

INTERNATIONAL FORENSIC SCIENCE
AND INVESTIGATION SERIES

Firearms, the Law, and Forensic Ballistics

Third Edition



Tom Warlow



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Series Preface

International Forensic Science Series

The modern forensic world is shrinking. Forensic colleagues are no longer just within a laboratory but across the world. E-mails come in from London, Ohio and London, England. Forensic journal articles are read in Peoria, Illinois and Pretoria, South Africa. Mass disasters bring forensic experts together from all over the world.

The modern forensic world is expanding. Forensic scientists travel around the world to attend international meetings. Students graduate from forensic science educational programs in record numbers. Forensic literature—articles, books, and reports—grows in size, complexity, and depth.

Forensic science is a unique mix of science, law, and management. It faces challenges like no other discipline. Legal decisions and new laws force forensic science to adapt methods, change protocols, and develop new sciences. The rigors of research and the vagaries of the nature of evidence create vexing problems with complex answers. Greater demand for forensic services pressures managers to do more with resources that are either inadequate or overwhelming. Forensic science is an exciting, multidisciplinary profession with a nearly unlimited set of challenges to be embraced. The profession is also global in scope—whether a forensic scientist works in Chicago or Shanghai, the same challenges are often encountered.

The International Forensic Science Series is intended to embrace those challenges through innovative books that provide reference, learning, and methods. If forensic science is to stand next to biology, chemistry, physics, geology, and the other natural sciences, its practitioners must be able to articulate the fundamental principles and theories of forensic science and not simply follow procedural steps in manuals. Each book broadens forensic knowledge while deepening our understanding of the application of that knowledge. It is an honor to be the editor of the Taylor & Francis International Forensic Science Series of books. I hope you find the Series useful and informative.

Max M. Houck, PhD

*Director, Forensic Science Initiative, Research Office
Director, Forensic Business Research and Development
College of Business and Economics
West Virginia University*

Foreword

I worked with Tom as a member of the Firearms Consultative Committee for five years. Turning the pages of his book was a riveting experience for me. It rekindled the interest of bygone days: the Parliamentary debates, amending the law on firearms, and Tom sitting in the Minister's Advisers' box on the floor of the House of Commons, and subsequently on the red leather of the House of Lords. We all look to him for guidance on the complex issues involved.

Away from Westminster, at the Huntingdon Laboratory, some of us were able to see the operation of the "Outstanding Crimes File System." Over the years, this system has been a powerful source of crime intelligence for the police and for the authorities in accurately predicting the most likely make of weapon used in a criminal incident and then, in turn, linking its use with other serious offenses, such as acts of murder, terrorism, and armed robbery, in widely scattered parts of the realm.

Tom has been a proficient user of firearms of all types, whether this involved their use on the firing range, the field, or upon the hill, and many a deer must have been thankful for death by a good, clean killing shot. His lifelong fascination with old firearms ensured that on many occasions in his youth he might be found walking up game on a rough shoot or out on the marshes after duck or curlew with an old muzzle-loading shotgun.

However, the nature of his employment also caused him to witness the darker side of the misuse of firearms or shotguns. He might be called out in the middle of the night to journey across country to attend the as-yet-undisturbed scene of a serious shooting incident in one of the northern industrial cities such as Manchester or Newcastle, or to a hill farm in South Wales, an opulent residence in Essex, or a pub in Devon. There he would assist the police investigative team in untangling the often confusing effects remaining at the scene so as to determine the likely previous course of events. This initial task would be followed by assisting the Home Office pathologist in the interpretation of the injuries and recovered missiles during the subsequent postmortem examinations and by then arranging for the necessary collection and transfer of crucial exhibits to the laboratory for examination. All of these tasks would constitute the necessary preliminary to him eventually acting as an expert witness at the subsequent court hearing. Despite such experiences and much else, he always attempted to speak up and act in the best interests of responsible sportsmen and target shooters. He provided technical support

to the Home Office and to the Firearms Consultative Committee. He never shrank from speaking out against those who by their irresponsible conduct so endangered the interests of the vast majority of decent sportsmen.

Tom so obviously reveled in his work and his desire to share his knowledge. The charm and simplicity of his style reflect his obvious pleasure in writing about his life's work.

I am more than honored that he should have asked me to add this Foreword to a subject so near to my heart.

The Lord Kimball

I was delighted to be asked by Tom Warlow to pen a few words in introduction of his new work.

I first met Tom some four years ago when I was appointed chairman of the Firearms Consultative Committee. Interesting times were just around the corner, and although none of the FCC had any idea of what was to happen in the near future at that state, a great deal of work was being undertaken by the committee. Tom—from my day one—stood out among the members of the FCC as a solid and forthright expert not only in the field of forensic ballistics, but also as a lifelong shooting and countryside enthusiast. His knowledge of weapons, their history, evolution, and use is very wide indeed, to say the least.

Then in March 1996, the most awful tragedy at Dunblane took place, and immediately the FCC was thrown to the forefront of a highly emotional and political matter. The rest of course is history, and the 1997 Firearms (Amendment) Acts put a complete stop to the private ownership of handguns. Tom's help and advice to me throughout those unhappy days were superb, and I simply do not know how he has found time to pen this excellent book!

The Earl of Shrewsbury and Waterford

Preface

From my youth to my 70th year, I have been fascinated by firearms and their application. Over the years I have tried, and in some instances mastered, just about every type of firearm and shooting discipline. Even today I am still filled with awe by the accuracy of a fine rifle and its ability to deliver a compact package containing so much destructive force to a distant target. My own rifle, which I use for target shooting and deer stalking, frequently produces sub-minute of angle groups at 100 yards. (Somewhat less than one inch in measurement between the centers of the most distant bullet strikes in the group.) When one considers that such feats are achieved with what is in reality a heat engine of Victorian design, the results seem even more remarkable.

One day many years ago, I decided to extend my interest further by accepting an offer of employment from the Home Office at the National Firearms Laboratory of the Forensic Science Service at a laboratory location in the center of Nottingham. This unit was later moved to a new and expanded site at Huntingdon, Cambridgeshire, where it dealt with firearms cases received from 41 of the 43 police forces in England and Wales, which at that date represented casework submissions generated from a population of about 45 million people. We also dealt with a small amount of casework submissions from the London area policed by the Metropolitan and City of London police forces. For approximately ten years of my time in service, I dealt with all queries and firearms-related matters submitted by the firearms-related division of the Home Office in London, as well as inquiries originating from the other Whitehall departments. These matters also resulted in my providing advice to government ministers, helping with technical aspects of proposed new legislation, and providing assistance to the ministers in the chamber during parliamentary debates and subsequent procedures in the House of Lords. I also spent ten years serving on the statutory Firearms Consultative Committee as the Home Office technical representative.

The subsequent restructuring of the Home Office Forensic Science Service also resulted in the integration of the London Metropolitan Police Forensic Science Laboratory within the government agency entitled "The Forensic Science Service," thus adding several million more to the population previously referred to. As a result, I was moved, along with two of my colleagues, to the firearms section of the London Forensic Science Service Laboratory, where I continued to work for the final two years of my service on criminal casework, Home Office, and parliamentary business until my retirement in

February 2000. The restructuring also involved the creation of the Northern Firearms Unit of the service, situated in Manchester, where the remainder of the old Huntingdon firearms reporting staff were relocated along with some additional staff. Both units have been subject to expansion and change in terms of both staff and facilities, including the acquisition at both sites of Ibis (Forensic Technology) integrated ballistics identification systems from Forensic Technology. Later on, the Metropolitan Police set up their own dedicated unit in London, taking on some of the old laboratory staff with them. At the same time other services such as "Forensic Alliance" and "The Laboratory of the Government Chemist" bid for work with the various police forces and also with the various firms of independent solicitors. For some years I also was involved in these activities, in some instances acting as an independent consultant working for various police forces, the media, firms of solicitors, and Her Majesty's Coroner with respect to Gulf War incident inquests.

In order to consider oneself to be an expert witness in such a specialized field, it is necessary to try to understand all aspects of the subject, rather than to lock on to one small discipline. I have decided, therefore, to start this book with a short chapter on the development of arms and ammunition from the fourteenth century to the present day in order that a balanced understanding of firearms and ammunition can be acquired. I hope that this chapter will also be of general interest to all those who have a genuine interest in firearms, as although wide reaching, it is set out in a relatively condensed form, which will not be found elsewhere. This is followed by a chapter concerned with firearms law around the world, with particular emphasis on the situation in the United Kingdom, followed by a chapter on the origins and the development of the new science, the controversies, the pioneers in the new field, and the quack purveyors of pseudo-science. The chapter concerning the mechanisms of various firearms, although not comprehensive, should be a useful guide for any forensic examination. The three chapters concerning internal, external, and terminal (wound) ballistics, followed by the one on the role of the ballistics expert at the scene of crime investigation and the subsequent examination of casework exhibits at the laboratory, should then provide the basic foundation for the other aspects of the work of a forensic firearms examiner to build on. I have also included a section on recently introduced computer search techniques applied to captured and digitally stored images of marks left on fired bullets and cartridge cases.

Along with my working colleagues I have dealt with and experienced a great many things and changes over the years. It now seems appropriate that I should try to set down on paper some of the positive products of this experience, which I hope will prove to be of use to others wishing to take up a similar profession, to some already in this field and, finally, to those fellow souls who share a similar interest in all matters relating to firearms.

Acknowledgments

This updated and expanded second edition of my book is dedicated to the pioneering workers Colonel Calvin H. Goddard (1892–1955) and his colleagues C.E. Waite, Philip O. Gravelle, and John H. Fisher, who established the Bureau of Forensic Ballistics in New York City in April 1925 to provide firearms identification services throughout the United States, and to Dr. J.H. Mathews and his milestone publication *Firearms Identification* (Springfield, IL: Charles C Thomas, 1962). Some aspects of their work and that of others are contained in Chapter 3, Marks and Microscopy: The Emergence of a New Science.

The word “forensic” comes from the Latin “forum,” where the Romans held their courts, and forensic science means the application of science in helping the courts arrive at the truth. When most people think of forensic science, it is hard for them not to recall the fictional accounts of Sir Arthur Conan Doyle’s great detective Sherlock Holmes and his loyal companion Doctor Watson. Although some present-day forensic scientists might try to distance themselves from such an association, it would be well for them to remember that the methods used by him did not involve inspired guesswork, intuition, or the beliefs initially expressed by others, and in this respect it is useful to recall some of the first imperfect conclusions arrived at by Inspector Lestrade of Scotland Yard. Over the years, I have dealt with a number of cases where fanciful advice has been given by others to the senior investigating officer. Such “helpful” advice is never beneficial in bringing the investigation to a successful conclusion, and acts by way of a disruptive distraction to the best use of police manpower, and even to miscarriages of justice to be uncovered at some future date. The worst start that any scientist can make, whatever his profession, is to start with a belief that he then proceeds to attempt to prove. There can be a great deal of difference between perception and reality. Holmes refused to make guesses based on insufficient information. In response to a question from Dr. Watson in Conan Doyle’s account of *A Scandal in Bohemia*, Holmes replied: “I have no data yet. It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories instead of theories to suit facts.” Although Holmes’ sagas are in reality a product of literary fiction, this despite my good friend Jerry Miller truly believing himself to a reincarnation of the same great consulting detective, today’s real forensic scientists would be wise to be guided by such a cautious attitude.

The *Oxford English Dictionary* defines the expression “forensic” as pertaining to or used in a court of law, and in relation to the detection of crime. The expression “ballistics” is defined as the science of the motion of projectiles, especially that part of the subject connected with firearms. Exterior and interior ballistics are defined as dealing, respectively, with motion after and during the period when a projectile is subject to propulsive force or guidance. Strictly speaking, a good deal of the work of the people mentioned above was related to the microscopic comparison of marks left on cartridge cases and bullets with test firings obtained from suspect firearms. However, most of these same marks are imparted during the firing process, the period covered by internal ballistics. The expression “forensic ballistics” forms part of the title of this book, as a good deal of it explains how such marks are produced during the process of interior ballistics, the flight of projectiles, and the consequences of their impact on human tissue and other objects.

Finally, I must give due recognition to the outstanding and continuing contributions to the science made by members of the Association of Firearm and Tool Mark Examiners (AFTE). I can but urge membership of this organization to all practitioners and students of this fascinating subject.

Tom Warlow

The Author

Tom Warlow has more than 50 years experience in using and handling firearms and was for nine years a member of the statutory Firearms Consultative Committee, which advised the U.K. Government on firearms and firearms legislation as well as providing an annual report to Parliament. He was a casework reporting officer for more than 25 years in the national Firearms Unit in the United Kingdom and has a keen interest in gun sports.

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