Crime and Measurement

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Methods in Forensic Investigation

Second Edition

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Foreword

> " … And they took Joseph's coat and killed a kid of the goats, and dipped the coat in the blood … and they brought it to their father and said: This have we found: know now whether it be thy son's coat or no.… And he knew it and said: It is my son's coat; an evil beast has devoured him.…"
>
> Genesis 37:31–33

This touching epigraph from the book of Genesis brings the story of the sons of Jacob, who after selling their younger brother, Joseph, to the Ishmaelites, wanted their father to believe he was dead. Jacob had no reason to suspect that the story was a fake, but a simple forensic test could have told him immediately that not only was the blood not his son's, it was not even human. Today, legal systems depend much less on human testimony. They can lean, instead, on the collection and scientific interpretation of physical evidence. Besides providing much more relevant information and being far more objective, these methods reduce the need for a "brilliant detective," who can resolve complicated crime mysteries single-handedly, leaning solely on his power of reasoning.

As a matter of fact, observation and interpretation have been the primary components of crime investigators since early times, but only in the middle of the nineteenth century have scientific methods become a significant tool in such investigations. The continuous refinement of analytical techniques often helps law officers in using the tiniest bits of physical evidence in their investigations, thus enabling them to decipher many crimes that would otherwise have remained unsolved, and provide solid and objective evidence to be presented in courts of law.

In this book, Myriam Nafte and Brian Dalrymple illuminate the concept of forensic science from a rather unusual angle: measurements. They show that measuring is actually "the core of almost every discipline in forensic science." Furthermore, *Crime and Measurement* provides readers a wide spectrum of topics pertaining to the application of science in criminal investigations. They start with basic definitions, followed by a short, evolutionary history of criminalistics and forensic science. They describe and discuss numerous forensic disciplines, from crime scene work to the interpretation of DNA results, the relationship between forensic scientists, law-enforcement agencies, and the legal system. Great emphasis is placed on death investigations.

Crime and Measurement is highly recommended both as a reference and as a textbook to be used in classrooms, as well as support material for police investigators, criminal lawyers, and anyone involved in the administration of justice.

Dr. Joseph Almog
Hebrew University of Jerusalem

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About the Contributors

Joseph Almog was born in Tel Aviv in 1944. He obtained his Ph.D. in organic chemistry from the Hebrew University of Jerusalem and conducted research with Nobel Prize laureate Sir Derek Barton, at Imperial College in London, and with Sir Jack Baldwin at MIT. Dr. Almog joined the Israel Police in 1974, and in 1984 was appointed Director of the Division of Identification and Forensic Science (DIFS), the national crime-lab of the State of Israel. In October 2000, Dr. Almog retired from police service and joined the Science Faculty of the Hebrew University of Jerusalem, where he is currently Professor of Forensic Chemistry, at the Casali Institute of Applied Chemistry. His main fields of interest are: development of simple field-tests for crime-scene officers, explosives detection and identification, and the visualization of latent fingerprints. Over the past two decades, he has been active in advancing forensic science as a tool against terrorism. He has written over 100 articles and book chapters in chemistry and forensic science. In 2005, Dr. Almog was awarded the Lucas Medal by the American Academy of Forensic Sciences "for outstanding achievements in forensic science." In March 2009 he was appointed the first non-North American member of the editorial board of the *Journal of Forensic Sciences*.

Scott Collings joined the Hamilton Police Service in 1980 as a civilian member. In 1985 he embarked on a career as a sworn member and has worked in several areas of the police service. In 2001 he became a member of the Forensic Services Branch. Sergeant Collings is a member of the Canadian Identification Society (CIS), the International Association of Bloodstain Pattern Analysts (IABPA), and the International Association for Identification (IAI), and he is a past member of the Ontario Police College Forensic Advisory Board. In 2005 Collings became the course coordinator of the Ontario Police College-sanctioned Scenes of Crime Officer (SOCO) training program in Hamilton, where he instructs officers from Hamilton and other local police services. In 2006 he completed the training and mentorship required to become Hamilton's first Certified Bloodstain Pattern Analyst, one of approximately forty in Canada. He has been a co-instructor on the Basic Bloodstain Recognition Course and the Advanced BPA Course at the Ontario Police College, and has sat on the BPA Certification Board. He has been published in the Canadian

Identification Society journal and provided expert testimony to Ontario district courts on several occasions. With training in Forensic Post Disaster procedures and subsequent to the earthquake of January 2010, Collings was deployed to Haiti as part of a Disaster Victim Identification (DVI) team as coordinated by the RCMP. Sergeant Collings currently resides in Ancaster, Ontario with his wife, also a Hamilton officer, and his two teenaged children.

Wade Knaap is a part-time faculty member in the forensic science program at The University of Toronto where he teaches an introductory forensic science course and specific courses related to forensic identification. Prior to accepting his faculty position with the University, Wade was a Detective Constable with the Toronto Police Service and a Forensic Identification Specialist in the Forensic Identification Services Unit (FIS). In this capacity, Detective Constable Knaap served as training officer, providing forensic training needs to police and military personnel. Currently, Wade regularly lectures and conducts workshops at universities and colleges throughout Canada and the United States on forensic related topics, and is actively involved in presenting at conferences held on a yearly basis throughout North America regarding forensic identification techniques. He was past president of The Canadian Identification Society, and a former chair of The Ontario Police College Forensic Advisory Board. At present, he is an active member of the Forensic Advisory Committee at the University of Ontario Institute of Technology. His research, collaborations, and methods, on forensic identification concepts have been published numerous times in *The Journal of Forensic Identification* and *Identification Canada*. Since 2012, Wade has been the editor of *Identification Canada.* In 2002–2003, Wade Knaap was the recipient of The Al Waxman Award for "Excellence in the Field of Forensic Identification." Wade lives with his wife Charlene and family in Port Perry, Ontario.

About the Authors

Brian Dalrymple, formerly manager of the Ontario Provincial Police Forensic Identification Services, was personally responsible for deciphering some of the most challenging crimes that took place in the province of Ontario during the last quarter of the twentieth century. He co-developed the use of lasers to detect fingerprints and introduced the first police computer image enhancement service in Canada. He was awarded the John Dondero Award in 1980 by the International Association for Identification for "the most significant and valuable contribution to identification in the previous year." In 1982 he received the Foster Award from the Canadian Identification Society. In 1984 he was presented with the Lewis Minschall Award for "outstanding contribution to the fingerprint profession." In *Crime and Measurement* he presents a wealth of personal experience, applicable to the various phases of technical and scientific crime investigations.

Myriam Nafte is a forensic anthropologist and visual artist trained in anatomy. She received her Honors B.A. in medical anthropology from York University, followed by a B.Ed. degree in general sciences, an M.A. and PhD in physical anthropology from McMaster University in 1992 and 2013 respectively. For a number of years she has taught police workshops and university level courses in skeletal biology, forensics, and health sciences, while volunteering her services for criminal casework across North America. Myriam's present research interests focus on the worldwide traffic of human remains, and the use of the undisposed dead as material culture in contemporary societies. She is author of the book *Flesh and Bone: An Introduction to Forensic Anthropology*.

Introduction

> "Every measurement slowly reveals the workings of the criminal. Careful observation and patience will reveal the truth."
>
> —Alphonse Bertillon

All aspects of investigating a crime scene and its evidentiary material entail a science of measuring whether it is in the preliminary police sketch of the site, the counting of ridges and dots on a fingerprint, or observing the pattern and direction of blood spatter. Measuring for comparison, observation, analysis, and interpretation is, in fact, the core of almost every discipline in forensic science. In a pure sense, the science of forensics is the thoroughly objective mathematic search for the patterns, sequences, and traits left behind in the physical traces of a criminal and his crime.

A variety of identification systems have evolved over the past two hundred years that require lesser amounts of evidentiary material to measure but have greater and more vivid results. Forensic light sources, high-powered microscopes, and computer technology have opened up a new world in the extraction and examination of physical evidence from the once obscure 'dust' of a crime scene.

While examiners still look at the traditional array of latent evidence such as fingerprints, fibers, and blood, this can now include three-dimensional views of bullet striations, colorful genetic markers, and virtual crime scene reconstructions.

The justice systems of the world rely heavily on this continually evolving technology, a variety of which is offered in almost every discipline of forensic science. To keep up with increasingly sophisticated crimes and advances in technology requires constant resource and intelligence sharing. Hence, where once the relationship between science and the law was tenuous at best, good legal investigations now draw exclusively from a scientific methodology and an array of analyses offered by lab and criminalist technicians.

Accordingly, the forensic methodology detailed throughout the pages of *Crime and Measurement* can best be summarized as the ultimate and varied search for everything from mass, volume, texture, and length, to distance, height, shape, and sequence as revealed in the endless possibilities inherent in all forms and traces of physical evidence.

As an introductory guide, the goal of this book is to provide students in law enforcement, members of the justice system, law enforcement professionals, criminalists, and anyone interested in the field, a starting point in understanding the pivotal relationship between police, the investigator, and the scientist, in service of the law. From the first responder called to a death scene to the final analysis in the courtroom, *Crime and Measurement* outlines the processes, the rules, the protocols, and the principles of what it takes and what it means to measure and solve crime.

Beginning with the definition of all things forensic, chapter 1 outlines the various branches of the growing field of forensic science and offers a thorough discussion of what constitutes evidence, testimony, and an expert witness. Chapter 2 delves briefly into the history of criminology through a look at the emergence of uniformed police forces and the establishment of criminalists. In its exploration of the relationship between science and the legal system, this chapter also highlights the seminal work of pioneers such as Alexandre Lacassagne and Edmond Locard, founders of legal medicine, as well as Hans Gross, the judicial magistrate who officially brought science and the law together.

Going right to the scene of the crime, chapter 3 focuses on the primary role of police beginning with the requirements of first responders, the rules around barricading a crime scene, and a complete overview of the principles of search and recovery. The chapter also examines evidence collection and a special section on the use of forensic light sources in detecting latent evidence and reconstructing crime scenes.

Chapters 4, 5, and 6 discuss the events and protocols around encountering death at a scene, highlight various forms of trauma, and outline the processes of death and decomposition.

Three methods used by police and forensic scientists in assigning a positive identification to both victim and criminal are thoroughly outlined in chapter 7. The relatively short history and highly controversial use of DNA analysis is detailed from its first case in the 1980s to the current policies surrounding its use and storage in databases around the world. Following this section is a discussion of the much longer history of fingerprinting in pursuing and keeping track of criminals over the past two hundred years. Descriptions include the varying characteristics and features of the tips of our fingers that make us unique, and how technicians map these traits to identify and distinguish perpetrators. The chapter concludes with the popular and visually dynamic field of facial reconstruction.

Chapter 8 investigates an array of evidence, and the methods used by police to access, uncover, and highlight the latent (hidden) information in these items. Firearms, computer data, footwear, and tires all leave their mark on a variety of surfaces, and the challenges in documenting, retrieving, or reproducing these marks are presented in this last section.

Finally the appendix offers a series of high-profile cases provided by the authors and contributors. Each case highlights a variety of methods and tools that were employed to solve the crimes presented, and best illustrate the many areas of forensic analyses outlined in the book.

Throughout each chapter there are graphic photographs depicting human bodies that have sustained severe trauma or are in various stages of decay. The use of such images comes with an understanding that *mortui vivo docent*—the dead teach the living. To honor this process and out of respect for the victims and their families, the photographs published do not reveal their identity or the details of their case history.