

FORENSIC CHEMISTRY AND SCIENTIFIC CRIMINAL INVESTIGATION

By

A. LUCAS
O.B.E., F.R.I.C.



EDWARD ARNOLD & CO.

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CONTENTS

CHAPTER	PAGE
PREFACE	5
I INTRODUCTION	9
II BLOOD STAINS	23
III CLOTHING	50
IV COUNTERFEIT COINS	62
V DOCUMENTS	69
VI DUST, DIRT, GLASS FRAGMENTS, STAINS AND MARKS . . .	135
VII EXPLOSIVES AND EXPLOSIONS	145
VIII FIBRES, WOVEN FABRICS, STRING AND ROPE	155
IX FINGER PRINTS, FOOTPRINTS, TRACKS OF VEHICLES AND ERASED NUMBERS ON METAL	164
X FIRES AND INSURANCE FRAUDS	171
XI FIREARMS, CARTRIDGES AND PROJECTILES	179
XII MICROSCOPY, PHOTOGRAPHY, X-RAYS, ULTRA-VIOLET RAYS AND INFRA-RED RAYS	246
XIII POISONS	256
XIV PRESERVATION OF THE HUMAN BODY AFTER DEATH . . .	313
XV ROBBERY FROM LETTERS AND PARCELS	318
XVI TOBACCO	328
INDEX	332

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PREFACE

ADVANTAGE has been taken of the demand for a new edition of Forensic Chemistry to bring it thoroughly up to date, and alterations and additions have been made throughout, and about 200 fresh references have been added.

During the recent war a large number of cases were submitted by the British Army in the Middle East (including the New Zealand, South African and Indian Forces), and the Royal Air Force in the Middle East, and a few by the United States Army and Air Force. These included 273 questioned document cases (chiefly handwriting, but also a few dealing with typewriting, with erasures and other alterations, and with charred documents); 37 shooting cases and a few miscellaneous cases, including erased inscriptions from rubber tyres and from metal.¹

The most interesting points in connexion with these cases, except the shooting cases, have been incorporated in the appropriate places, but the shooting cases, many of which are very instructive, are given in greater detail and the important features of all of them are described.

A. LUCAS.

Cairo, 1945.

¹ The cases included are those received between December 1940 and December 1944.

CONTENTS

CHAPTER	PAGE
PREFACE	5
I INTRODUCTION	9
II BLOOD STAINS	23
III CLOTHING	50
IV COUNTERFEIT COINS	62
V DOCUMENTS	69
VI DUST, DIRT, GLASS FRAGMENTS, STAINS AND MARKS . . .	135
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VIII FIBRES, WOVEN FABRICS, STRING AND ROPE	155
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X FIRES AND INSURANCE FRAUDS	171
XI FIREARMS, CARTRIDGES AND PROJECTILES	179
XII MICROSCOPY, PHOTOGRAPHY, X-RAYS, ULTRA-VIOLET RAYS AND INFRA-RED RAYS	246
XIII POISONS	256
XIV PRESERVATION OF THE HUMAN BODY AFTER DEATH . . .	313
XV ROBBERY FROM LETTERS AND PARCELS	318
XVI TOBACCO	328
INDEX	332

FORENSIC CHEMISTRY

CHAPTER I

INTRODUCTION

Definition of Forensic Chemistry. Forensic or legal chemistry may be defined as chemistry applied to the solution of certain problems that arise in connexion with the administration of justice. It is chemistry exercised in the service of the law.

Forensic Chemistry is often confused with Forensic Medicine; thus one writer states¹ that "One of the most valuable functions of the Medical Profession is the detection of poison, blood and other matters by chemical examination," and again, "Chemical analysis is in fact a special branch of medical jurisprudence . . ." This, however, is not so, and "the detection of poison, blood and other matters by chemical examination" is manifestly purely chemical and in no way medical, though it is convenient that the specialist undertaking such work should possess, as he often does, a medical as well as a chemical qualification so that he may combine the two subjects of Forensic Chemistry and Forensic Medicine.

Scope of Forensic Chemistry. The scope of forensic chemistry is very wide and the boundaries are ill-defined. Not only does it include the chemical side of criminal investigation, with which it is generally associated in the public mind, and to which it will be limited in the following pages, but it is concerned also with the analysis of any material the quality of which may give rise to legal proceedings. Forensic Chemistry, too, deals not only with purely chemical questions, such as the nature, composition and quality of materials as determined by analysis, and the examination of articles for the presence or absence of particular substances, such as poisons, but also with questions that are only partly chemical, for example the examination of blood stains, documents, counterfeit coins, fibres and textile fabrics, and the expert in forensic chemistry should be not only a capable analyst, but also an experienced microscopist and photographer.

Practice of Forensic Chemistry. The practice of forensic chemistry resolves itself naturally into three stages, namely (1) the reception of the article to be examined, (2) the examination, and (3) the communication of the results, all of which may be considered usefully in detail.

I. Reception of the Article. It is most important that whenever possible the expert should himself personally take such specimens as are

¹ W. R. Donough, *Principles of Circumstantial Evidence*, Calcutta, 1918, p. 131.

required for examination, except viscera to be tested for poisons, which are taken necessarily by the medical man who conducts the post-mortem examination. Unless this is done, something essential to the elucidation of the problem may be omitted, or the objects may be taken, handled or packed in such an unsatisfactory manner as to render them almost useless for purposes of investigation. Sometimes too it is necessary that the expert who examines an object should know not only the condition, but even the precise position in which it was found, and this can only be done when he is called in at the commencement of the enquiry and before anything is disturbed or removed. It is impossible to lay too much stress upon this point, for just as fingerprints or footprints may be obliterated and thus valuable evidence lost, so other clues may be destroyed or even misleading indications may be produced. Whenever possible therefore in all cases of criminal investigation in which a chemical expert is consulted, he should visit the scene of enquiry, make a detailed examination and take notes and measurements and also any specimens that may be required. This, however, is not always practicable and, even when practicable, the necessity is not always recognized and in the majority of cases the expert will not have the opportunity of taking specimens, which will generally have been done before he is called in and they will be handed or forwarded to him. If any object received is unsatisfactory by reason of its condition, its possible contamination with other objects, its small size, or its unsuitability for the purpose required, this should be pointed out at once and the necessary steps taken to procure additional specimens.

When taking over objects to be examined, a note should be made of the date and time of reception, from whom received, the number and kinds of objects, their identification marks and the manner in which they are packed.

When summoned to the scene of enquiry the expert should go fully prepared for all contingencies and should take with him everything that is likely to be required: a lens, a reading glass with a handle, a pen-knife, a few small round cardboard boxes for small objects and a measuring tape generally will be found useful, and a notebook of good quality and not too small a size and a pencil are indispensable. A camera is also frequently of service.

A neatly and accurately drawn sketch with all the important measurements shown will be found a great help in writing the report. This, however, should not be reproduced in the report, as unless drawn to scale it will be too inaccurate to be of practical value in Court. If a plan is necessary only one made by a trained surveyor should be used. In the case of a fire, explosion or similar occurrence, as much information as possible should be obtained regarding the exact previous condition of things, also an account of what was seen or heard at the time and the explanation that is given of the occurrence by those concerned. It should be remembered that generally

it is difficult or impossible to repeat a visit, and that, unless full details are obtained in the first instance the report will be incomplete and, in the absence of some small fact that has been omitted, it may be found impossible to express a definite opinion or to explain what otherwise might have been a very simple matter. Special care should be taken to make the notes not only full but neat and clear, since it may be necessary to produce them in Court, and if any mistakes are made these should not be erased but should be corrected in such a manner that the original entry can be read plainly. A careless superficial examination and any inaccuracy in recording the facts are inexcusable. When the expert himself takes the samples, full particulars should be written on each at the time and exact notes made of the place, date and circumstances.

As no conclusions of value can be formed without a knowledge of all the facts, no opinion whatever should be given until the articles have been examined and the matter carefully considered.

As soon as practicable after an article has been received it should be registered, and the register should show the date of receipt, from whom received, the nature of the article and details of all numbers or other distinguishing marks.

At this stage the package should not as a rule be opened, but, whenever it is opened, this should be done by the expert himself.

As a rule it is sufficient to keep one general register in which all articles are entered in order of date, each being given a special number, these being consecutive in any one year. The serial number of the article and the year should be marked on the outside of the package. If, however, a large number of articles of any one kind are being received constantly it will be found convenient to have more than one register, though rarely, if ever, will it be necessary to have more than two, one for the class of articles that predominates and a second for miscellaneous cases. As the reports are frequently too lengthy to be transcribed conveniently into a register, it is generally best to keep typed copies in separate files according to the nature of the case, though a brief summary in the register will be found useful. The register also should show the date of the report and the number and page of the laboratory workbook in which the original facts and figures were entered at the time the article was examined, so that they may be found quickly when required for reference.

In addition to the general register or registers, however, a series of abstracts, one for each kind of article, in which the results of the analyses are summarized, will be found useful. These are for quick reference to the details of the cases. In the Poisons Abstract, for example, there should be a separate page for each kind of poison, and the cases should be entered in numerical order with details showing the nature and weight of the article

analysed and the amount and percentage of poison present. In the Counterfeit Coin Abstract, such particulars as the denomination of the coin, the year, weight, specific gravity, composition and whether struck or cast, should be given in tabular form. Thus the number of cases of any particular kind and the details of each case may be seen at a glance.

Articles are frequently very badly packed, very inadequately marked, and insufficiently secured and sealed or sometimes even not sealed at all.¹ This is not the fault of the expert but, by drawing attention to it each time it occurs, improvements in this respect may be brought about. The commonest faults are the use of wet or dirty bottles; dirty corks; insufficient protection of glass vessels during transit; the use of thin cardboard boxes which cannot be closed securely and which break easily or become forced out of shape, and so allow the contents to escape; the use of ordinary correspondence envelopes from which finely powdered materials always leak; the packing of several articles in one parcel in such a manner that contamination of one with another is almost inevitable, and the use of sealing wax on the corks of bottles containing alcoholic liquors or other liquids in which sealing wax is soluble. Many articles too are received without sufficient marks of identity or else bear such marks only on the outside wrapper, which has to be removed. It does not seem to be recognized sufficiently that ordinary gummed labels do not adhere well to tins or to painted or glazed surfaces, with the result that such labels frequently come off and the articles are left without any means of identification. For small specimens of dry material the round cardboard boxes, that are sold in nests of different sizes, will be found useful. Oblong envelopes with the opening at the end are satisfactory, except for powders, and such envelopes are made in all sizes specially for holding samples, and many have ingenious methods of fastening. Explosives, acids and other dangerous materials are frequently packed in a very unsafe manner. Thus gelignite of uncertain age and stability has been handed to me for examination merely wrapped in a handkerchief; a potassium chlorate explosive was forwarded in a glass-stoppered bottle with some of the material adhering to the neck of the bottle and liable to explode on any movement of the stopper; a solution of phosphorus in carbon disulphide, which is spontaneously inflammable when the solvent evaporates, was forwarded in a bottle having a loose-fitting stopper and was packed very insecurely, and it is a common experience to find strong acids and alkalis put into bottles provided with corks instead of glass stoppers, with the result that the corks become corroded and the liquid escapes. Instructions regarding packing will be found in many of the chapters dealing with special subjects.

¹ See F. G. Tryhorn, "The Packing of Exhibits," *Police Journal*, 8 (1935), pp. 19-26. Also F. Bamford, *Poisons: Their Isolation and Identification*, 1940, pp. 1-4.