

SEGMENTS OF HISTORY

THE LITERATURE OF BLOODSTAIN PATTERN INTERPRETATION

Segment 00: Literature through the 1800's

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International Association of
Bloodstain Pattern Analysts News,
Vol 8, #1, March, 1992, pp 3-12.
History #00

INTRODUCTION

Literature on bloodstain pattern interpretation is difficult to find. However, more research has been conducted in this discipline than was originally believed. Unfortunately, it is not to be found in any one library. To the contrary, in order to locate and compile a comprehensive bibliography on this subject it has been necessary for me to visit forensic, academic and medical libraries throughout the world. Even so, many of the known works cited by other authors have not been located.

During my first effort to locate references that described what I believed was a specialty of common practice in the field of crime scene investigation I was very disappointed. Only general references were made in the few books and articles available in my library on this subject. In fact, in October 1970 I wrote, "Although it would seem that prior investigations of physical evidence would have resulted in a wealth of knowledge regarding the significance of bloodstains, such is not the case". This statement appears in the beginning of the report I prepared for the U.S. Department of Justice titled, FLIGHT CHARACTERISTICS AND STAIN PATTERNS OF HUMAN BLOOD ⁽¹⁾. Today, some twenty-five years later, I am well aware of just how wrong I was in making that statement. In fact, the total bibliography in that brief report to the Department of Justice consisted of only fifteen references of which the late Dr. Paul L. Kirk authored four. Unfortunately, I did not have any of the classic works in this field or that bibliography would have been more complete.

In 1983 I revised this first report and simplified the title to the more descriptive, BLOODSTAIN PATTERN INTERPRETATION ⁽²⁾. The bibliography was not significantly expanded and consisted of just twenty-seven references. Of these I had written eleven out of the twelve new additions. Unfortunately, having collected additional references from Karl Schmidt, I did not have the time to include them in the revision. In fact, Karl had sent me the classic work of Balthazard, et. al. and I thought the paper he presented in Paris in 1939, which was later published, should deserve considerable recognition ⁽³⁾. Now, over ten years later, I am doing just that by including much of his research in this publication.

Naturally, I have also visited several of the larger public and university libraries in the United States and Canada including the excellent facilities of the Centre of Forensic Science in Toronto and the National Research Council in Ottawa.

In 1983 I had not yet traveled to various libraries around the world to locate material with which I have since become familiar. Nevertheless, in reading Karl Schmidt's translation of Balthazard, I realized that most of my research in the study of bloodstain patterns was not as original as I had first believed. I could not have anticipated the work of others.

My search for literature describing the research of others began, in a practical sense, during my trips to Europe. Fortunately, my wife, Phyllis, (a technical documents librarian) was responsible for my finding many references that I may have otherwise overlooked in cities such as Munich, Zurich, Frankfurt, Edinburgh, London, and Dundee to mention just a few. Additional references were also later located in the libraries of Sydney, Melbourne, and Auckland.

To date over four hundred references directly concerned with bloodstain pattern interpretation, and over fifty scientific references that describe the more technical aspects of drop formation and its flight characteristics have been located, copied and, when necessary, translated into English. I have also obtained several appellate court decisions regarding bloodstain evidence and some excellent legal briefs relative to this subject. Finally, many transcripts of testimony given by expert (and not so expert) witnesses have been reviewed to provide examples of how evidence of this type has been presented in the past.

Others who have written articles in this discipline have experienced similar problems in finding copies of earlier published research. In 1973, Richard E. Howell introduced an article stating, "[i]n the last ten years hundreds of papers have been written regarding the development of bloodstain grouping techniques, but to my knowledge not one has been written on bloodstain patterns"⁽⁴⁾. This interesting article, which will be described later, was the twelfth reference added to BLOODSTAIN PATTERN INTERPRETATION.

It would be unfair to omit crediting a man who assisted me considerably in locating and translating many of the foreign references. This man, Karl Schmidt, designed hospitals and, at the time, lived in Frankfurt, Germany. Karl first contacted me in 1981 after writing a series of letters to various agencies. He was sure he needed an expert in bloodstain pattern interpretation and he had researched the subject sufficiently to find my 1971 LEAA report. Karl Schmidt had been convicted of the 7 June 1978 murder of his wife and had just spent three years in prison. Karl knew that he did not kill his wife, and he was sure that he was convicted as a result of testimony on "blood spatter" on the back of the shirt he was wearing on the day his wife was murdered. If that testimony could be shown to be in error he could clear his name.

Later, after I had received his clothing and examined it in my laboratory, it was my opinion that the testimony given on the few bloodstains on his shirt was definitely "in error", and he should never have been convicted on the misinterpretation of that evidence.

While his case is a story in and of itself, suffice it to say that Karl Schmidt, both while in prison through correspondence and later after he had been released, searched many libraries for books and articles on my behalf. I testified in his case on 20 July 1983. Karl also translated articles, books, newspapers, and anything else I requested from German, French, Russian, Spanish, or Polish. He was a brilliant, innocent friend. I was saddened to learn that Karl died last year (1990). Whoever may read this article will read much of what Karl Schmidt translated into English.

Occasionally, research that was described in detail was only discovered when it was quoted in publications of more recent researchers. Fortunately, when credit was given to the earlier investigator as a literature reference it was often possible to locate such material. Without doubt, the earliest reference to blood as evidence in a criminal case has to be the following:

"And Cain talked with Abel his brother: and it came to pass, when they were in the field, that Cain rose up against his brother, and slew him.

And the Lord said unto Cain, where is Abel thy brother? And he said, I know not, am I my brother's keeper?

And He said, What hast thou done? The voice of thy brother's blood crieth unto me from the ground"⁽⁵⁾.

In this unique instance, blood itself cried out to be heard so its significance could be realized. Today, the forensic scientist has to be the spokesperson for bloodstain evidence. Without someone completely familiar with this otherwise mute evidence, its value to a case would remain undiscovered.

THE HISTORY OF BLOODSTAIN PATTERN INTERPRETATION - GENERAL

In considering how best to document the history of any subject it seems logical to access the amount of literature that is available for review in order to estimate the scope of work that will be required. Considering the fact that well over four hundred references have been reviewed, if the majority of these deserve recognition, the task appears formidable. Therefore, I decided the only sensible way to review such a large number of reference sources was to review them in short segments. Nothing seemed more sensible than to divide the three hundred sources, exclusive of legal or scientific references, by their chronology. Initially, this was done by decades until the number of articles dictated shorter periods per segment. Also, the first segment included all references I had located up until 1900 as this number, twenty-three, was not excessive. Some of the earliest references do not contain information that is directly related to bloodstain patterns. However, some of these are included more as records of historical interest than of value when they have novel or unusual information.

It must be emphasized that the degree of accuracy, and scope, of earlier works varies considerably. Some articles and books are excellent and should be considered as major contributions to this subject. Unfortunately, many others are inaccurate to the point of providing false information and are of no value whatsoever. As a result, it is necessary to prepare not one but three separate bibliographies to guide anyone who wishes to read further on this subject so they will not waste time attempting to locate worthless articles. Naturally, this system of classification, "excellent", "interesting", and "worthless" is subjective and my own designations. Other readers may very well disagree, especially if he or she wrote the article or book! I shall take all responsibility for this classification and hope that it will save others the disappointment of finding that you cannot judge an article or book by its title or cover. The classification of materials will appear as a separate listing at the end of the last segment published rather than as individual listings included with each segment.

THE HISTORY OF BLOODSTAIN PATTERN INTERPRETATION - SEGMENT 00

Undated - HOLY BIBLE: Perhaps the earliest documentation of bloodshed in a homicide. This was described above in the introduction and is not repeated here.

1829 - JOHN GORDON SMITH ⁽⁶⁾: On page 125 Smith describes postmortem lividity and quotes a case in the Lancet ⁽⁷⁾, as follows: "blood in the body was everywhere in a fluid state - a circumstance which, he says, he never found in a case of a natural death." This comment and others on the evacuation of blood seem to give conclusions that certainly are not held as meaningful today.

1834 - J. CHITTY ⁽⁸⁾: On page 152 Chitty concluded that the color of blood is indicative of its origin within the body. He observed that arterial blood is scarlet while venous is dark purple to almost black. No application of this color difference to a criminal was made, unfortunately

1847 - WILLIAM B. CARPENTER ⁽⁹⁾: Describes the differentiation of species from the diameter of the red corpuscles in blood. He concluded that no correlation exists between the size of the animal and the size of the red corpuscles in its blood.

1858 - CH. ROBIN AND SALMON ⁽¹⁰⁾: The research of Ch. Robin and Salmon was reported in the comprehensive research by Walcher in 1939 ⁽¹¹⁾. At this time I have not been able to locate a copy of the original article. Nevertheless, their research, as described by Walcher, is concerned mainly with miscellaneous serology and the identification of blood. They used a chemical reagent, known only as Bourgogne's Fluid No. 4a, to identify a red stain on a blouse as either human or duck's blood. This remarkable, rather mysterious, mixture had some limitations, however, as it did not "fix the age or sex of the person from whom it was derived." The precipitin test was not reported until some forty years later so, at best, the reliability of this fluid is suspect. Sutherland ⁽¹²⁾ also made reference to the work of Ch. Robin and Salmon.

1863 - THEODRIC ROMEYN BECK AND JOHN B. BECK ⁽¹³⁾: This article contains different cases in which observations were made at crime scenes where blood could be used as evidence. Also, observations were made as to the position of the victim and the "situation" of wounds, and location of evidence. Blood sprinkles are referred to as coming from a wounded artery which we term arterial gushing today.

Very interesting comments were made at the bottom of certain pages. The article states that in several cases of "late years", medical witnesses have been successful in detecting not only murder, but also the manner, thereof, by examination of the dead body, even when in a state of putrefaction or decay. A few examples of this are given. The article discusses some chemical characteristics of blood.

In another case, it states, "...there was no blood in the bed, saving a tincture of blood...but no substance of blood at all. From the bed's head there was a stream of blood on the floor which ran along until it ponded in the bendings of the floor. It was a very great quantity, and there was also another stream of blood...which ponded also on the floor to a very great quantity."

References are made to blood sprinkling: "...many spots of blood, apparently the sprinkling from a wounded artery;" "...the blood from the artery had sprinkled the wall...;" "...great mass of blood was found, and there the blood from the artery sprinkled the wall." Other earlier articles and books frequently have used the expression "sprinkling of blood" or "blood sprinkles" as may have been noted.

1871 - SCHMIDT (¹⁴): Published in St. Petersburg (Russia) but in the German language. The English title would be **Suspicious Stains**. This article discusses external physical characteristics of bloodstains. It also lists some ways by which the characteristics of bloodstains may be destroyed. It also suggests that certain facts may be needed for the accurate identification of bloodstains. For example, the hardness and permeability of the object on which stain is found. He also discussed the circumstances relating to the origin of a bloodstain pattern; was it from spurts, direct contact, or just what was its source?

Color of dried bloodstains is also mentioned. Much detail is given to the characteristics of dried bloodstains under specific conditions. Chemical and microscopic examination of bloodstains is discussed as well as the recognition of bloodstains on iron objects and on soil.

The origin of bloodstains in relation to other species, such as mammals, birds or fish is also discussed. Schmidt found that in fresh bloodstains of fish, small scales and a fish odor, which can be enhanced with the addition of sulfuric acid, will usually be present. Some other chapter headings listed in this book include: Stains Through Menstrual Blood; Hair in Bloodstains; Examination of Stains that Outwardly Resemble Blood. Eight exceptional color plates are included in this book. Seven of these show cell structure detail but not bloodstain patterns.

1875 - MALININ (¹⁵): The early work of Malinin is of interest as it relates to identification of blood in specific locations. A case is reported where stains on a board were identified as sheep's and goat's blood. Two nobles were freed as a result of Malinin's findings. Obviously, he also had some kind of a "fluid" that could be used to differentiate such species, but whether it was the same reagent used by Robin and Salmon in 1858, Bourgogne's Fluid #4a, is not reported.

1877 - W. BATHURST WOODMAN AND CHARLES MEYMOTT TIDY (¹⁶): These authors used a unique, but certainly appropriate, term to describe angular impact of blood drops. They characterized the resulting bloodstain as having a "comet-shaped" form and correctly described the direction of the drops travel prior to impact. They also discussed how they believed the color of bloodstains depended upon age, thickness, the moisture content and the material upon which the blood had fallen.

1880 - HENRY FAULDS (¹⁷): In his celebrated article that was published in NATURE, (October 28, 1880), Dr. Faulds was first to mention the possible usage of fingerprint patterns in criminal cases. He observed the bloody transfer patterns of ridge detail and suggested how they might be useful for the identification of criminals at a crime scene. This was perhaps the first time anyone had described a transfer pattern wherein blood was the medium of transfer. It is important to realize that the courts have allowed "bloody fingerprints" testimony on such transfer patterns, so the precedent has already been set for the admission of other blood transfer patterns.

1882 - CHARLES MEYMOTT TIDY (¹⁸): Professor Tidy observed that, "In questions of personal identification, more especially in criminal trials, few things hold so important a place as, or involve investigations of greater nicety, than determining the precise nature of various spots or stains found on fabrics, instruments, and etc". Before attempting to apply any tests in such cases he suggested that, with reference to bloodspots, a recording in writing of:

- 1) Their number, size, and shape. It should also be noted whether the stains are of [sic] the nature of spots or more like smears.
- 2) Their exact position on the garment or instrument submitted for examination.
- 3) If upon a fabric, the side of the fabric on which they occur."

Tidy suggested that it was advisable for the medical jurist to place a "private" mark upon all articles that were sent him for examination by which he could recognize them readily in the witness-box, and identify the precise place on each where the stains were found. He believed that much trouble could be saved if this were done. Your present author will agree with this observation.

In examining suspected bloodstains, Tidy suggested the investigator note the general appearance of bloodstains and examine them for that purpose with a large magnifying glass. If bloodstains occur upon a colored substance, they are best seen by artificial light according to Prof. Tidy. He felt that, as a rule, "blood spots have well-defined and somewhat raised edges." He concluded that the color of bloodstains will depend on:

- 1) their age
- 2) thickness
- 3) the moisture and temperature to which the blood has been subjected
- 4) the kind of material upon which it has fallen.

He also stated that if a bloodstain was on a polished body, it would generally appear as a dark and shiny spot that was easy to remove, with cracks radiating from its center. If the bloodstain occurs upon cotton, silk, or linen, etc., he reported that it would usually have a more-or-less stiffened appearance, and would feel "like a spot of dried gum."

According to Tidy, blood spots should be subjected to three sets of tests. These are: microscopic, spectroscopic, and chemical. Of these, he felt that the second is infinitely the most delicate and the most important. Overall, Prof. Tidy's book is very similar in content to Woodman's in 1877.

1883 - ALLAN MCLANE HAMILTON ⁽¹⁹⁾: This article discusses the wounds inflicted by suicides, and states that it is quite difficult to differentiate wounds that have been inflicted in a murder or in a suicide wherein the throat has been cut. Hamilton states in both instances there are a series of preliminary cuts, described as "tentative", which are to be found at the place of commencement of the major incision. (Today these would be called "hesitation marks.")

This article describes the direction of knife wounds from their external character. An illustration of a suicide by cutting of the throat is provided somewhat graphically. Also, the number of wounds in regard to "suicidal cutthroat" is discussed.

1887 - MARSHALL D. EWELL ⁽²⁰⁾: This book contains essentially the same information as that found in the work of Woodman and Tidy in 1877 and in the 1882 work of Tidy some five and ten years earlier. Ewell discusses how the microscope may be used for the identification of blood using magnifications up to 1000 to 1500 diameters. This book is worth reviewing, especially if the other references are unavailable.

1890 - BROZEIT ⁽²¹⁾: A somewhat technical discussion of blood volume is reported along with more conventional serological procedures. As yet, a complete copy of this article has not been available for review.

1892 - H. HAMMEREL ⁽²²⁾: This article is surprisingly technical for the period. Although a copy of this publication has not yet been obtained, other authors describe Hammerel's work on the age, color, solubility and chemistry of blood in detail.

1893 - EDWIN H. PORTER ⁽²³⁾: This book by Porter, *THE FALL RIVER TRAGEDY*, is somewhat of a mystery not only in content but in the fact that, "Lizzie Borden prevented its circulation by buying out and destroying the entire edition." Robert A. Flynn is of the opinion that only three copies survived so he had this interesting book reprinted in 1985. Thus, it is available again, essentially, for the first time.

Dr. Dolan, who examined the scene of the double hatchet homicide on 4 August 1892, noted blood spots on the wall. He suggested a hatchet or an axe of four to five pounds weight must have been used. Later Professor Edward S. Wood examined a blue skirt and found "a smirch and looked as if it might be a blood smooch, but it was not." Professor Wood later wrote an article on blood in 1901 which mentions this case. This exciting terminology has, fortunately, not been adopted and if it were, no further definition of these terms appears in the text to guide us.

Overall, this is an interesting book as it describes the case in some detail. However, as will be noted much later, a 1991 book on the same case, *LIZZIE BORDEN: THE LEGEND, THE TRUTH, THE FINAL CHAPTER* ⁽²⁴⁾, by Arnold R. Brown, is much better. Brown's book provides a somewhat detailed description of bloodstains on the wall behind Mr. Borden. He also includes fifty-three pages of interesting testimony given by Lizzie Borden during the inquest. As a final note on this book, it is of interest that author Brown is currently in the process of determining if bodies of four members of the Andrew J. Borden family and two other bodies may be exhumed for DNA study. In this manner he hopes to solve the murders of Abby and Andrew Borden "...and forevermore, place Miss Lizzie Borden in her proper perspective." ⁽²⁵⁾

Another book written about the Borden murders, *LIZZIE* ⁽²⁶⁾, by Frank Spiering, is also interesting but does not demonstrate the depth of research that is present in Brown's work.

1893 - HANS GROSS ⁽²⁷⁾: This is an excellent reference for not only bloodstain patterns but almost everything else that may be considered within the field of criminalistics. Thus it is not difficult to understand why it was translated into English in 1906. Gross described precautions to be taken to protect blood upon the ground, "by covering them over, e.g., with pots, baskets or boxes." One of his rules, as accurate today as in 1893, was, "The greater the surface guarded the better." He thought it important to know whether the person from whom the blood had dropped was, at the time when the drop fell, standing still or moving, and in the latter case in which direction and how fast. Gross gave some rules for the determination of such information. Taken literally, some of these suggestions seem to be contrary to what we know today, however. For example, Gross states, "We shall be able to establish, first that each drop which falls from a tolerable height on a surface not too rough, produces a splash." As is well known, when a single drop of blood (or any similar liquid) falls to a smooth, hard, surface there is no spatter or splashing, whatsoever. Thus, it must be concluded that Gross meant all those drops that fell into a prior drop which, of course, precludes the first drop. In fact one of his figures actually shows a characteristic drip pattern that he produced as he allowed blood to fall "with a steady hand" and produce "splashes."

Dr. Gross also described directionality very well as he did many of the other somewhat elementary bloodstain patterns. An entire chapter titled "Traces of Blood" contains a wealth of practical information on the study of bloodstains at a crime scene than any other reference even today. This book by Gross is a major contribution to understanding bloodstain evidence in a more general practice than simply determining origin or sequence. It has long been a classic reference by those who have been fortunate enough to secure a copy. My personal copy of the second edition contains an inscription, "This book I regard as the base of all criminal investigation." It is signed F. W. Bennett and stamped, "Bureau of Identification, Department of Police, Evanston, Ill., June 10, 1930." I do not know who Mr. Bennett was, but I agree with his statement. In fact, my library has a copy of all but the first edition, editions two through five.

1895 - E. PIOTROWSKI ⁽²⁸⁾: If copies of this early work still exist I have been unable to locate one. Quite fortunately, however, much of this work was reported by Walcher in 1939. As a result, little material is available for review so we are restricted to what Walcher reproduced in his own chapter, "The Shape of Blood Stains" ⁽²⁹⁾. It is fortunate that so much of Piotrowski was preserved in this manner. Some of Walcher's own work, which is reported in his 1939 article, is described in detail later in the appropriate segment.

Without doubt, the research of E. Piotrowski was the first original study of bloodstain pattern interpretation. Hans Gross and others were certainly aware of this discipline, however, no one preceded Piotrowski in designing meaningful scientific experiments relative to blood dynamics with such imagination, methodology, and thoroughness. If they did, it was either never documented or, as yet, I have not found it in the literature. Piotrowski had an excellent knowledge of the scientific method, a good understanding of its practical application to bloodstain pattern interpretation, a unique imagination to design worthwhile experiment models, and the intellectual capability to interpret results and draw meaningful conclusions which, fortunately, he documented.

Some of Piotrowski's experiments relating to beatings with a hammer, a stone, and a hatchet were reported in detail, and with illustrations, by Walcher in his article in 1939. In some experiments Piotrowski used what he referred to as a "clot", but he actually prepared a large blood soaked piece of cotton on a plate. He used animals, in this report a rabbit, as a more realistic blood source. No doubt he was criticized by the 1895 equivalent of the Humane Societies or the Animal Rights groups. Whether or not the test animals used by Piotrowski were anesthetized is not mentioned in the article by Walcher. Today, of course, research animals are always anesthetized for such experiments. Yet doctors and scientists still have problems justifying the experiments they conduct regardless of scientific justification. It was recently reported in the Tampa Tribune ⁽³⁰⁾ that an Army Surgeon wanted to resume research involving the shooting of cats as an aid to understanding how best to give treatment for human head injuries. Personally, I feel that Piotrowski's scientific experiments, including the beating of a rabbit, and the recording of the resulting blood spatter were worthwhile. Those familiar with my research in 1969-1970 should be aware that we performed similar experiments with old, decrepid, dogs.

A brief review of Piotrowski's work follows below:

A rabbit was placed in front of the screens with its head resting on its legs (D) and the head was hit with the stone (E) having sharp and irregular edges, as seen in figure 11. All the strokes were conducted from above. In this manner stains were produced:

The letters Piotrowski used in his text are shown in the illustration, his figure number 11 (Abb. 11).

1. A large blood pool around the head.
2. Lengthy stains (A) in exclamation mark form on the floor and the screen X at (D).
3. Round, irregular stains on the floor, the fur and the screen X at (B).
4. Small stains in the form of a hand on X at (E) with the heel down, and with the finger-like spines upward.

All the stains were dispersed symmetrically, but a tendency towards a pattern of radiation can be recognized. The wound was produced immediately after the first stroke. Both the stone and offender were blood spattered, and the offender also received some spatter from the cast-off drops from the stone. (H).

The illustration in Piotrowski's 1895 article is reproduced as figure 1.

Piotrowski's treatise of 1895 also reported on additional experiments he conducted with a hammer and a hatchet. These were used to strike blood soaked cotton "knots" to produce impact spatter patterns. In addition, he also created some cast-off patterns. The spattered blood was projected to, and recorded on, "screens" that were small vertical walls both ahead of and beside the point of impact. No mention was made as to how the cast-off patterns were recorded but, no doubt, it was done in a similar manner using targets to the side or overhead and possibly even behind the person who was delivering the blows.

The research of Piotrowski is clearly a milestone in the study of bloodstain pattern interpretation.

1895 - V. HOFMANN ⁽³¹⁾: An article by Hofmann which appeared in the Vienna Medical Press (WIENERMEDIZINESCHE PRESSE) in 1895 described the work of Piotrowski in somewhat general terms. My late friend and translator, Karl Schmidt, could not find this work himself, either in Germany or in Vienna. In fact, Hofmann refers to the reproduction in Walcher's book of 1939, which Schmidt had already translated, and mentions some of the 15 colored plates from the original work of Piotrowski.

The following is a translation of the text from the Wiener Medizinische Presse:

In his paper containing 15 colored plates (5, Piotrowski E., Natural death or wounds inflicted by police officers. Wien, med. Pr. S. 4), Piotrowski explains the results of his tests about the origin, shape, direction and distribution of blood stains after slash wounds to the head. He reported that only a small part of blood spatter originates from projected blood from a wounded artery; the predominant part results from the weapon, either when inflicting the first wound, or due to blows into already existing wounds. In case of perpendicular blows, blood spatters into all directions, but when the blows are conducted under a certain angle, blood spatters away into the opposite direction, so that despite numerous stainings no blood spatter strikes the perpetrator. A different kind of blood spatter occurs as a result of casting off blood from the swung weapon, either during the downward swing, aiming at inflicting new wounds with an already blood covered weapon. The shape of the bloodstains varies, depending on the manner how the spatter impacted the target. If they impacted perpendicularly, the stains have irregular borders, if they impacted under an angle, the stains will be lengthy and their pointed end will be at the extremity opposite to the impact site; the stain will be the longer the sharper the angle of impact and the higher the impact velocity. The stains originated from cast-off drops from the weapon may have an opposite directionality than those originating directly from the wound; also, those stains which are being projected to a wall in a curved trajectory will have an opposite directionality. Certain laws ruling the directionality, distribution and shapes of blood stains found on objects near the wounded body can thus be recognized, and these can be used in the forensic evaluation of the corresponding criminal cases. This is the end of the description of Piotrowski's research in the Wiener Medizinische Presse.

It is quite evident from this translation that the work of Piotrowski was well recognized in 1895. Nothing need be added to the above translation inasmuch as Piotrowski's own research was also thoroughly discussed in Walker as reported later. It would be desirable if a copy of Piotrowski's book could be located. Other writers have indicated that the last known copy was in either Vienna or Krakow but that was over fifty years ago. Attempts to locate a copy of this early research thus far have been disappointing but are not abandoned.

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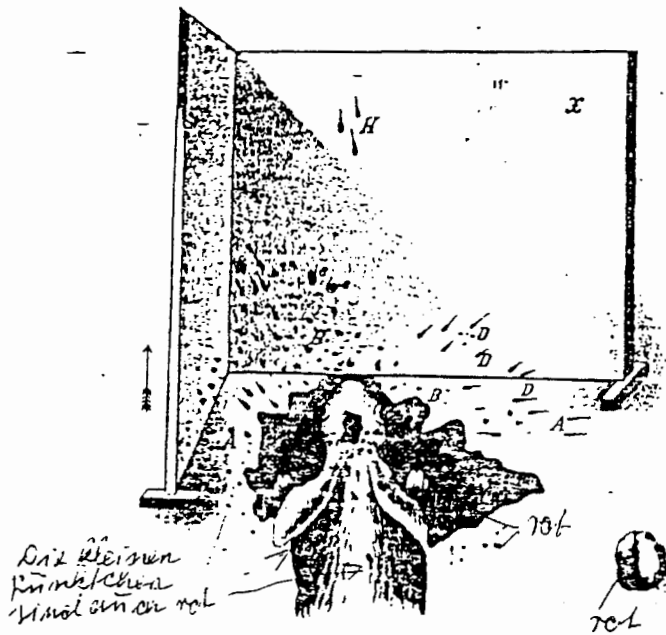


Abb. 11. Mehrere Schläge mit Stein.
 H = Schleuderspuren, vom wiederholten Ausholen mit dem Stein.