxide is next added, when, if the substance tested is blood, the paper will turn to a beautiful blue colour. A particle of blood which is scarcely visible to the naked eye may be detected in this way.

The human blood discs are very small. It would take 3,200 of them placed side by side in a row, to measure one inch in length Though very minute, they are so numerous that a volume of blood not larger than the head of a pin is believed to contain five millions of them. In fact, they are present in the blood in such vast numbers that some scientists have made the astonishing statement that if all the blood discs which are in one person were arranged side by side in a continuous line, that line would be long enough to reach four times around the earth

Without discussing the differences between blood from the veins and that from the arteries, and the differences in colour as affected by the different substances on which it falls and dries it may be noted that in general, when blood stains are fresh, their colour is scarlet and they dissolve readily in water. As the stains get older they become darker, first changing to reddish brown and later to dark brown. They also become less and less soluble in water Finally they become entirely insoluble in water, and chemicals must be used for their solution. From these facts it will be seen that the analyst can, under favourable conditions, determine the age of blood stains. He cannot be exact in his conclusions, it is true, but he can say whether the stain is a few days old, a few weeks old, or a year old.

By the examination of a blood-spattered surface, one does not need to be a Sherlock Holmes to determine pretty accurately the direction of fall of the drops and the distance from which they came.

An important question arises After determining that the stain is blood, can the investigator decide whether it is human blood or the blood of a beast? In deciding this question, he must rely entirely on the microscope. All chemical tests give exactly the same results, whether the blood is that of a man, a bird, or a reptile. Many suggestions for differentiation along this line have been made, which, however, would not stand the test of practical experiment in the laboratory, many fine theories have been advanced, only to be overthrown. So it must be acknowledged that up to the present time it has been found impossible by any other process or instrument to distinguish human blood stains from those of other animals. But under favourable conditions, when the blood is fresh, the microscope will give results which are satisfactory and reliable. The blood discs of birds and reptiles are oval and nucleated, while human blood discs are circular and have no nucleus. The blood of pigeons and frogs may be taken as types of blood of birds and reptiles. Therefore, if a man who is arrested for murder claims that certain stains on his clothing were caused by killing a chicken, a reptile, or a fish, the microscopist can easily determine the truth or falsity of the statement.

The camel and llama have oval blood discs like those of birds and reptiles; but all other higher animals classed as mammals have circular blood-discs closely resembling those of human blood. In fact, the resemblance is so close that the only way of determining the difference is by measuring the discs. For this purpose, exceedingly delicate instruments are used in connection with the microscope. The blood of sheep, goats, horses, and cattle has discs which are considerably smaller than those of human blood. But monkeys, dogs, rabbits, and guinea pigs have blood discs so nearly like those of man that it appears doubtful if it is possible for any scientist to decide positively between them.

It has also been found impossible to distinguish the blood of a man from that of a woman or child, or the blood of any one person from that of another under any ordinary circumstances. Notwithstanding the limitations mentioned, the specialist has in very many cases, rendered eminent service in the identification and conviction of criminals.

Britain's Growing Trade.

TINNED MEAT IMPORTS DROP MORE FRUIT EATERS.

The Board of Trade returns issued show further enormous increases in Britain's oversea trade. As compared with the same month last year, imports were greater in value by £3,867,836 and exports by £5,621,911.

The imports for the whole of last year showed an increase of £14,240,774; for the seven months of this year the increase is £31,299,367. Exports last year increased £29,312,427, but this year they have already increased £30,509,206. The following table gives the values of trade —

July 1906.	July, 1905.	Increase.
Imports—		
£48,609,674 ..	£44,741,838 ..	£3,867,836
Exports—		
£33 442,962 ..	£27,821,051 ..	£5,621,911
Seven months. 1906.	Seven months 1905	Increase.
Imports—		
£349,146,766 ..	£317,847,399 ..	£31,299,367
Exports—		
£214,036,478 ..	£183,527,272 ..	£30,509,206

The imports of tinned meat show a decrease during July of 2,687 cwt representing a value of £18,975.

Britons are daily becoming more fruitarian apparently In July they took £29 088 of apples, as against £24 589 at the same time last year; £236 265 worth of bananas, compared with £185,941; £63,569 worth of cherries, as against £61,340; £116 735 worth of raw currants, as against £76,663; £10,549 worth of raw gooseberries, as against £3 712; and £48 946, worth of raw pears as against £22,813. Strawberry imports were four times as great—£12 672, as against £2,975 in 1905.

CHIMNEY v. MECHANICAL DRAFT.

A chimney with natural draft will have a draft dependent upon its height, the power of which will not vary, except upon the rise or fall of the internal temperature. It has, therefore, no sucking power, in fact, the term suction in this connection is a fallacy. The chimney acts because the external air is heavier than the internal, and thus presses into the chimney by the only available opening, viz., that at the bottom, the furnace front. The pressure or intensity of the draft fixes the amount of fuel it is possible to burn on a given area of grate. It therefore becomes necessary, when it is desired to increase the steaming capacity of a boiler by increasing its coal consumption, to increase the intensity of the draft, and the only way in chimney draft is to increase the temperature of the gases passing up it, or increase the height of the chimney. The first method, of course, means a large amount of waste, and is a very uneconomical arrangement; the second is expensive and unusual. A chimney stack 150 ft. high will burn from 15 lb. to 20 lb. of coal per sq. ft. of grate area per hour under normal conditions, but in wet or foggy weather it will be very much less than this, as the wet air is lighter than the dry, and thus produces less pressure at the furnace (the weight of water vapour is about half that of air). A fair average of temperature in the furnace is 2,400° F., and that of the escaping gases at the chimney, without economisers, 600° F. This means that one-quarter of the total heat generated is sent up the chimney to waste. Thus, on a 2,000 h p. plant, almost 500 h.p. is going up the chimney per hour, and the coal bill necessary to sustain this will come to a big figure in the year.

It is not the author's contention, but it has become a well ascertained fact, that it is cheaper and better in every way to provide the necessary supply of air for burning fuel in steam boilers by mechanical means, and to take as much heat out of the hot gases after they have ceased to be in contact with the boiler itself, before they are turned out into the atmosphere, than to do it in the older way by utilising a portion of the heat generated to create the necessary supply of air. This is the primary reason for using a mechanical means of moving the air. The heat previously necessary to create the draft by means of a chimney may now be employed usefully in other directions.—*The Engineering Review (London)*

Still Believes the Earth is Flat.

The hopelessness of convincing every living being of the truth of any proposition, remarks *Building & Contracting News* is again illustrated by what one, Aurin F. Hill, of Boston, says about an item that appeared in a recent issue of the *Springfield* (Mass.) *Republican*, to the effect that Springfield is 65.8 feet above sea level. Mr. Hill says regarding this "Springfield is about 100 miles from Boston. Is this grade at Springfield correct? If the earth were a globe 8,000 miles in diameter, Springfield ought to be about 6,666 above or below Boston. Is it? Can our engineers survey a level and straight line—a horizontal line—from Boston to Springfield? I think they can. I think they did it; and by their works prove that this earth is a plane and stands fast. They prove by their works that water is level—straight on its surface. Consider the curvature on a globe 8,000 miles in diameter at the centre circle; also at what we call 42 degrees north latitude, going east or west. We are on a plane that stands fast."

It will be news to engineers that a level line is a straight line, and if by considering the curvature of the earth, Springfield is found to be something over 6,000 ft. above Boston, then in the same way we should find that Boston was about 6,000 feet above Springfield, which discovery we imagine would be somewhat confusing. The dictum to the effect that "this earth is a plane and stands fast," when uttered by a man who exhibits so much and such comprehensive ignorance of the elementary principles of levelling, does not amount to very much.

In the past six months the use of the steam turbine has increased from 65,000 h p. to more than 2,000,000 h p on land, and from 25,000 h p to 800,000 h p at sea On land the chief applications of the turbine were in large electrical generating stations The chief items of saving resulting from the use of turbines as compared with reciprocating engines were reductions of 25 to 40 per cent. in the total capital cost of steam, from 10 to 30 per cent in the cost of fuel from ¼ to ⅓ in the consumption of oil, and from 25 to 30 per cent in the engine-room staff.