

Bloodstain Pattern Analysis **Third Edition**

**With an Introduction to
Crime Scene Reconstruction**



**Tom Bevel
Ross M. Gardner**

 **CRC Press**
Taylor & Francis Group



Practical Aspects of Criminal and Forensic Investigations Series

Bloodstain Pattern Analysis

Third Edition

**With an Introduction to
Crime Scene Reconstruction**



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Tom Bevel and Ross M. Gardner

Editor's Note

This textbook is part of a series entitled “Practical Aspects of Criminal and Forensic Investigations.” This series was created by Vernon J. Geberth, New York City Police Department Lieutenant Commander (Ret.), who is an author, educator, and consultant on homicide and forensic investigations.

This series has been designed to provide contemporary, comprehensive, and pragmatic information to the practitioner involved in criminal and forensic investigations by authors who are nationally recognized experts in their respective fields.

Bloodstain Pattern Analysis

Third Edition

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Crime Scene Reconstruction**

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Ross M. Gardner**



CRC Press

Taylor & Francis Group
Boca Raton London New York

CRC Press is an imprint of the
Taylor & Francis Group, an **informa** business

CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway NW, Suite 300
Boca Raton, FL 33487-2742

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CRC Press is an imprint of Taylor & Francis Group, an Informa business

No claim to original U.S. Government works
Printed in the United States of America on acid-free paper
10 9 8 7 6 5 4 3 2 1

International Standard Book Number-13: 978-1-4200-5268-8 (Hardcover)

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Library of Congress Cataloging-in-Publication Data

Bevel, Tom.
Bloodstain pattern analysis with an introduction to crime scene reconstruction, / Tom Bevel and
Ross M. Gardner. -- 3rd ed.
p. cm. -- (CRC series in practical aspects of criminal and
forensic investigations ; 46)
Includes bibliographical references and index.
ISBN 978-1-4200-5268-8 (alk. paper)
1. Bloodstains. 2. Forensic hematology. 3. Crime scene searches. I. Gardner, Ross M. II. Title. III.
Series.

HV8077.5.B56B48 2008
363.25'62--dc22

2007040618

Visit the Taylor & Francis Web site at
<http://www.taylorandfrancis.com>

and the CRC Press Web site at
<http://www.crcpress.com>

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Foreword

Bloodstain Pattern Analysis with an Introduction to Crime Scene Reconstruction Third Edition in full-color by Tom Bevel and Ross M. Gardner is long overdue. This completely revised and enhanced edition is a practical and concisely written text. It is the most complete and comprehensive handbook to date from the perspective of the criminal investigator and forensic scientist on the subject of bloodstain spatter analysis.

The authors have provided the reader with an eloquent and practical guide for the analysis of bloodstain patterns and crime scene reconstruction based on many years of practical experience. Their original lab manual published over 24 years ago was entitled “*Bloodstain Pattern Analysis: Theory and Practice*.” This manual eventually became the framework for the first edition of ***Bloodstain Pattern Analysis with an Introduction to Crime Scene Reconstruction***, which challenged some of the subjective interpretation systems of bloodstain pattern assessments.

This new edition is based on a true taxonomy. The future of bloodstain pattern analysis will be based on description. Building on well-established classifications ideas in bloodstain pattern analysis (BPA) the authors have refined an objective classification system based on a taxonomic approach. ***Bloodstain Pattern Analysis with an Introduction to Crime Scene Reconstruction Third Edition*** is the basis for standardization of blood spatter analysis and establishes the need for universal rules that define this discipline by stressing the underlying scientific basis and how best to objectively apply this knowledge to cases in the field.

Ross Gardner first brought the idea of taxonomy to the attention of the SWGSTAIN GROUP in 2002. Bevel and Gardner introduce a new Chapter 3 to clarify and present a taxonomic classification system, which clearly describes the characteristics of different patterns. A taxonomy is simply a defined set of rules for classification. It establishes criteria against which the analyst can compare the scene stains to. The idea of taxonomy is derived from biology where organisms are classified by shared characteristics. These characteristics create a hierarchical relationship between the various groups. Although other authors have previously provided the hierarchy, Bevel and Gardner are the first to clearly describe the supporting characteristics for that hierarchy.

In addition to elucidating the classification system, the authors have included within the text, a full-color foldout of a Bloodstain Pattern Decision Map, which can be used for ready-reference in reaching a classification decision no matter what classification system they use. They also provide a detailed methodology for bloodstain pattern analysis, which is described in Chapter 4

Bloodstain Pattern Analysis with an Introduction to Crime Scene Reconstruction Third Edition provides specific details on Crime Scene Analysis/ Reconstruction in explaining a proven methodology involved in the process. This methodology is built upon scientific method and provides focus and structure to the analyst as they conduct the analysis.

The authors provide an excellent historical perspective to acquaint the reader with the significant chronology of the application of this technique. The authors provide excellent

information on distinguishing crime scene analysis from behavioral analysis and discuss the many considerations involved in the reconstruction of the crime.

Bloodstain Pattern Analysis with an Introduction to Crime Scene Reconstruction Third Edition explains the complex mechanics of blood spatter analysis with a new chapter which addresses the medical examiner and the anatomical issues related to bloodstain pattern analysis, which includes a discussion of blood and the circulatory system and the nature of bleeding associated with various traumatic and non-traumatic injuries. Other new chapters include bloodstain pattern analysis associated with clothing and fabric issues as well as a chapter that describes presumptive testing in detail. All of the existing chapters have been revised and updated to address taxonomy.

The most significant improvement in this third edition with the exception of the revised chapters is the inclusion of almost 400 photographs, three hundred and seventy of which are in full-color, which graphically illustrate the dynamics of bloodstain pattern analysis.

The authors bring over 50 years of practical experience to this text especially with their respective backgrounds in actual criminal investigations. Tom Bevel, my friend and colleague for many years, is a retired police captain from Oklahoma City, Oklahoma. Tom Bevel is the owner of TBI, LLC a forensic education and consulting company. He is also an adjunct professor in the Masters of Forensic Science program at the University of Central Oklahoma. Captain Bevel (Ret.) holds a master's degree in Criminal Justice and has extensive training in the area of criminal investigation both in the United States and Europe. Tom Bevel has numerous professional affiliations including; The Association for Crime Scene Reconstruction (ACSR, a distinguished member of the International Association of Bloodstain Pattern Analysts (IABPA), and the American Academy of Forensic Sciences. Tom has acted as a police consultant in over forty-six different states and eleven foreign countries. He has personally participated in more than 3300 criminal investigations in which bloodstain spatter evidence was the issue and has testified in numerous trials as an expert witness.

Ross M. Gardner, served for The United States Army Criminal Investigation Command (USACIDC) for over twenty-four years as a felony criminal investigator, served four years as a chief of police for a small suburban Atlanta police department.

He retired from public service in 2003. He holds a Master's Degree in Computer and Information Resource Management and has extensive training in the area of criminal investigation through the United States Military. He served as an adjunct professor for Central Texas College in the Police Science program. He is also certified as a senior crime scene analyst with the International Association of Identification and has published as a recognized expert in the field of bloodstain pattern analysis. Special Agent (Ret.) Gardner, who now consults in crime scene analysis, bloodstain pattern analysis and crime scene investigation, also has numerous professional affiliations.

He is the former president of the Rocky Mountain Association of Bloodstain Pattern Analysts (RMABPA) as well as the Association for Crime Scene Reconstruction (ACSR) and served as chairman of the education committee for both the RMABPA and the International Association of Bloodstain Pattern Analysts (IABPA).

In my textbook ***Practical Homicide Investigation: Tactics, Procedures, and Forensic Techniques Fourth Edition***, I point out that; "Solving homicides, especially those without witnesses are extremely more difficult to solve because your main witness, the deceased, is dead. One must develop the ability to "absorb" the crime scene, and be able to read the uncollectible nuances of the event." The classification and analysis of bloodstain patterns

within the crime scene oftentimes provides the investigator with the critical information to reconstruct the crime. Used properly, bloodstain pattern analysis can help establish specific events associated with the crime.

I personally believe that without practical scene experience there is a deficiency in crime scene reconstruction. Seasoned practice necessitates that the practitioner have that ability to “absorb” the crime scene, and be able to read the uncollectible nuances of the event. This is what we refer to as “scene experience” as opposed to a strict “laboratory” mentality. Tom Bevel and Ross Gardner both have this “scene experience” as well as the necessary knowledge to evaluate and apply the scientific methodology to the reconstruction process.

Bloodstain Pattern Analysis with an Introduction to Crime Scene Reconstruction Third Edition is a masterful blend of “Practice and Theory” with practical crime scene knowledge and the application of scientific methodology to the process of crime scene reconstruction. The new edition follows a logical path throughout the text, highlighted with excellent color examples starting with an explanation of what bloodstain pattern analysis is, the terms used, the basic classifications, a methodology for BPA and then a discussion of the various skills utilized in BPA. It is organized in such a manner to allow the reader quick and easy references into specific areas of blood spatter which includes the full-color foldout of the Bloodstain Pattern Decision Map.

Vernon J. Geberth, M.S., M.P.S.
Author of Practical Homicide Investigation
Series Editor

Preface

The goal of forensics and crime scene reconstruction is simply to seek the truth. The analyst has no other agenda. In pursuing this end, we revisit what we hope is a not too distant past and attempt to recreate the events that unfolded. This task is anything but simple and the tools employed are all of the forensic disciplines.

Each area of forensics provides insight and a glimpse back into this past. Each has its place in evaluating the aftermath of crime — the physical evidence. In the most classical sense, the majority of the forensic disciplines provide us knowledge as to the “who” of crime. Fingerprints, serology, and trace and fiber evidence all give us the ability to associate people or objects with a crime scene. Forensic pathology, on the other hand, has always been a primary link to the “what” of crime, providing insight to some of the events that occurred during the incident.

Bloodstain pattern analysis is a discipline that serves a significant role in answering the question of “what” happened. Used properly, bloodstain pattern analysis helps establish specific events associated with violent crimes. In this capacity, bloodstain pattern analysis acts as a critical bridge between classical forensics and crime scene reconstruction.

Although certainly not a young discipline, bloodstain pattern analysis is just beginning to recognize some of the universal rules that define it. We still see aggressive discussions between analysts over what they can or cannot infer from a specific stain. More often than not, these arguments consume our objectivity. These arguments lead us to a darker side of forensics, where subjective analysis reigns. To fight this tendency, our continuing goal must be to understand the discipline, its underlying scientific basis, and how best to objectively apply this knowledge to cases in the field. The investigator’s mission is to always illuminate the truth, not shroud it in shadows.

The authors of this book come to you from two distinctly different backgrounds, though both have a high level of experience in “on scene” crime scene evaluation. One is a career civilian law enforcement officer, and the other is a retired criminal investigator for the U.S. Army. Both are nationally and internationally respected in their fields. Two very different roads led them to the same destination. Interestingly enough, those roads crossed outside the city of London, at the Metropolitan Police Detective Training School. There both authors, although several years apart, attended the Scenes of Crimes Officer (SOCO) Course.

The British approach to scenes of crime is, at the very least, one of the most methodical in the world. The SOCO course teaches the students to understand and incorporate all forensic evidence in the evaluation of crime. It places responsibility for understanding the interrelationship of that evidence on none other than a generalist, the crime scene investigator.

Perhaps then it is the SOCO course that serves as the wellspring of the authors’ shared passion and belief: conduct crime scene evaluations using a holistic approach. Inherent in this thought is that case resolution is critically dependent upon proper crime scene analysis. However, case resolution is not just a matter of proving someone guilty. The investigator

seeks to establish the truth, no matter what it may be. This demands a consideration of all evidence available, and the correlation of such evidence in an attempt to identify reasons for contradictory results when they happen to occur. Crime scene reconstruction as a discipline offers an avenue to this goal. Crime scene reconstruction (or crime scene analysis) provides proven methodologies that allow objective snapshots of the crime to be established, and in many instances, sequenced. This information, although not defining an absolute truth, is always effective for helping the criminal justice system define its concept of what that “truth” may be.

In the criminal justice system, it is not uncommon to encounter a lawyer who adamantly believes, no matter what the nature of the testimony, that the investigator established in his or her own mind the innocence or guilt of a subject before completing the crime scene evaluation. It appears incomprehensible to counsel that the investigator can take the often subjective information reported and conduct an objective investigation. Such a reaction should not surprise us because the idea of objectivity is relatively foreign to trial law. No matter what the underlying truth, lawyers (both the prosecution and defense) highlight the information that best serves their position, and attempt to diminish or ignore that which works against them. Law professors refer to science as a smorgasbord, where the lawyers can step up to the table and take from science what they want. Anything that looks unappetizing is simply ignored. This is the actual mindset of those who claim criminal investigators are subjective!

The crime scene analyst, however, can ill afford to pursue his or her end with the same mindset. Choosing what evidence one will or will not consider in the analysis is heresy. Unfortunately, that trap is far too easy to fall into.

Within the scene lies the evidence, which, if properly analyzed, provides everyone with an ability to define specific facts and certainly infer others. Based on the totality of this information, it may well be possible to determine the most probable events surrounding the situation. Even if unable to define the overall event, proper analysis still allows for the elimination of certain events, which alone adds clarity.

No single forensic discipline has the potential to provide as much clarity regarding the occurrences at a crime scene as does bloodstain pattern analysis. However, that cannot lead to an expectation that the bloodstain evidence will stand alone. But in the right hands, bloodstain pattern analysis is an extremely effective tool for defining the truth.

Bloodstain pattern analysis and crime scene analysis are not for the casual investigator who intends only to graze the surface, find a quick answer, and move on. The bloodstain pattern analyst is truly one who reconstructs crime scenes. As such, he or she must understand all of the forensic disciplines. The analyst must be able to objectively apply each category of evidence to the situation, inferring as little as possible, but recognizing the whole. In order to accomplish this task the bloodstain pattern analyst must also understand and apply proven crime scene analysis methods. In that fashion, the evidence establishes a knowledge base from which the analyst reaches the “truth.”

In this third edition, we have significantly expanded the discussions of both bloodstain pattern analysis and crime scene analysis. Included are proven, practical, detailed methodologies to apply in the field for each discipline. We hope the student and practitioner find this book a single source document that can aid in teaching these disciplines or in maintaining or enhancing the practitioner’s skills.

As we stated in previous editions, the business of investigations and forensics is about defining truth as effectively and objectively as possible. In part, the oath of office for a U.S. Army Criminal Investigation Special Agent states: “I shall at all time seek diligently to discover the truth, deterred neither by fear nor prejudice...” We dedicate this newest edition to everyone, analysts and investigators alike, who recognizes and understands the importance of their roles as objective truth seekers.

Acknowledgments

In considering a project of this nature, the effort of the authors alone rarely ensures success. We would like to offer thanks and acknowledgment to the following individuals for their support and efforts:

Our editor, Vernon Geberth, for his continued support over the years and editions.

Phillipe Esperança, for his significant contributions in formulating and refining the decision map explained and presented in Chapter 3. Phillipe's background in entomology, as well as his understanding of bloodstain pattern analysis, were instrumental in our efforts to build a functional decision map.

Rudi Jaehser of Frankfurt Germany, for his untiring efforts in leading Ross through the bowels of the Frankfurt University library those many late evenings.

Regina Dearborn, for her expert translations of many of the articles discussed in Chapter 2. Without her skill in German and her ability as a legal translator, many of these articles would have remained unknown.

Toby Wolson of Miami, Florida, for his support in providing excellent examples of the Roadmapping concept.

Sgt. Ron Wortham with the Oklahoma City Police Department, who designed and constructed equipment used in bloodstain pattern research, the results of which appear in this text.

Jouni Kiviranta of the Helsinki Police, whose outstanding photography skills produced many of the enclosed figures.

Dr. Martin Fackler of Florida, for his support and critical eye. Dr. Fackler readily shared his knowledge and research with us, providing important information for Chapter 7.

Leonard Conn, formerly with the University of Oklahoma Police Department, who assisted in building equipment for both the stop-motion photography of blood impacting at various angles, and for the high-speed photographs of a bullet impact into a bloody target. Examples of both are included in this book.

Dr. Alfred Carter of Carleton University, Ottawa, for remaining patient and calm in the face of Ross' repetitive need for physics instruction, as well as his permission for using images from the FCO software Backtrack Images, Tracks, and Backtrack/Win. Special thanks from the authors go out to Dr. Carter for no reason other than no other single scientist or member of academia has given as much to this discipline as he has.

Dr. Kenneth Beard of the University of Illinois at Urbana-Champaign, whose original research led to our five-year search to better understand droplet impacts. Much of our understanding from Chapter 4 would not exist without Dr. Beard's initial assistance.

Don Coffey, of the U.S. Army Criminal Investigation Command, for sharing his approach and knowledge on dealing with pattern transfers.

David Baldwin, Ph.D., Director of the Midwest Forensic Resource Center, Iowa State University and Todd Zdorkowski, Assistant Director, for their support of the numerous high-speed digital film experiments.

Dr. Ronald O. Gilcher and Arlene Wilson with the Oklahoma Blood Institute, who over many years have provided much information about blood components and the processing involved in blood products provided for research.

The members of the Metropolitan Police Forensic Crime Laboratory, London, England, who allowed the use of still images from their outstanding video “Blood in Slow Motion.”

To all the students from the basic bloodstain pattern schools conducted by Tom and Ross. They have constantly demanded more and more knowledge that caused their teachers to continue to grow within this discipline. The same is true of all of the students of the Basic Crime Scene Reconstruction course. From every class we have gained knowledge and learned new techniques.

Lt. Travis Witcher (Ret.) Oklahoma City Police Department, for securing funding from outside sources that allowed Tom to attend training under MacDonell and Bunker at Hendon Police College in England. Lt. Witcher required at the end of this training that Tom start his own research and training to pass on the knowledge gained to OCPD officers. We can all benefit from the insight in his comment, “Teaching will force you to really learn the discipline.” His wisdom is more than evident and serves as a challenge for both of us.

William Turner, formerly of the USACIDC, who sparked a flame in Ross by sharing the knowledge he gained from a Corning Institute bloodstain pattern course. Bill probably has no idea of the events he set in motion, but we thank him anyway.

The many instructors of the Scenes of Crime Officer Course, Metropolitan Police Detective Training School, Hendon, England. Their insight and knowledge are responsible in a large part for forging Tom and Ross’ shared passion.

Three units of the Oklahoma City Police Department and their respective members through the years: Technical Investigations, the Forensic Lab, and Homicide. All of them helped focus this discipline and develop Tom’s “scene sense.” Thank you for your neverending support.

Martin Eversdijk of the Amsterdam Police Laboratory, for his excellent photographs used in support of Chapter 9.

The following agencies and individuals for supplying various photographs in support of the project: Henry Muse, E-Systems; Lt. William D. Gifford, Anchorage Police Department, Alaska; Donald R. Schuessler, Department of Public Safety, Eugene, Oregon; Tom J. Griffin and Barie Goetz, Colorado Bureau of Investigation; John Graham, Arvada Police Department, Colorado; Helena Komuleinen, curator of the Finnish National Gallery; Assistant Chief Johnny Kuhlman, Oklahoma City Police Department; the Edmond Police Department, Oklahoma; Ray Clark, the Oklahoma City Police Department; Heikke Majamma, National Bureau of Investigation, Helsinki, Finland; *The Journal of Forensic Identification*; T. Daniel Gilliam, Larimer County Sheriff’s Department, Ft. Collins, Colorado; David Stiles, Texarkana Police Department, Arkansas; Louis Laurel, State of Texas Attorney General’s Office; Don Blake and Bill May, Norman Police Department, Oklahoma; Mike McGuffey, Covington Police Department, Kentucky; Claire Dawson-Brown, Travis County District Attorney’s Office, Texas; Iris Dalley, OSBI, Oklahoma City, Oklahoma; Steve Chancellor, USACIDC; Sandra M. Roberts, Eugene Police Department, Oregon; Lt. Steve Kohne, Tippecanoe County Sheriff’s Office, Indiana; Michael Taylor, Institute of Environmental Science and Research, New Zealand; Matt Noedel, Tacoma,

Washington; Malcolm Fletcher, United Kingdom; Herbert MacDonell, Corning, New York; Jeff Svobda, Ft. Collins Police Department, Colorado.

The International Association of Bloodstain Pattern Analysts, the Rocky Mountain Association of Bloodstain Pattern Analysts, and the Association for Crime Scene Reconstruction, for establishing an environment in which we can all grow.

There are many more individuals who may not be named here. All have contributed to this discipline in some fashion, which in turn assisted in the writing of this book. We salute them for their individual effort, insightfulness, and resulting research in support of bloodstain pattern analysis and crime scene reconstruction.

Please note. Solely for the purpose of readability, we used male references throughout the book. In no way should this be construed by the reader as ignoring the many female analysts in our profession.

Introduction

Bloodstain pattern analysis and crime scene reconstruction are distinct forensic disciplines. Bloodstain pattern analysis seeks to define “what” caused the bloodstains in the scene. In pursuing this end, the bloodstain pattern analysts cannot help but reconstruct crime. Crime scene reconstruction, also referred to as crime scene analysis, seeks to establish all of the actions associated with the crime or incident in question and, when possible, to order those actions. Thus, crime scene reconstruction is concerned with the “what” of crime as well.

The purposes of both disciplines are so intertwined that it is often difficult to see a distinction between them and, as we will see, the two disciplines share clearly common threads and methodologies.

Crime scene reconstruction demands that we evaluate all physical evidence to derive some conclusion as to what occurred. As Geberth reminds us, for homicide investigations, case resolution hinges on “*careful and intelligent* [italics added] examination of the scene.”¹ Much as a reporter does, the criminal investigator attempts to define the who, what, when, where, how, and why of a crime to assist in understanding what really happened. There is an unfortunate problem associated with this process: there is no standard by which we can test our ultimate conclusions. An archaeologist once made an analogy about this difficulty — discussing a dig and the conclusions drawn from it, he said, “It’s something like putting together a jigsaw puzzle without having access to the box. You really don’t know what the picture is supposed to look like.”²

The crime scene investigator shares the archeologist’s dilemma, because the investigator’s box top is not available either. Despite this limitation, crime scene analysis attempts to define the nature of actions that are so dynamic that even if we had a videotape of the incident, they might not be fully understood. It should not be surprising that we share in the archeologist’s dilemma, for, as we will explain, archeology and crime scene analysis also share common purposes and methodologies. We will call upon some of the established principles of archeology to help define crime scene reconstruction methodologies.

The crime scene analyst’s primary goal is to identify those actions that make up the crime or incident being evaluated, as well as the order of those events. Thus, identifying specific actions associated with the crime, i.e., the “what” of a crime, is of significant concern.

In their most classic use, the majority of forensic disciplines provide the investigator with information regarding the “who” of the crime. Blood typing, DNA evaluations, fingerprint evidence, and hair examinations help us decide who was or was not present at the scene. In this concept of who, we also include areas such as forensic chemistry, biology, geology, and trace evidence examinations, as they help associate items with our players and with the scene. This, too, ultimately serves the function of defining the “who” of the reconstruction.

Our answers to “what,” the actions that occurred during the crime, are sought quite often through the application of forensic pathology. As Dr. James Luke stated, “From the standpoint of forensic pathology, the two major parameters that form the basis of any case investigation are (1) identification and documentation of the postmortem findings present, and (2) interpretation of those findings in the context of the circumstances of death.”³

In the past few decades, the discipline of bloodstain pattern analysis has reawakened to its role in documenting these circumstances. Bloodstain analysis brings to the investigation the ability to define those events which could or could not have occurred during the course of bloodshed. Once identified, these facts are considered in light of all other evidence as a means of corroborating or refuting statements, confessions, or investigative theories.

Bloodstain pattern analysis in many ways mirrors the role of forensic pathology. Once again quoting Dr. Luke, "It is the responsibility of the forensic pathologist finally to construct a scaffolding of factual information against which witnesses' and suspects' statements can be evaluated."⁴ Bloodstain evidence in this role (acting as a scaffolding or part of the lattice) cannot stand apart from other evidence.⁵ Reconstruction demands that we consider all evidence. Viewed from a holistic approach, all the evidence available should preferably lead those who view it to a similar conclusion.

This concept of a generally agreed-upon conclusion should not be a foreign thought, particularly when considering bloodstain patterns. They are, after all, graphically oriented. For example, in describing a pattern transfer as "consistent with" something, any analyst should be able to point to some physical characteristic of the stain and then to the correlating item that created it. The analyst should then be able to create some generalized reproduction of the pattern using the item. Having done so, another analyst cannot simply ignore this information. Granted, we may discover a secondary method of stain creation, but this simply adds a responsibility to discover which of the two represents the best explanation. If a stain is observable and reproducible, it is difficult for two analysts to rationally argue their beliefs from mutually exclusive positions. When this occurs, it is very likely the result of subjective analysis on the part of one or both. Unfortunately, subjective analysis in both bloodstain pattern and crime scene analysis is a fact of life. To help preclude subjectivity, the analyst should attempt to achieve several things.

First, the analyst must understand all areas of forensic science and have been directly exposed to crime scenes. Tom Griffin of the Colorado Bureau of Investigation often remarks that analysts need a "scene sense." This sense gives the analyst a more rounded perception, taking into consideration the many subtleties and interrelationships found at scenes. Evidence viewed from the confines of a white-walled laboratory is far too sterile. It leaves the viewer lacking a realistic perspective of crimes and crime scenes. It is this perspective that makes up "scene sense." As the SOCO course at the Hendon Detective Training School teaches, we gain much from viewing evidence *in situ*. This is true not only from a case perspective, but also for the long-term development of the investigator.

Do not construe the necessity for understanding these disciplines as meaning the analyst is an expert in all of them. Far from it, crime scene analysts are generalists. They have, much like a manager, the knowledge to take the experience and expertise of the other team members and put them all together. This process is at the heart of crime scene reconstruction.

Second, analysts must understand their discipline. Bloodstain pattern analysis in particular is far from being a static field. Our understanding changes every day due to research efforts. But as we base bloodstain pattern analysis on the application of physical laws on blood, there are certain universal rules we can apply. These rules are as true today as they were when first observed.

In the third edition, we have introduced three significant additions to bloodstain pattern analysis. First, we have presented a true taxonomic bloodstain pattern classification system in which the criteria that the analyst should judge a bloodstain are written out and (hopefully) clear. With the assistance of Phillipe Esperanza, we have also included a decision

map, which is intended to guide the analyst through that classification process. These two additions are a major step forward, removing the claims of “subjectivity” leveled at bloodstain pattern analysis. The third addition is a practical methodology to employ in bloodstain pattern analysis that follows the scientific method. Once again, this addition should functionally aid every analyst who employs it and help fend off the “subjectivity” attack in court. These three elements are long overdue. The practice of forensics demands we find objective ways to pursue our discipline; each addition serves this function and attempts to pull bloodstain pattern analysis up by its bootstraps into the twenty-first century.

As with bloodstain pattern analysis, there are common themes throughout the history of crime scene reconstruction that guide the analysts in their purpose. Understanding these universal applications and themes, and then seeking those areas that require further study should be the lifetime goal of every analyst. Since 1997, we have taught and refined the methodology known as Event Analysis, which incorporates these basic themes. We have always correlated the archeologist’s dilemma to our discipline, and when we turned to literature on archeology we found significant correlations in purpose, which we will discuss.

The interrelationship of these two disciplines places an added burden on the practitioner. Because crime scene reconstruction so often relies on the information developed by the bloodstain pattern analysis, it is imperative that the crime scene analyst have a solid understanding of bloodstain patterns. Just the same, as the bloodstain pattern analysts are engaged in creating a partial reconstruction, they must understand and apply the basic tenets and methodologies of crime scene reconstruction to be effective.

Neither of these disciplines can be taken lightly. The analyst must approach them with a willingness to immerse himself in the history and methodology of both. Neither discipline is for the faint of heart; both demand a level of objectivity, dedication, and significant study. But when these disciplines are applied in an appropriate and acceptable fashion, they provide functional and objective data that will aid juries and judges in seeking justice.

This text will explore the tenets of bloodstain pattern analysis in depth — what it is, how it is used, and practical methodologies to employ in order to achieve defensible results. We will also explore the role of crime scene analysis and reconstruction and its relationship to bloodstain pattern analysis.

We do not pretend to offer the “only” methodologies and techniques for pursuing bloodstain pattern analysis and crime scene analysis, but we will offer proven methodologies and techniques. Applied appropriately, the ideas and practical approaches in this book will guide and focus any investigative effort.

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Captain Bevel has served as a crime scene consultant in over 46 U.S. states and 9 foreign countries. He has been qualified as an expert in crime scene reconstruction and bloodstain pattern analysis in both state and federal courts.

Special Agent Ross M. Gardner (Ret.) worked for the U.S. Army Criminal Investigation Command (USACIDC) as a felony criminal investigator for nearly 20 years. He retired as a Command Sergeant Major and Special Agent in 1999 after serving a total of 24 years in the U.S. Army law enforcement. Mr. Gardner subsequently served four years as the Chief of Police for Lake City, Georgia, a small suburban Atlanta police department. He is now retired and active in independent consulting.

Mr. Gardner holds a Master's degree in Computer and Information Systems Management from Webster University, a Bachelor's degree in Criminal Justice from Wayland Baptist University, and an Associate's degree in Police Science from Central Texas College. He graduated first in his class at the Scenes of Crime Officers Course, New Scotland Yard, Hendon, England in 1985, and between 1988 and 1996 served as an adjunct professor of the police science program at Central Texas College. He is a former president of the Rocky Mountain Association of Bloodstain Pattern Analysts (RMABPA), as well as the Association for Crime Scene Reconstruction (ACSR), and has served as the chairman of the Education Committee for both the RMABPA and the International Association of Bloodstain Pattern Analysts (IABPA). Mr. Gardner was recognized as a Distinguished Member of ACSR in 2006. He is a charter member of the FBI Scientific Workgroup on

Bloodstain Pattern Analysis (SWGSTAIN) and is the current chairman of the Taxonomy and Terminology subcommittee.

Mr. Gardner is certified by the International Association for Identification as a Senior Crime Scene Analyst, a rating he has held for 16 years. He is an active instructor and consultant throughout the United States in crime scene analysis, bloodstain pattern analysis, and crime scene investigation, teaching to a variety of groups ranging from police and investigative organizations, to trial counsel professional development groups. He is also the author of *Practical Crime Scene Processing and Investigation*, published in 2004.

Bloodstain Pattern Analysis: Its Function and a Historical Perspective

1

And Cain quarreled with Abel his brother: and it came to pass, when they were in the field, that Cain rose up against Abel 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 the Lord said, What hast thou done? The voice of thy brother's blood crieth unto me from the ground. And now art thou cursed from the earth, which hath opened her mouth to receive thy brother's blood from thy hand. When thou tillest the ground, it shall not henceforth yield unto thee her strength; and a vagabond shalt thou be on the earth.¹

Genesis 4:10

Reading these passages one might wonder, was God really unaware of what transpired between Cain and Abel? Was He then convinced of the crime only by the presence of Abel's blood? This seems unlikely given the nature of the Judeo-Christian God. Rather, it would appear that God was reminding Cain that no matter what Cain's denial, the physical evidence of the deed spoke in as strong, if not a more convincing, voice. In these few short paragraphs we find what may be the first recorded use of bloodstain pattern analysis in a judicial setting.

The Function of Bloodstain Pattern Analysis

What is the function of bloodstain pattern analysis? Like any forensic discipline, bloodstain pattern analysis seeks to define the facts surrounding some incident that is in question. The examination of the physical nature of bloodstains provides information specific to the events that occurred during the incident.

We often refer to what the analyst evaluates as the "static aftermath" of an event.² Dispersion, shape characteristics, volume, pattern, the number and size of bloodstains, and their relationship to the surrounding scene are part of this aftermath. This information provides the investigator with a window into the past, helping define an objective history for a given incident. Clarity is not a guarantee, for it is possible the information present in the bloodstains will fail to illuminate any of the issues in question. Often, however, the analyst finds direct and convincing information that makes the role of the fact finder much easier.

Bloodstain pattern analysis is based on a very simple theory: blood as a fluid (a colloidal fluid, but a fluid nonetheless) will react to external forces in a predictable fashion. The cohesive forces of surface tension and viscosity, the various external forces (e.g., impact, accelerated motion, stream ejection) as well as gravity and air resistance will act together to produce similar results (patterns) under generally similar conditions. Thus, bloodstain patterns are reproducible phenomena. The physical characteristics of the bloodstain pattern help define the general nature of the event that created it. As we will discover, the basic event types that can be differentiated include:

- Blood dispersed from a point/area source by a force (e.g., impact patterns)
- Blood ejected over time from an object in motion (e.g., cast-off patterns)
- Blood ejected in volume under pressure (e.g., spurt and gush patterns)
- Blood dispersed as a function of gravity (e.g., drip, drip trails)
- Blood that accumulates and/or flows on a surface (e.g., pools and flows)
- Blood that is deposited through contact transfer (e.g., smears and pattern transfers)

Additional information we are likely to discover through an examination of the bloodstain patterns includes:

- The direction in which a stain was traveling when deposited
- The angle of impact
- The area of origin (in 3-dimensional space) for impact patterns
- The direction from which a force was applied
- The nature of object(s) involved in creating the pattern
- In some instances, the approximate number of blows struck during an incident
- The relative position(s) in the scene of the suspect, victim, or other related objects during the incident
- Movement of individuals and/or objects during and after bloodshed
- Sequencing of multiple events associated with an incident

The end product of a bloodstain pattern analysis is a series of defined events that occurred during the incident; that is, the bloodstain patterns help us understand not only the nature of the action that created them, but also where in the scene these actions occurred, any direction or motion associated with these actions, and in what order the actions occurred. The ultimate conclusions offered by the analyst are intended to put this information into a context for the incident in question, associating them when possible to specific acts or actions (e.g., associating an impact pattern to a gunshot) by involved parties.

Historical Perspective of Bloodstain Pattern Evidence

In seeking an understanding of bloodstain pattern analysis, it is important to look back at its evolution. In his book, *Blood Evidence*, Craig Lewis wrote: “The science of bloodstain pattern analysis, a field in which the only textbook in existence was written by MacDonell, was little known.”³ This viewpoint, although inaccurate, is not uncommon. Out of ignorance, authors, judges, and investigators continue to proclaim the discipline as something “new.”

To those who spend time at scenes of violent crime, it seems unimaginable to ignore the presence of blood, or not ask some simple questions as to its relationship to the crime. As we will discover, bloodstain pattern analysis has a nearly 150-year history that predates many modern forensic disciplines. This history is a consistent history. Although study and research have increased our overall understanding of cause and effect in bloodstain pattern analysis, the basic ideas that early pioneers claimed they could apply, we can still accomplish. Therefore, it is helpful to understand the genesis of bloodstain pattern analysis.

The mere presence of blood, excluding any formal analysis, has long been held as evidence of foul play. For example, in the development of early Germanic law, tribal code (private, as compared to state) was often created. One of the surviving documents of

this nature is the *Sachsenspiegel*. Compiled as a record of Saxon custom, a knight named Ritter Repkow wrote the document during the period of 1220–1235. Common Law II, 63, Article 1–3 dealt in part with the raising of the “hue and cry” and the necessity of proving one’s innocence for acting against a criminal caught in the act. He who had acted was required to prove an incontestability of the criminal’s deed.⁴ Examples of this proof, although not quite beyond a reasonable doubt, included “a criminal caught red handed.”⁵ The *Sachsenspiegel*, with its detailed illustrations, refers to the criminal having been caught with blood on his hand.

The work of William Shakespeare, although not the typical reference material of the criminalist, is filled with references to blood and the prejudicial nature by which its discovery is viewed. Shakespeare’s various works, written between 1582 and 1616, like all those of authors, reflect the perceptions of his time. For example, in Act II, Scene II of Macbeth, after stabbing King Duncan, Macbeth says:

What hands are here! Ha! they pluck out mine eyes. Will all great Neptune’s ocean wash this blood Clean from my hand?

The *Sachsenspiegel* and Shakespeare’s plays may not be of significant concern to the modern-day bloodstain pattern analyst, but they do reflect the consideration of bloodstains as a basic issue, preceding the formal development of forensic science. They also reflect the prejudicial manner in which bloodstains are often viewed. An interesting artistic example of the prejudicial nature of bloodstains hangs in the Central Art Archives of Finland. The work is entitled *Fratricide*, by Akseli Gallen-Kallela (*circa* 1897). It shows a young man with a bloodied sword and clothing as his mother points to numerous stains on his clothing (see Figure 1.1).

Another author whose writings reflect man’s inquisitive nature with blood evidence is Sir Arthur Conan Doyle. In 1887, Doyle wrote *A Study in Scarlet*, introducing the world to his brilliant character Sherlock Holmes. In this story, the master detective concerns himself not only with discovering a reliable reagent test for blood, but also in the examination of “gouts and splashes of blood, which lay all around.”⁶ Again, we see artistic indications that those concerned with the early investigation of crime considered the relationship of bloodstains to such crime.

Early Scientific References

Having considered literary references, it seems appropriate to turn our attention to the scientific evaluation of bloodstain patterns. We intend to discuss some of the more critical and insightful research conducted over the last century; however, there are many references that may not be mentioned or discussed in detail. The analyst should recognize this and consider seeking these historical references for greater enlightenment.

Europe was the primary location in which bloodstain pattern analysis found its initial footing. The primary periodical through which many of the continental authors expressed themselves was the *Vierteljahresschrift für gerichtliche Medizin* (*Quarter-Year Writings for Forensic Medicine*), which was published in Germany. Although much of the concern between the period of 1850 and 1940 dealt with the identification of blood, scattered throughout these discussions are references to patterns observed at scenes.

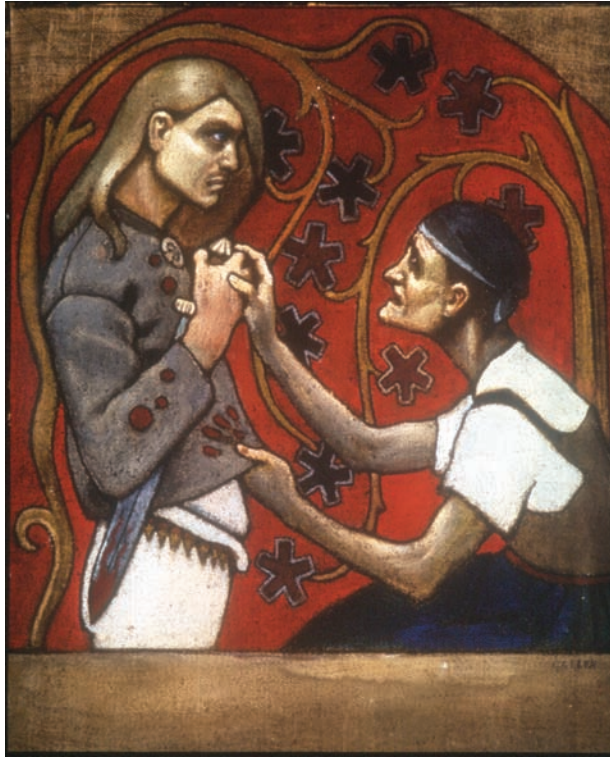


Figure 1.1 *Fratricide* by Akseli Gallen-Kallela (1897), a painting owned by the Anteneum, the Antell Collection, and the Central Art Archives of Finland, photographed by Hannu Aaltonen. Beyond the issue of his bloody sword, the pattern transfer and blood spots on the young man's garments speak his guilt to his mother. (Photo courtesy of the National Art Archives, Helsinki, Finland.)

Before proceeding, it is important to note that in German the term “*blutspritzen*” was widely used by various authors. This term is translated most often as “blood sprinkles.”⁷ There is, however, no absolute translation and the terms sprinkle, spatter, splash, or spurt are all acceptable usage.⁸ It becomes difficult, then, to always understand the specific context intended by any author. Caution is in order when considering the translations offered here.

In 1856, J.B. Lassaigne wrote “*Neue Untersuchungen zur Erkennung von Blutflecken auf Eisen und Stahl*” (“New Examination to Differentiate Bloodspots from Iron and Steel”). In the latter section of his paper, Lassaigne discusses marks that appeared similar to bloodstains, but were caused by insects.⁹

Although, Lassaigne made it clear he believed “crushing” of dead flies created such stains, he implied having found such stains at scenes and associated their presence with the presence of flies. Based on the description, these stains seem similar to what we might refer to as “fly specks.” Unfortunately, the translation and overall description by Lassaigne cannot satisfy the issue. Had Lassaigne found “fly specks”? Was he then establishing a causal connection without considering the regurgitation of blood by flies at bloodstained scenes? Whatever the case, Lassaigne’s observations establish his attention to detail and concern for differentiating such stains from other types of bloodstains.

In 1863, John Beck and Theodric Beck wrote “*Elements of Medical Jurisprudence*.” The article, as reviewed by Herbert MacDonell, discussed various cases in which bloodstain

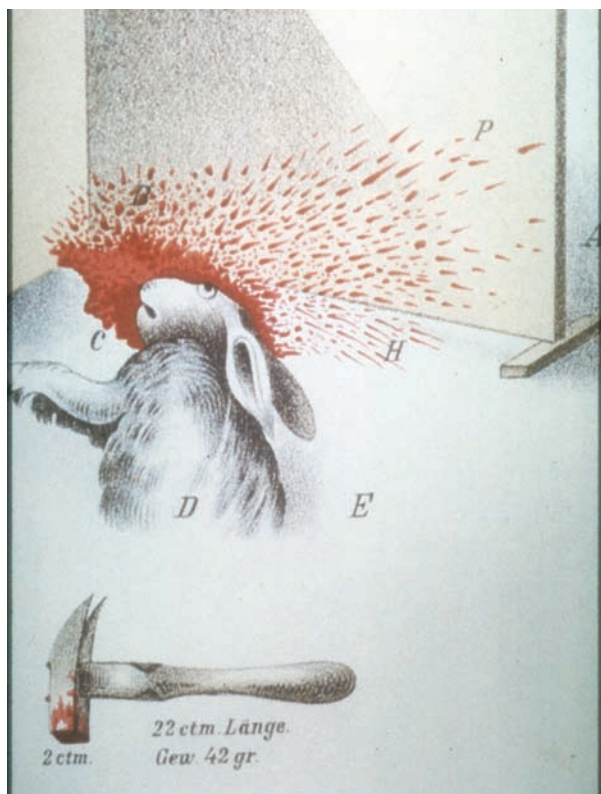


Figure 1.2 In addition to his written description, Piotrowski created detailed drawings of his various experiments and their results. (Photograph courtesy of Herbert MacDonell, Laboratory of Forensic Science, Corning, NY.)

pattern analysis was utilized. Specific references were made to the “situation” of wounds, and as MacDonell noted, the authors also used the term “blood sprinkles.” The latter term tends to indicate a German influence, although the article originated in Philadelphia.¹⁰

In 1880, Dr. Henry Faulds published “On Skin-Furrows of the Hand,” describing bloody fingerprints and their likely usage to identify the criminal.¹¹

In 1882, Professor Charles M. Tidy of London published “Legal Medicine,” in which he stated:

Few things hold so important a place as, or involve investigations of a greater nicety, than determining the precise nature of various [blood] spots or stains found on fabrics, instruments...¹²

Perhaps one of the most impressive treatises written on the subject of bloodstain pattern analysis is “Ueber Entstehung, Form, Richtung und Ausbreitung der Blutspuren nach Hieb- und Stosswunden des Kopfes,” (“Concerning Origin, Shape, Direction and Distribution of Bloodstains Following Blow Injuries to the Head”) written by Eduard Piotrowski in 1895 at the University of Vienna.

Dr. Piotrowski’s application of scientific method to his observations and evaluations of bloodstains is unequaled in the known writings of the time. He reconstructed his scenes to model those in question, and controlled and adjusted various variables to determine their specific effect, his experiments using live rabbits (see Figure 1.2). Although the

use of live animal models would not sit well with many modern groups, Dr. Piotrowski recognized the dynamic nature of what he was studying, and felt the use of live subjects assisted his understanding.

Dr. Piotrowski considered this dynamic nature and used it as one of his variables. Calling the concept a “*complicirtem morde*,” he used multiple methods of attack against his study subjects (rabbits); thereby ensuring himself that he was considering all possibilities and their effects.¹³

In considering this *complicirtem morde*, Dr. Piotrowski properly recognized bodily reactions of his subjects when struck. In the following example, he observed small stains “similar to dots” that radiated out from the rabbit’s head, and concluded:

As far as their position is concerned, they spread out in a radiating pattern. The center of this outward radiating droplet [pattern] was the nostrils and mouth from which the accumulated blood was forced out ... [expectorate blood].¹⁴

Evident to Dr. Piotrowski was the correlation between the location of the stain’s tail and the direction the droplet was traveling at impact. He also recognized the causative factors of cast-off stains. He included in his evaluation of the first the effect of a parabolic arc on the resulting stain. In the latter, he isolated not only the fact that blood flung from a weapon would create a specific stain, but also correlated this with stain directionality, giving him an ability to define the direction in which the weapon was being moved.¹⁵ In this work’s concluding statement, Dr. Piotrowski commented:

The formation, shape, and distribution of bloodstains follow specific rules and that these, allowing for many modifications considering the nature of the case, are not to be underestimated and are of great value in the judgment.¹⁶

In 1901 Jurgen Thorwald, writing about the efforts of Professor A. Florence stated:

[Florence] had worked out a whole system for classifying bloodstains caused by dripping, splashing, spurting, or grazing contact. Round stains, or roundish jagged stains, for example, indicate that blood fell vertically; oblong stains result from impact at various angles.¹⁷

Thorwald based his discussion on Florence’s article “Les Taches de Sang au Laboratoire De Medicine Legale De Lyon.” This article originally appeared in the *Archives De Anthropolgie Criminelle* in 1901.

In 1902, Dr. John Glaister discussed the role of bloodstains in his book *Medical Jurisprudence Toxicology and Public Health*. As with other authors of his time, Glaister’s primary concern was the issue of whether various stains were or were not human blood, but he also commented on patterns of blood and, in particular, the basic pattern types:

As has already been pointed out, in every case in which a dead body with wounds upon it is examined *in situ*, examinations should be carefully made for the presence of blood-stains and their incidence upon the body and in its vicinity. The examiner must expect to meet every possible variety of stains, both in respect to character, incidence and magnitude: as (a) sprays, spurts, or jets; (b) smears of various forms; or (c) pools of blood.”¹⁸

Dr. Glaister did not further refine his ideas of what these different patterns looked like, but it is clear investigators at the time were considering not only the presence of blood, but also the nature of the bloodstains.

In 1904, Hans Gross wrote *Handbook fur Untersuchungsrichter Als System Der Kriminalistik*. In it he provided a detailed discussion of not only the evaluation of bloodstains, but also their collection and documentation.¹⁹ Gross felt bloodstains were of critical importance in the investigation, and he devoted some 30 pages of the book to his considerations of blood and bloodstain patterns in the investigative process (see Figure 1.3). This book was considered the reference of its time, and in 1924 with Gross' permission, it was translated into English and republished by J. Collyer Adam as *Criminal Investigation*.

In 1912, Russian Professor R.A. Reiss discussed the use of bloodstain patterns in an article entitled "Scientific Techniques of Criminal Investigation." His primary considerations were shape, but also included a discussion of arterial patterns and concern over the difference between stains on an absorbent target compared to those on a non-absorbent target.²⁰

In 1914, Haberda wrote "Eine besondere Form von Blutspritzen" ("A Special Form of Bloodstain"), discussing a specific pattern observed in airway injuries. He described such stains as droplets of various shapes that contained small air bubbles mixed with the blood. Beyond his consideration for this particular stain, Haberda offers many insightful lessons which are still applicable. Consider the following:

The discovery of quantity, spread, form, and arrangement of bloodstains at a blood spattered crime scene can be of high importance. Evaluation requires many years of experience, usually learned little by little through practice, but never from books. Never the less, experts are often not careful enough when it comes to the necessary evaluation.

Forced by precise questions of police, jurisdictional or governmental authorities, the experts sometimes answer too exclusively and draw the wrong conclusions about the bloodstains on a corpse or in the surrounding crime scene.²¹

We would agree wholeheartedly that oftentimes analysts make conclusions that are far too exclusive.

Haberda also made reference to bloody fingerprints, clothing pattern impressions, and his particular stain — the foamy bloodstain. In describing the shape of stains that might be encountered, Haberda said:

Even though the distance of the fall, or the angle with which the blood hits the ground influences the shape of bloodstains, which are for example more or less round, bear paw like, club or bottle like...²²



Figure 1.3 One of many drawings from Gross' translated text. This drawing depicts variations in the shape of a stain as a function of how it falls to the ground (the impact angle), and the correlation of satellite stains and scallops to the directionality of the stain.

How similar to modern descriptions are Haberda's? *Round* and *bear paw* are still adjectives used to describe stains, whereas *elliptical* replaced terms like *club* or *bottle-like*. There can be no doubt Haberda was observing and classifying the very things we still look for today.

Ernest Ziemke is another author of interest. His work is found in *Gerichtsärztliche und polizeiarztliche Technik*, a book written by Theodor Lochte in 1914. Chapter 7, entitled "Die Untersuchung von Blutspuren" ("The Examination of Blood Tracks"), was written by Dr. Ziemke. The work includes 14 pages of text with numerous pictures; it details various stains and the information represented by those stains. Ziemke dealt with a wide range of issues affecting bloodstain pattern analysis.

In the chapter preamble, Dr. Ziemke states:

Blood tracks [blood effects or evidence] are the most important tracks that stay behind after a crime is committed. Very often they alone have been of significant enough importance for the conviction of the suspect, and have been the focal point in a trial with only circumstantial evidence... Their evaluation should be efficient, because during an investigation it may be hard to foresee what might be of importance later during a court trial.²³

In discussing the search for blood, both for serological and bloodstain pattern evidence, Dr. Ziemke offers that:

The suspect, his clothes, all items he carries, or which are in his pockets should be carefully examined for bloodstains.²⁴

This is sound advice that some of the best bloodstain pattern analysts in the country continually stress and teach today. Far too often, such minute traces are simply overlooked by investigators.

In discussing pattern analysis and the conclusion drawn, Dr. Ziemke comments:

Very important conclusions can be drawn from the arrangement, location, size, and form of bloodstains ... Based on our own experience and experiments we want to point out that it is necessary to be cautious and not draw conclusions from a single or very few blood tracks. This happens quite often... Only when a large number of bloodstains are examined and compared, is it possible to exclude errors [in logic].²⁵

Dr. Ziemke provided detailed descriptions of various types of bloodstains. His terminology followed that of Piotrowski, but he added terms such as "thorn apple shaped" to refer to the bear claw stain. He acknowledged that secondary droplets (satellite stains/wave cast-off stains) in these instances would assist in understanding the direction of motion of the blood droplet. He included figure examples of cast-off blood and drip patterns in which he described how to define directionality. Figure 1.4 is an example of one of these illustrations. In closing his discussion of bloodstain patterns, he said:

When the examination of bloodstains is done efficiently and carefully, and if all possibilities are exhausted, shape, location, and the site of the bloodstain can give important details about the circumstances of the deed, eventually even be of importance for the conviction of the suspect.²⁶

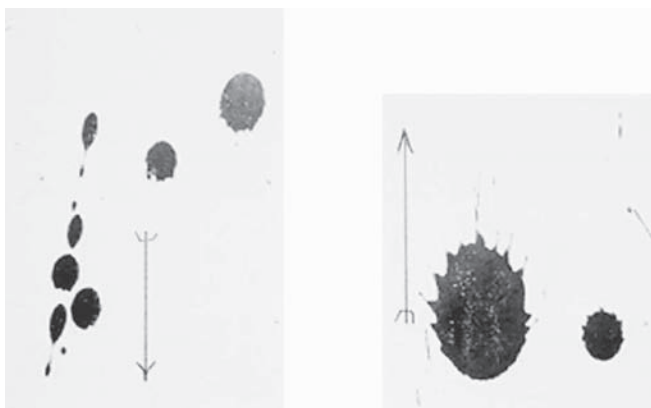


Figure 1.4 Illustrations from Dr. Ziemke's chapter on bloodstain pattern analysis. The two figures (Ziemke's Figures 42 and 43) demonstrate a drip effect from walking and running. Ziemke added the arrows to show directionality evident in the stains.

Dr. W.F. Hesselink considered various issues related to bloodstain analysis in his article "Blutspuren in der Kriminalistischen Praxis" ("Bloodtracks in Criminalist Practice") written in 1931. For example, Hesselink considered the subsequent condition of the dried stains on clothing as a manner of differentiating whether such clothing had been worn or in use since the deposit of the stains. He also considered a method of dissolving the bloodstain to determine its relative age when compared to some other stain. Hesselink eventually concluded this technique was inaccurate, indicating that the manner in which each droplet dried and coagulated would affect the results.

He also considered whether a suspect would or would not be stained in a violent murder, making the following observations:

The answer depends upon two main circumstances: one, if many bloodstains are found at the scene, and two, what instrument was used. Regarding this I did several experiments. When using the hammer, the liquid squirts in all four directions, and will also cover the suspect. If a stick is used, the blood squirts left and right, and the suspect might not show any blood marks. When a forward bent file is used, the blood squirts only to the front. The foreground [of an illustration] shows many spatter while only a few went towards the subject. While the suspect of a bloody murder, performed with a hammer, usually will be bloodstained, the suspect, in case of death caused by hitting with a bent file might have few or no bloodstains on the clothes.²⁷

Hesselink then described the use of a pattern transfer he discovered, stating:

In one murder, I found a blood spot on the bedroom floor. First, it did not look too informative, but when I examined it later with a very strong light, I found remarkable prints of about 14 shoe nails.²⁸

Hesselink sought not only to define the nature of the stains found, but also to define the manner of the event creating the stains. He then correlated the information with other forensic evidence, resulting in a partial reconstruction of his scene and the crime. His recognition of the importance of bloodstain pattern analysis for scene reconstruction is reflected in his closing statement:

Therefore, when examining blood, the blood investigation [to identify a substance as blood] itself is not as important as the clarification of surrounding circumstances.²⁹

In 1931, Henry T.F. Rhodes, a criminologist in England, member of the International Academy of Criminology, and an admirer of the great criminologist Edmund Locard, published *Some Persons Unknown*. The book was a compilation of case studies with a history of the scientific development of criminology. Although Rhodes did not discuss the use of bloodstain patterns in and of itself, he discussed in depth the development of the identification of blood in forensic investigation. He commented on the ever-increasing discrimination required by the court in terms of making identification of blood. Rhodes stated this manifested itself in the change of accepted testimony from “it looks like blood,” to “yes it is blood,” to “yes it is blood and it is human.” At the time of publication, the four categories of blood, which ultimately became known as the ABH/ABO grouping system, had just been discovered. Rhodes recognized this advancement as a significant investigative tool with which to primarily exclude individuals as suspects.³⁰

Rhodes followed his first book with a second entitled *Clues and Crime*. Published in 1933, the theme of the book was consideration of how science assisted in the detection of crime. Although Rhodes did not personally comment on bloodstain patterns, he gave specific mention to the efforts of Hans Gross in the area of bloodstain pattern analysis.³¹

In their writings it is obvious that Hesselink and Rhodes clearly viewed blood in different perspectives. Rhodes understood what Gross was pursuing in the area of bloodstain patterns, but still felt the scientific individualization through the blood grouping systems of the time was of greater significance. Hesselink, on the other hand, felt that individualization and identification were secondary, and that the patterns themselves were of greater significance. Today we recognize that both were correct. The individualization of bloodstains without consideration of the pattern itself or vice versa is tantamount to reading a book but skipping chapters.

In 1939 at the XXII Congress of Forensic Medicine, Dr. Victor Balthazard, R. Piedelievre, Henri Desolille, and L. Derobert presented one of the most insightful papers relating to bloodstain pattern analysis. Entitled “Etude Des Goutes De Sang Projecte,” the proposed purpose of the research was to pinpoint characteristic elements of a bloodstain which might “give decisive hints” as to its origin.³²

Balthazard et al. felt it necessary not only to examine the resulting spatter and stains, but also to understand the manner in which blood exits wounds, the trajectories of such blood, and the manner in which the blood droplet changed to become the resulting stain. As with Piotrowski, Balthazard recognized the importance of the dynamics involved in bloodshed, and realized bloodshed could not always be mimicked under laboratory conditions. To provide more realistic data, Balthazard utilized rabbits to produce actual bleeding injuries.³³

Balthazard’s consideration of the length-to-width ratio of a stain as a function of impact angle is one of the most important contributions of this work. Analysts repeat his experiment in nearly every 40-hour bloodstain pattern analysis course taught today. Professor Balthazard offered a caution in considering impact angle estimations, however, stating:

In practical application, it [impact angle evaluations] should not be looked after for an illusionary accuracy. Nevertheless, this curve permits an estimate of the impact angle with an acceptable accuracy, sufficient for practical purposes.³⁴

Another important consideration was determining the point of origin. Balthazard furthered the cause and process for making such estimations. His group's efforts established the basis for current "stringing" techniques. Yet, in considering the issue of the unknown parabola of the droplet, Balthazard stated:

Practically these methods can only be applied in a limited manner. [For instance] sometimes it is necessary to find out whether a victim, at the moment he was injured, stood on his feet or was lying.³⁵

Finally, Balthazard's group considered the nature of the target on which a droplet fell. They found that many deformations would be possible, given various target characteristics. In summary, Balthazard stated:

These modifications [deformations caused by the target] are sometimes obvious, but we must constantly remember that on an apparently homogeneous target, uneven areas can occur which may cause slight disfigurements.³⁶

It is likely that world events in Europe prevented further effort in developing the research of Balthazard and his fellow researchers. Nevertheless, their efforts were not completely lost or without some impact. In 1941, John Gohringer, a U.S. citizen studying for his medical degree at the Institute of Forensic Medicine, University of Heidelberg, wrote as his inaugural dissertation "Kann Aus Dem Bild Auf Verscheidenen Unterlagagen Die Fallohe Und Richtung Des Gefallenen Tropfens Ermittelt Wreden?" ("Is It Possible To Establish The Falling Height and Directionality of a Dropped Down Drop Of Blood from the Appearance of the Stain on Various Targets?"). Much of Dr. Gohringer's inspiration developed out of Balthazard's research. As an interesting historical note, Dr. Gohringer completed his studies in December of 1941 and was subsequently held as an internee by the German government for seven months before he was released to Vienna.³⁷ He later returned to the U.S., where he left forensics and began practicing medicine. In 1992, Dr. Gohringer had occasion to speak before the International Association of Bloodstain Pattern Analysts, (IABPA) training conference in Colorado Springs, Colorado, sharing some of his thoughts on the history of bloodstain pattern analysis.

Dr. Paul Leland Kirk, of Berkeley, California, also added immeasurably to the knowledge of bloodstain pattern analysis. Dr. Kirk, a professor of criminalistics and biochemistry, was active in assisting law enforcement organizations in the U.S. between 1935 and 1967. Dr. Kirk's book, *Crime Investigation*, published in 1953, included a chapter entitled "Blood: Physical Investigation." In that chapter, Kirk discussed the application of bloodstain pattern analysis to criminal investigations.

Another source for Kirk's beliefs on the subject is evident in his affidavit filed in the Court of Common Pleas, Criminal Branch, in the case of *State of Ohio v. Samuel H. Sheppard*. This document provides immense insight on his approach to bloodstain analysis.

In the Sheppard case, Dr. Kirk considered the drying times of blood and the evaluation of blood trails as evidence. He specifically sought to evaluate plausible causes for such trails. Further, he identified a void in the bedroom of Mrs. Sheppard that others missed, which established the most likely position of the attacker. He then correlated the cast-off patterns found in the room to the position of this void. Dr. Kirk clearly utilized a whole-scene approach.³⁸

In 1955, Svensson, Wendel, Sodermann, and Stenlund published *Rikospaikka-Tutkimus* (*Techniques of Criminal Investigation*) in Helsinki, Finland. The text included 12 pages depicting various aspects of bloodstain pattern analysis and describing its role in the criminal investigation. Although the primary purpose of the text was to explain what kind of evidence to look for and how to collect it, they also described basic types of patterns, discussed directionality, and understood that bloodstain pattern analysis was an integral part of violent crime investigation. In 1965, American Elsevier Publishing reprinted the book in English.

In 1960, Dr. Jozef Radzicki of Warsaw, Poland, published “Ślady Krwi w Praktyce Śledczej” (“Bloodstain Prints in the Practice of Technology”). Although a full translation is not yet available, portions were translated for inclusion in the IABPA library. In this work, Dr. Radzicki established three basic groups of bloodstains, based on their mechanisms of creation. They are:

1. Bloodstains resulting directly from extravasations — drops, gushes, and pools of blood
2. Bloodstains resulting from the application of various instruments — spatter, cast-offs, and patterns resulting from direct contact
3. Bloodstains resulting from the wiping or removal of blood³⁹

As with previous authors, Radzicki cautioned that a critical consideration was the characteristics of the target surface, as bloodstains created under similar circumstances but falling to different targets might well result in dissimilar stains. Several other interesting points made by Dr. Radzicki included his consideration that “how” an instrument was employed would clearly affect the nature and distribution of the resulting spatter. Dr. Radzicki also discussed arterial bloodstain patterns in depth.⁴⁰

Modern Works in Bloodstain Pattern Analysis

Having dealt with a “historical” view of bloodstain pattern analysis, we arrive at a more recent history. Following Dr. Kirk’s efforts through the 1960s was what might be considered the modern renaissance of the discipline. The number of authors writing on this subject increased dramatically, professional associations related to the field were established, and the discipline as a whole took on a far more accepted status in court.

Many proclaim Herbert MacDonell as the father of modern bloodstain pattern analysis. Whether this is accurate depends upon your individual perspective. What cannot be denied is that Herbert MacDonell brought about a distinct reawakening of this discipline.

In 1970, after conducting extensive research, MacDonell and Lorraine Bialousz co-authored *Flight Characteristics and Stain Patterns of Human Blood*. As the two were working under a Law Enforcement Assistance Administration (LEAA) grant, the LEAA published the report. The LEAA document remained available for nearly 12 years before going out of print. In 1982, the revised paper was released as *Bloodstain Pattern Interpretation*. MacDonell subsequently completed a third work on the subject in 1993, entitled *Bloodstain Patterns*.

In 1983, Dr. Henry Lee, Peter Deforest, and Dr. R.E. Gaensslen wrote *Forensic Science: An Introduction to Criminalistics*. Included in this work is a 12-page section dedicated to explaining bloodstain patterns.

In 1983, the IABPA was formed. The association's stated purpose is to promote the general knowledge, techniques, and understanding of bloodstain pattern evidence.

In 1986, the *Journal of Forensic Science* published two papers by Peter Pizzola, Steven Roth, and Peter Deforest, entitled "Blood Droplet Dynamics I and II." The group sought to examine the dynamics of liquid droplets in flight and photographed droplet impacts, providing a more accurate understanding of the action that is often called "wave cast-off." In "Blood Droplet Dynamics II," Pizzola et al. clearly demonstrated that motion in the target could mimic characteristics of an impact at a greater angle than that which occurred. Their findings are extremely important in our efforts to understand dynamic scenes of crime.⁴¹

In 1989, William Eckert and Stuart James published *Interpretation of Bloodstain Evidence at Crime Scenes*. Although the book received a very critical review in the *Journal of Forensic Science*, it was the first attempt in almost seven years to tackle bloodstain pattern analysis as a single reference text.

The following year, the International Association of Identification accepted bloodstain pattern analysis as a discipline, removing it as a subcategory of crime scene analysis. That same year, we wrote *Bloodstain Pattern Analysis: Theory and Practice: A Laboratory Manual*.

In 1998, James and Eckert published their second edition of *Interpretation of Bloodstain Evidence at Crime Scenes* with CRC Press, significantly adding to the book's value. Prior omissions were corrected and the text remains a valuable reference.

James followed this work with *Scientific and Legal Applications of Bloodstain Patterns Interpretation*. James put together an impressive group of contributors, including Alfred Carter, William Fischer, Carol Henderson, Paul Erwin Kish, Maria Saccoccio, and T. Paulette Sutton. The text was directed toward trial counsel in an effort to help lawyers better understand how to apply bloodstain pattern analysis in criminal trials.

In 2001, Anita Wonder published her book, *Bloodstain Dynamics*. Although from an overall viewpoint this work is a significant resource, Wonder included issues that were, to say the least, controversial. This included the claim that she could differentiate the nature of spatter based on a single stain from any spatter pattern. Despite some of these more controversial issues, the book remains an excellent resource for the discipline.⁴²

In 2002, the Federal Bureau of Investigation formed the Scientific Working Group for Bloodstain Pattern Analysis (SWGSTAIN). Calling on expertise from police, laboratory, and independent consultants worldwide, the purpose and focus of this group was to explore and define functional guidelines for the discipline.

In 2005, Stuart James, along with co-authors Paulette Sutton and Paul Kish, published *Principles of Bloodstain Pattern Analysis Theory and Practice* with CRC Press. This work was a far more comprehensive document than his previous text, *Bloodstain Evidence at Crime Scenes*.

Summary

Whatever we might say of bloodstain pattern analysis, it has a rich history; one that indicates the consideration of bloodstains in solving crime predates even modern forensics. As to the issue of being a "new" discipline, the examination and consideration of bloodstain patterns and their historical acceptance in forensics is well documented. Bloodstain pattern analysis has a nearly 150-year documented history; and as important as the length of that history is, just as important is the fact that it is a consistent history. Long recognized for its

ability to support the evaluation of scenes of crime, bloodstain pattern analysis serves the investigator by illuminating “what happened.” It cannot tell us in all cases “who,” but as Piotrowski and Hesselink discussed, the ability to define the “situation” or “circumstances” of the crime is often just as important.

Working with an understanding of all areas of forensics and with experience in evaluating crime scenes, the investigator can often use bloodstain pattern analysis to reconstruct the events surrounding a given incident. More and more, this process of crime scene reconstruction is being tested in our judicial system, but it is only through the application of quality objective analyses that the discipline can hope to serve its intended function. Our purpose as analysts must always be to guard against subjective analysis.

As we wrote in 1990, each day blood from scenes of a crime cries out to investigators. The use of proper bloodstain pattern analysis simply enhances the criminalist’s ability to be an active listener to this very vocal witness.

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Figure 10.43 Diluted stains. The stains on and in this sink were created by blood mixed with

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Figure 11.21 A close-up photograph of Stain

#5 from the item depicted in Figure 11.16. As this

pattern is made up of several very small stains,

additional macro-photographs are necessary. Figure 11.22 A close-up photograph of Stain #5A from Pattern 5 depicted in Figure 11.21. The larger orange label is too big for the macrophotograph, so an additional small millimeter scale is introduced alongside the stain and annotated so the viewer knows which stain they are looking at.

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Control Line Test Line
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- specific,” these tests are more specific than other presumptive test techniques. After sampling
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