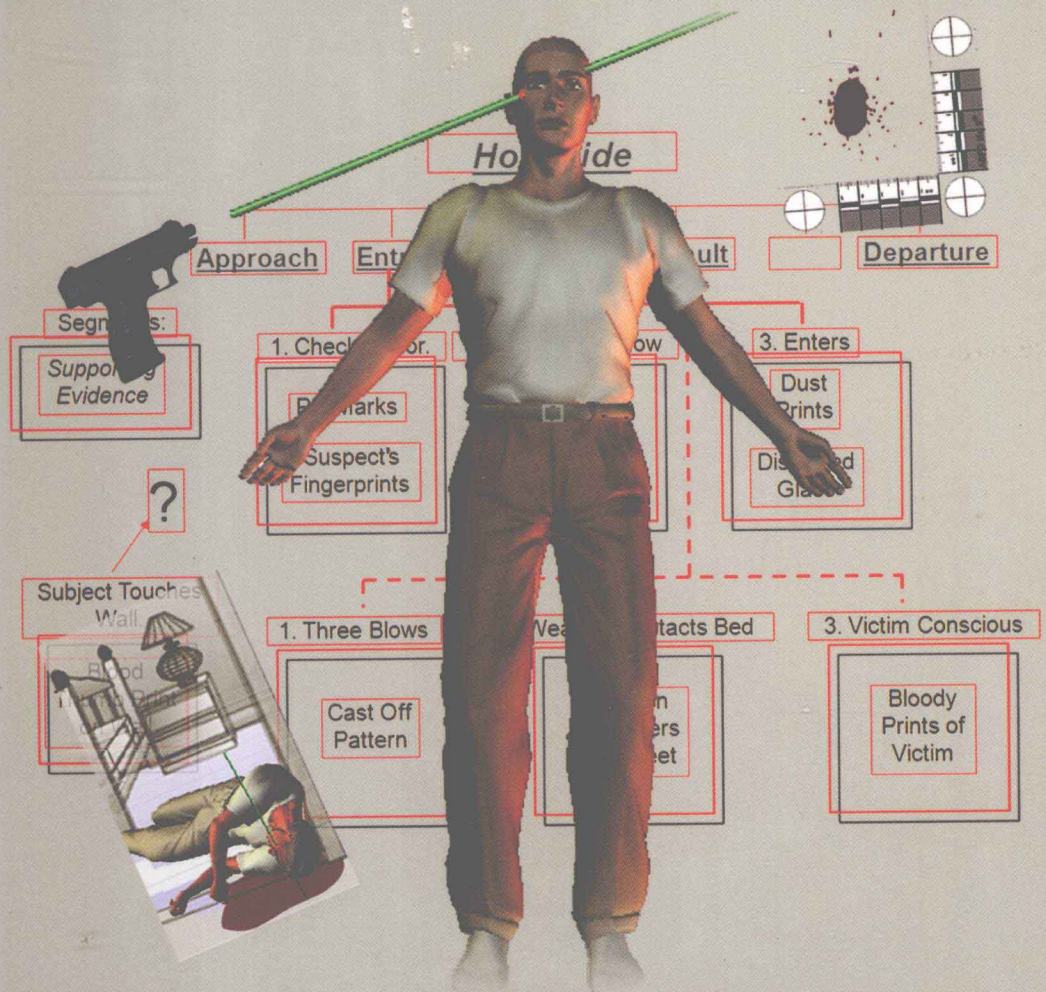


Practical Crime Scene Analysis and Reconstruction



Ross M. Gardner and Tom Bevel



Practical Aspects of Criminal and Forensic Investigations Series

Practical Crime Scene Analysis and Reconstruction

Ross M. Gardner and Tom Bevel

**Contributions by
Matthew Noedel
Scott A. Wagner, MD
Iris Dalley**



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

© 2009 by Taylor & Francis Group, LLC
CRC Press is an imprint of Taylor & Francis Group, an Informa business

No claim to original U.S. Government works
Printed & bound in Singapore by Markono Print Media Pte Ltd
10 9 8 7 6 5 4 3 2 1

International Standard Book Number-13: 978-1-4200-6551-0 (Hardcover)

This book contains information obtained from authentic and highly regarded sources. Reasonable efforts have been made to publish reliable data and information, but the author and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The authors and publishers have attempted to trace the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission to publish in this form has not been obtained. If any copyright material has not been acknowledged please write and let us know so we may rectify in any future reprint.

Except as permitted under U.S. Copyright Law, no part of this book may be reprinted, reproduced, transmitted, or utilized in any form by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying, microfilming, and recording, or in any information storage or retrieval system, without written permission from the publishers.

For permission to photocopy or use material electronically from this work, please access www.copyright.com (<http://www.copyright.com/>) or contact the Copyright Clearance Center, Inc. (CCC), 222 Rosewood Drive, Danvers, MA 01923, 978-750-8400. CCC is a not-for-profit organization that provides licenses and registration for a variety of users. For organizations that have been granted a photocopy license by the CCC, a separate system of payment has been arranged.

Trademark Notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

Library of Congress Cataloging-in-Publication Data

Gardner, Ross M.

Practical crime scene analysis and reconstruction / Ross M. Gardner and Tom Bevel.
p. cm. -- (CRC series in practical aspects of criminal and forensic investigations ; 49)

Includes bibliographical references and index.

ISBN 978-1-4200-6551-0 (acid-free paper) 1. Crime scene searches. 2. Criminal investigation. 3. Evidence, Criminal. 4. Forensic sciences. I. Bevel, Tom. II. Title. III. Series.

HV8073.G317 2009
363.25'2--dc22

2008048951

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

Dedication

*To our wives, Karen and Liz, and our children, Dawnielle, Jeremy,
Christopher, and Cody, for their undying patience and love.*

Series Editor

The series editor for Practical Aspects of Criminal and Forensic Investigations is Lieutenant Commander (retired) Vernon J. Geberth, New York City Police Department, who was the commanding officer of The Bronx Homicide Task Force, which handled over 400 homicides a year. Geberth has been president of P.H.I. Investigative Consultants, Inc., since 1987. He has more than 40 years of law enforcement experience and has conducted homicide investigation seminars for more than 60,000 attendees from more than 7,500 law enforcement agencies.

Commander Geberth is an author, educator, and consultant on homicide and forensic investigations. Geberth has published three best selling books in this series, *Practical Homicide Investigation, 4th edition*; *Sex-Related Homicide and Death Investigation: Practical and Clinical Perspectives*; and *Practical Homicide Investigation: Checklist and Field Guide*.

Commander Geberth created, edited and designed this series of more than 40 publications to provide contemporary, comprehensive, and pragmatic information to the practitioner involved in criminal and forensic investigations by authors who are nationally recognized experts in the respective fields.

Vernon Geberth welcomes the opportunity to review new proposals for books covering any area of criminal and forensic investigation, and may be reached at **vernongeberth@practicalhomicide.com**

Foreword

Crime scene analysis and reconstruction has experienced a reawakening of sorts. The immense proliferation of television, print, and electronic media has generated significant public interest and helped shape public perception of our profession. Graduate level programs of investigative sciences have increased exponentially. Unfortunately, information about our profession is sometimes disseminated with little regard for accuracy and relevance. The net result of this condition is the creation of a morass of information with few guides available to navigate this wasteland. *Practical Crime Scene Analysis and Reconstruction* confronts this issue and bridges the gap between perception and reality.

For more than a century, noted criminal investigators have relied on the concept of reconstruction to aid them in their analysis of crime. There is nothing new about the practice of crime scene reconstruction, but the true practitioners are few and the methodology is varied. This book is the first serious attempt to resolve that issue and bring professionals to a common place of understanding. As the forensic community becomes more compartmentalized, there is a clear and distinct need to maintain a generalist perspective. Absent that perspective, we risk a discontinuity of facts comprising the criminal act. While the analytical scientist may be compared to the individual musician, the reconstructionist is the conductor. Each instrument may have a beautiful tune, but without the conductor to arrange the pieces there can be no melody.

The authors not only seek to enlighten the readers on the true nature of this discipline, but to guide them in their professional conduct. The readers of *Practical Crime Scene Analysis and Reconstruction* will understand the nature of scientific method and learn the proper application of its components. The text is generously augmented by realistic case scenarios, which highlight the relevancy of the concept being discussed. This is not simply the inclusion of crime scene photographs or case histories for the sake of imagery or theatrics. It is a careful selection of meaningful abstracts needed to convey each part of this complex methodology.

Those who read and study this text will gain a comprehensive understanding of the elements of crime scene analysis and reconstruction. Each author possesses a unique ability to distill complex issues into easily understood concepts. This book presents a clear and precise methodology that, when properly used, will give the practitioner the best opportunity to understand the events surrounding the commission of a crime. I have never been one to subscribe to the idea that any one book can be considered the “bible” of that profession. However, serious practitioners cannot afford to abstain from studying the information provided here. *Practical Crime Scene Analysis and Reconstruction* will be a welcome and well-used addition to a reference library.

Thomas W. Adair, President

Association for Crime Scene Reconstruction

Preface

Crime is a truly interesting phenomenon—not only in its root causes and long term effects on a society, but also in how society attempts to deal with it. When confronted with crime, communities ultimately find themselves asking a lay jury to decide the innocence or guilt of the parties involved. The expectation for these juries is immense: to objectively consider all information and judge who is, or is not, responsible. In the best of circumstances, this is no easy task, for even the best criminal investigation should not be expected to answer every single question relating to a criminal incident. This is not the nature of crime or the criminal investigation, for no one has an investigative crystal ball. Investigators arrive after the fact; they have only those pieces of the investigative puzzle found at the scene to work with, and are left to piece together the story using the oft times subjective testimonial evidence.

How is a jury to judge the truthfulness of those involved in alleged crimes? How are they to understand the true story of what really happened? Lacking this knowledge, the jury is left trying to decide who is truthful and who is not. Forensics and the criminal investigation exist for one reason—to answer such questions. They offer insight to the community on what really did occur. Unfortunately, forensic science, when offered as disparate disciplines (e.g., fingerprints, ballistics, DNA), doesn't always answer these questions for the jury. The jurors are still left pondering what took place. When presented with scientific evidence, that evidence is often offered in competing contexts, which does nothing more than confuse jurors.

In many instances, lawyers step forward to fill the gap of the jury's knowledge. In both opening and closing statements, counsel offer their own theories (valid or not) of what the "real" story is. They paint the scientific evidence in a context that works for them, many operating on what we now refer to as the Smorgasbord Theory of Science. They start with a conclusion, then choose that data that supports their theory, ignoring or dismissing any competing data. Like picking their favorite food at a buffet table, they choose only that information they like and then ask the jury to go along for the ride. This concept is not science; it is the antithesis of science.

Crime scene analysis (also known as *reconstruction*) is a discipline that fills this gap appropriately and effectively. The role of the crime scene analyst is to define as effectively as possible what occurred and in what order it occurred, as well as identifying what did not happen. This definition of events is never complete, playing out like a Hollywood movie; the limitations of the criminal investigation are ever present. There is only so much data to work with. But, crime scene analysis pulls the various forensic disciplines together and, using the refined conclusions from all of the experts involved, builds the most cohesive, most objective picture possible. This analysis guides the criminal investigation, assists both prosecution and defense in their tasks, and hopefully answers many of the questions being considered by the jury.

The role of the crime scene analyst is to answer as completely as possible what occurred and in what order it occurred. This idea of crime scene analysis is as old as the idea of the

professional criminal investigation. The themes driving crime scene analysis have been written and discussed for over 100 years and are nothing more than the application of scientific method. As forensic technology progressed, the only real change in crime scene analysis has been the nature of evidence available for consideration. “How” one proceeds in crime scene analysis is the same today as it was 100 years ago, but the data available to the analyst has changed dramatically. That change demands caution on the part of the crime scene analyst. The analyst has to pull information from the various disciplines associated with the investigation and place it all into a functional and objective context. This is no easy task.

What we offer in this text is an approach to that task, a means of developing context. A way of taking all of the data from the disparate forensic disciplines and building an objective picture from it. The theory offered for crime scene analysis is as old as the concept itself. The principles we describe have always been in play, but perhaps in the form offered here, they will be more evident and understood by the analyst. Our methodology, Event Analysis, is a proven path that incorporates all of the basic historical themes of crime scene analysis. It is not the only methodology, but it works when used as described. Appropriate and objective crime scene analysis is the only effective way for achieving justice. We hope this book aids those who choose to pursue the task of crime scene analysis, guides those involved in criminal investigations, and eventually serves the best interests of our communities and juries by answering the questions that may lead us to true justice.

Acknowledgments

As with all writing projects, no one author or group of authors can take credit for every single aspect of the effort. We would like to offer our thanks to the following individuals for their input, assistance, or support:

Vernon Geberth, our series editor, for his continued support and encouragement over the years.

Tom Adair, Westminster Police Department. Tom has been an excellent source of archived material over the years as well as a good sounding board for ideas related to crime scene analysis.

Andrea McDonald, Arapahoe County Sheriff's Office. While attending a Crime Scene Reconstruction course several years ago, Andrea challenged our prior worksheets and suggested that instead of having two, we should combine the two to create a single, more effective worksheet. Her simple but effective suggestion has indeed helped and the new worksheet in Chapter 4 is a direct byproduct of her comment.

Becky McEldowney Masterman, our representative at Taylor & Francis. Becky has continued to be our greatest cheerleader over the years. When we asked Taylor & Francis to break out the crime scene analysis aspects for this book from the third edition of *Bloodstain Pattern Analysis with an Introduction to Crime Scene Reconstruction*, Becky never hesitated.

Cal Jenkins and Todd Zdorkowski for their guidance and direction as we addressed the underlying principles associated with crime scene analysis.

Iris Dalley, Laura Delong, Kim Duddy, as well as Chuck Merritt and the San Diego County Sheriff's Office Crime Laboratory, for their effort and support in pursuing the case examples utilized in the book.

Carolyn Gannet, San Diego County Sheriff's Office Crime Laboratory, for allowing us to use her research data on ethics.

Rebecca Shaw, Tom Adair, Matthew Noedel, and Kim Duddy for their input and perspective on the ethics of forensic science.

Christian Bachhiesl with the Hans-Gross Museum and the Bancroft Library, University of California, Berkeley, for their assistance and support in providing figures for Chapter 1.

The instructors at the Scenes of Crimes Officers Course (SOCO) in England, who set cogs in motion for the authors of this book; those cogs would later mesh and, when joined, ultimately became the Event Analysis methodology.

Richard Wintory, one of the first district attorneys with whom Tom had occasion to use these methods. Richard understood their value and supported the development of these ideas.

Lt. Travis Witcher, retired Oklahoma City Police Department. Travis secured Tom's early training and encouraged him to go beyond Bloodstain Pattern Analysis.

The entire staff at Taylor & Francis for the support and assistance in bringing this book to reality.

About the Authors

Ross M. Gardner worked for the United States 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 U.S. Army law enforcement. Gardner subsequently served four years as the chief of police of Lake City, Georgia, a small suburban Atlanta police department. He now serves as vice president of Bevel, Gardner and Associates, Inc.

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, United Kingdom, in 1985 and between 1988 and 1996 served as an adjunct professor for Central Texas College in the Police Science Program. 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). 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.

Gardner is certified by the International Association for Identification as Senior Crime Scene Analyst, a rating he has held for 18 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 the author of the text *Practical Crime Scene Processing and Investigation* and co-authored with Tom Bevel *Bloodstain Pattern Analysis: With an Introduction to Crime Scene Reconstruction*, 3rd edition.

Capt. Tom Bevel (Ret.) is president of Bevel, Gardner and Associates, Inc., a forensic education and consulting company. He is also an associate professor in the Masters of Forensic Science program at the University of Central Oklahoma, Edmond. He retired after 27 years with the Oklahoma City Police Department. His last assignment was commander of the Homicide, Robbery, Missing Persons and the Unsolved Homicide Units.

Bevel holds a master of arts degree from the University of Central Oklahoma in the Administration of Criminal Justice. He also is a graduate of the Scenes of Crime Course, Hendon, United Kingdom; the Technical Investigations Course, Central U.S. Police Institute, Oklahoma State University at Oklahoma City; the FBI National Academy; and the Postgraduate Medical-Legal Course at London Medical College, United Kingdom.

Bevel is a charter member of the FBI Scientific Workgroup on Bloodstain Pattern Analysis (SWGSTAIN) and is on the Board of Directors. He also is a Fellow of the

Association for Crime Scene Reconstruction (ACSR), a Distinguished Member of the International Association of Bloodstain Pattern Analysts (IABPA), on the editorial board for the *Journal of Forensic Identification*, and a member of the Southwestern Association of Forensic Scientists (SWAFS), and the American Academy of Forensic Sciences (AAFS). He serves on the Board of Advisers for the Master of Forensic Science program for the University of Central Oklahoma as well.

Bevel has served as a crime scene consultant in 46 of the United 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. He is co-author of the text *Bloodstain Pattern Analysis with an Introduction to Crime Scene Reconstruction*, 3rd edition.

Table of Contents

Series Editor.....	xv
Foreword	xvii
Preface	xix
Acknowledgments.....	xxi
About the Authors	xxiii
1 An Introduction and History of Crime Scene Analysis.....	1
Introduction	1
Distinguishing Crime Scene Analysis from Crime Scene Processing	2
Distinguishing Crime Scene Analysis from Behavioral Profiling.....	2
Pioneers in Crime Scene Analysis: A History of the Discipline	4
The Future.....	8
Summary.....	9
References	9
2 Theoretical and Practical Considerations for Implementing Crime Scene Analysis	11
Introduction	11
Who Qualifies as a Crime Scene Analyst?	12
Fundamental Beliefs for Crime Scene Analysis	14
Theory and Applicable Principles for Crime Scene Analysis	14
Correlating Crime Scene Analysis with Archaeology	15
Principles of CSR.....	16
The Role of Scientific Method.....	18
Defining the Questions to Answer Using Scientific Method.....	20
Defining Additional Investigative Questions.....	28
When Is Crime Scene Analysis Employed?.....	29
Informal (Ad Hoc) Crime Scene Analysis.....	29
Summary.....	36
References	36
3 Event Analysis: A Practical Methodology for Crime Scene Reconstruction	37
Introduction	37
The Event Analysis Process	41
Summary.....	71
Reference.....	72

4	Resolving Significant Investigative Questions in CSR	73
	Introduction	73
	Using the Event Analysis Worksheet	78
	Event Analysis Worksheet Explained	78
	Statement Analysis Using the Worksheets.....	86
	References	92
5	Understanding Crime Scene Protocols and Their Effect on Reconstruction	93
	Introduction	93
	The Importance of the Crime Scene Investigator	93
	Role of the Initial Responding Officer	96
	Incorporating the Basic Crime Scene Activities into a Crime Scene Protocol	97
	Assessing	97
	Observing.....	98
	Documenting.....	99
	Searching.....	102
	Collection.....	104
	On-Scene Analysis	105
	Summary.....	105
	References	106
6	Applying Bloodstain Pattern Analysis to Crime Scene Reconstruction	107
	Introduction	107
	A Background of Bloodstain Pattern Analysis.....	108
	Impact Angle and Directionality.....	109
	Impact Angle	109
	Directionality.....	110
	Bloodstain Classification	113
	The Spatter Group	114
	Spurt.....	114
	Cast-Off	114
	Drip Trail.....	116
	Impact Pattern	117
	Expectorate Pattern.....	118
	Drip	119
	The Nonspatter Group.....	120
	Blood-into-Blood.....	120
	Gush	122
	Smear	123
	Pattern Transfer.....	124
	Pool.....	125
	Saturation	125

Flow	126
Complex Patterns.....	126
Altered Stains.....	127
Area of Origin Evaluations.....	127
Summary.....	129
References	130

7 Shooting Scene Processing and Reconstruction 131

Matthew Noedel

Introduction	131
Understanding Ammunition	131
Cartridges.....	131
The Primer.....	131
The Propellant.....	132
The Projectile	133
The Cartridge Case	133
Shotshells.....	134
Caliber	135
Reconstruction Potential Associated with Cartridges	135
Understanding Firearms.....	136
Chamber.....	136
Barrel.....	137
Trigger	137
Firing Pin/Striker.....	138
Firearm Safeties.....	139
Firearm Caliber	139
Reconstruction Potential Associated with Firearms	139
Accidental versus Unintentional Discharge.....	140
Handling Firearms at a Scene	140
Unloading Firearms.....	141
Semiautomatic Firearms	141
Revolvers.....	142
Fired Cartridge Cases.....	143
Ejection Patterns	143
Fired Bullets.....	145
Recovering Fired Components.....	145
Perforation versus Penetration.....	146
Shotgun Pattern Evaluation and Reconstruction.....	146
Recording Impacts and Ricochets.....	149
Evaluating Bullet Impact through Glass.....	150
Bullet Ricochet	152
Bullet Impact Evaluation	155
Field Tests for Copper: Dithiooxamide (DTO) and 2-Nitroso-1-Naphthol (2-NN).....	155
Field Test for Lead: Sodium Rhodizonate (NaRh)	156
Reconstructing a Fired Bullet Trajectory	157

Trajectory Measurement Technique.....	158
Horizontal Angle.....	158
Vertical Angle.....	159
Using a Laser to Define Trajectory.....	160
Photographing Laser Trajectories.....	162
Shots into Vehicles.....	162
Establishing a Baseline for Vehicles.....	163
Using a 360-Degree Scale for Vehicles.....	163
Recording Trajectory Angles.....	164
Reporting Measured Trajectory Angles.....	165
Horizontal Angles.....	166
Vertical Angles.....	166
Gunshot Residue Examination.....	167
Muzzle Effluent.....	167
Primer Residue.....	169
Processing Shooting Scenes.....	169
Summary.....	173
Chapter Author.....	174

8 The Forensic Pathologist, the Body, and Crime Scene Reconstruction 175

Scott A. Wagner, MD

Introduction.....	175
Theory and Approach to Death Scene Investigation.....	175
Homicides.....	176
Five Basic Questions Posed by the Death Investigation.....	177
Forming Preliminary Opinions: Be Suspicious but Objective.....	177
Detailed Questions to Be Considered at the Scene:.....	178
The Body and the Death Scene.....	178
Examination of the Body at the Scene.....	180
Photographic Documentation of the Scene and the Body.....	180
Position of the Body at the Scene.....	181
Blood at the Scene.....	182
Vomitus.....	182
Physical Examination of the Body at the Scene.....	183
Scene Assessment.....	183
The Body, the Four Signs of Death, and the Time of Death.....	183
Eyes.....	187
Clothing.....	187
Determining Time of Death by Scene Investigation.....	188
Forensic Entomology and Time of Death.....	188
Forensic Botany and Time of Death.....	189
Decomposition.....	189
Changes in the Body during Decomposition.....	189
Other Decompositional Changes.....	189

Identification Methods.....	190
Collection of Evidence at the Scene.....	190
Visual Identification	191
Other Visual Methods of Identification.....	191
“Softer” Forms of Identification	191
Scientific Forms of Identification.....	192
The Medical–Legal Autopsy	193
Phases of the Medical–Legal Autopsy	194
Jurisdiction and Permission for Autopsies	195
Misconceptions of the Autopsy	195
Traumatic Injuries	195
Blunt Force Injuries versus Sharp Force Injuries: The Importance of Terminology	195
Blunt Force Injuries.....	196
Features of Blunt Force Injuries	196
Sharp Force Injuries.....	206
Firearms and Gunshot Wounds.....	210
Gunshot wounds	213
Exit Wounds.....	216
Strangulation	221
The Autopsy Report	222
Reconstruction of a Bullet Trajectory	223
Conclusion	223
References and Suggested Reading.....	224
Chapter Author	224

9 Writing Crime Scene Reconstruction Reports 225

Introduction	225
Essential Report Elements	226
Statement of Purpose.....	226
References.....	227
Body of the Report	227
Body of the Report: Outline Format	228
Body of the Report: Narrative Format	230
Flow Chart	234
Summary.....	235

10 Arguments and Ethics..... 237

Deductive and Inductive Arguments.....	237
The Role of Logic in Crime Scene Analysis.....	242
Informal Fallacies Encountered in Analysis	242
An Ethical Approach to Crime Scene Analysis.....	244
Summary.....	247
References	247